23rd annual Congress of the

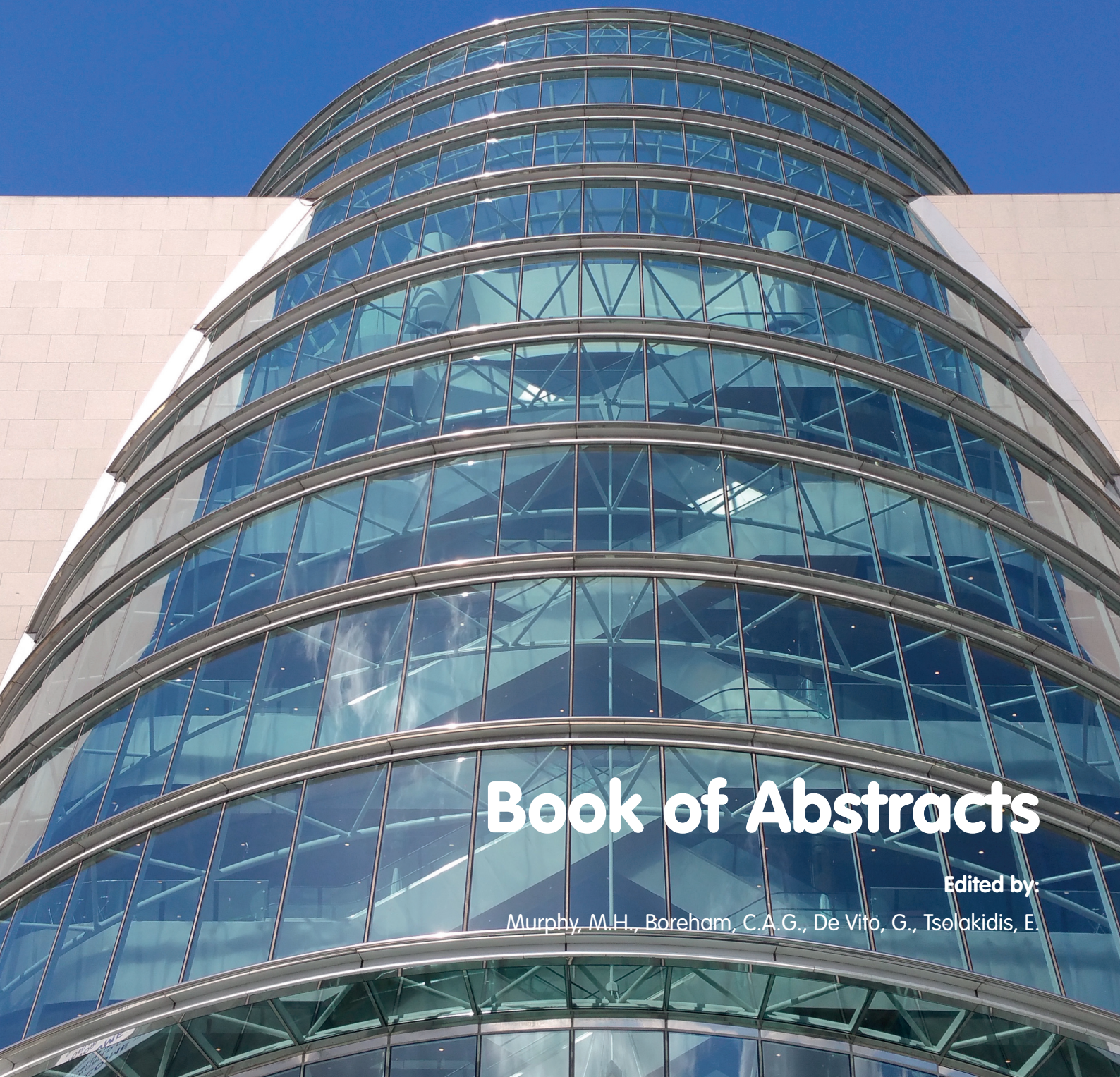
EUROPEAN COLLEGE OF SPORT SCIENCE

SPORT SCIENCE AT THE CUTTING EDGE

4 - 7 July 2018, Dublin - Ireland

Hosted by University College Dublin & Ulster University

ECSS DUBLIN 2018



Book of Abstracts

Edited by:

Murphy, M.H., Boreham, C.A.G., De Vito, G., Tsolakidis, E.

23rd Annual Congress of the

EUROPEAN COLLEGE OF SPORT SCIENCE

4th - 7th July 2018, Dublin – Ireland

BOOK OF ABSTRACTS

Edited by:
Murphy, M., Boreham, C., De Vito, G., Tsolakidis, E.

Hosted by
Hosted by University College Dublin & Ulster University

ISBN 978-3-9818414-1-1

European College of Sport Science:
Book of Abstracts of the 23rd Annual Congress of the
European College of Sport Science – 4th - 7th July 2018, Dublin – Ireland.
Edited by Murphy, M., Boreham, C., De Vito, G., Tsolakidis, E.

ISBN 978-3-9818414-1-1

Conception, DTP: SporTools GmbH – Data management in sports
Corrections: Patera, N., Tsolakidis, K.

supported by

SPORTOOLS
Data management in sports

Feldblumenweg 26, 50858 Cologne, Germany
www.SporTools.de

Organisation

CONGRESS PRESIDENTS

- Colin Boreham (IRL)
- Marie Murphy (GBR)
- Giuseppe De Vito (IRL)

ECSS EXECUTIVE BOARD

- Joan L. Duda - President (GBR)
- Tim Cable - Past President (QAT)
- Erich Müller - President Elect (AUT)
- Bente Klarlund Pedersen (DEN)
- Stephen Seiler (NOR)
- Jørn Wulff Helge (DEN)

ECSS SCIENTIFIC BOARD

- Flemming Dela - Chair (DEN)
- Susanna Hedenborg - Co-Chair (SWE)
- Jan Cabri - Secretary (NOR)
- Paul Greenhaff (GBR)
- Markus Gruber (GER)
- Martin Halle (GER)
- Luc van Loon (NED)
- Abigail Mackey (GBR)
- Nicole Wenderoth (SUI)
- Cecilie Thogersen-Ntoumani (AUS)

ECSS SCIENTIFIC COMMITTEE

- Per Aagaard (DEN)
- Jatin Burniston (GBR)
- José Antonio Lòpez Calbet (ESP)
- Annalisa Cogo (ITA)
- Wim Derave (BEL)
- Peter Federolf (AUT)
- Taija Finni (FIN)
- José González-Alonso (GBR)
- Elke Grimminger-Seidensticker (GER)
- Ylva Hellsten (DEN)
- Hans-Christer Holmberg (SWE)
- Pierre-Nicolas Lemyre, (NOR)
- Maria Francesca Piacentini (ITA)
- Olivier Seynnes (NOR)
- Afroditi Stathi (GBR)
- Janice L. Thompson (GBR)

ECSS OFFICE

- Thomas Delaveaux (GER)
- Elias Tsolakidis (GRE)
- Steffen Neubert (GER)
- Juliane Leyva Gonzalez (GER)
- Külli Teimann (EST)
- Tuulia Hokkanen (FIN)
- Alexandra Zavadska (SVK)
- Anish Rawat (IND)

CHAIRS ORGANIZING COMMITTEE

- Colin Boreham (IRL)

LOCAL ORGANIZING COMMITTEE

- Daniela Bossard (IRL)
- Gavin Breslin (GBR)
- Giuseppe de Vito (IRL)
- Eamonn Delahunt (IRL)
- Massimiliano Ditroilo (IRL)
- Adam Granger (IRL)
- Marie Murphy (GBR)
- Ann O'Hanlon (IRL)

CHAIR OF THE LOCAL SCIENTIFIC COMMITTEE

- Marie Murphy (GBR)

LOCAL SCIENTIFIC COMMITTEE

- Colin Boreham (IRL)
- Willem van Mechelen (NED)
- Chris Bleakley (IRL)
- Brian Caufield (IRL)
- Gareth Davison (IRL)
- Eamon Delahunt (IRL)
- Paul Darby (IRL)
- Massimiliano Ditrolio (IRL)
- Alison Gallagher (IRL)
- David Hassan (IRL)
- Seamus Kelly (IRL)
- Madeline Lowery (IRL)
- Aidan Moran (IRL)
- Helen Roche (IRL)
- Eric Wallace (IRL)

REVIEWING PANEL

- Stephen Bailey (GBR)
- Nick Ball (AUS)
- Bill Baltzopoulous (GBR)
- Gregory Bogdanis (GRE)
- Jerome Bourbousson (FRA)
- Leigh Breen (GBR)
- Neil Cronin (FIN)
- Paul Darby (GBR)
- Gareth Davison (GBR)
- Rosa Diketmüller (AUT)
- Marije Elferink-Gremser (NED)
- Sally Fenton (GBR)
- Christopher Gaffney (GBR)
- Dominic Gehring (GER)
- Daniel Green (AUS)
- Sydney Grosprêtre (FRA)
- Amelia Guadalupe Grau (ESP)
- Mette Hansen (DEN)
- Shane Heffernan (IRL)
- Ilkka Heinonen (FIN)
- Katy Horner (IRL)
- Jaak Jürimäe (EST)

- Marko Laaksonen (FIN)
- Robert Lamberts (RSA)
- Andrew Lane A (GBR)
- Benedikt Lauber (GER)
- Pierre-Nicolas Lemyre (NOR)
- Stefan Josef Lindinger (AUT)
- James Matthews (IRL)
- Jamie McPhee (GBR)
- Andreas Mierau (GER)
- David Morales-Alamo (ESP)
- Vassilis Mougios (GRE)
- Ramona Ritzmann (GER)
- Bart Roelands (BEL)
- Christopher Shaw (AUS)
- Ana Sousa (POR)
- Mike Stembridge (GBR)
- Wolfgang Taube (SUI)
- Dick Thijssen (GBR)
- Lex B Verdijk (NED)

HEAD OF VOLUNTEERS

- Massimiliano Ditrolio (IRL)

Welcome

Welcome to the 23rd Annual Congress of the ECSS

Welcome to Dublin

Dear colleagues,

On behalf of University College Dublin and Ulster University, we would like to extend a warm welcome to join us at the 23rd Annual Congress of the ECSS in Dublin, Ireland, from the 4th - 7th July, 2018. The conference will take place right in the heart of the city at the newly built and inspirational Convention Centre overlooking the River Liffey, surrounded by all the amenities this dynamic city has to offer.

We are confident that you will find the multidisciplinary academic programme, delivered by some of the leading exponents and thinkers in our field, invigorating and enjoyable, arising as it does from the combined expertise of University College Dublin (Centre for Sports Studies; Institute for Sport and Health) and Ulster University School of Sport. Our congress theme is "Sport Science at the Cutting Edge" and we aim to provide every opportunity for delegates to learn from, and contribute to the latest developments in Sports and Exercise science in a stimulating social and professional setting.

We look forward to seeing you there!

Prof. Marie Murphy PhD, FACSM, FBASES
(Ulster University School of Sport)

Prof. Colin Boreham PhD, FECSS, FACSM
(Director, Institute for Sport and Health, UCD)

Prof. Giuseppe De Vito MD, PhD, FECSS, FFSEM
(Head, School of Public Health, Physiotherapy and Sports Science, UCD)

Table of Contents

Wednesday, July 4th, 2018

12:00 - 13:30

Oral presentations

OP-PM01 BLOOD FLOW RESTRICTION EXERCISE

MUSCLE FIBER TYPE-SPECIFIC CELLULAR STRESS AND SUBCELLULAR MOVEMENT OF HEAT-SHOCK PROTEINS DURING FREQUENT BLOOD FLOW RESTRICTED RESISTANCE EXERCISE

BJØRNSEN, T., WERNBOM, M., PAULSEN, G., BERNTSEN, S., RAASTAD, T.

UNIVERSITY OF AGDER

INTRODUCTION: High-frequency blood flow restricted resistance exercise (BFRRE) can induce rapid muscle growth (1). In contrast to heavy-load strength training, a single bout of low-load BFRRE seems to preferentially stress type I fibers (2). Therefore, the aim of this study was to investigate heat shock protein (HSP) responses and changes in glycogen content, muscle fiber areas (MFA) and strength during frequent BFRRE.
METHODS: Thirteen participants (9 men, 4 women) performed two blocks of seven BFRRE sessions, separated by 10 days of rest. BFRRE consisted of four sets (30s rest) with unilateral knee-extensions to failure at 20% of 1 repetition maximum (1RM) with partial blood flow restriction. Biopsies were obtained from m. vastus lateralis at baseline, 1h after the first session each week, after 3 sessions, during the rest period, and two times post-intervention. Muscle tissue was homogenized and fractionated into cytosolic, membrane, cytoskeletal and nuclear fractions. HSP70, αB-crystallin, glycogen content and MFA were assessed using immunohistochemistry and western blotting. Strength was measured as 1RM in knee extension.
RESULTS: αB-crystallin levels were increased in the cytoskeletal fraction and decreased in the cytosolic fraction 1 hour after the first bout of each training week. Staining intensity of αB-crystallin (cytoskeletal-bound) increased in type I and II fibers 1 hour after the first bout each training week, however, the increases were larger in type I fibers. Cytoskeletal HSP70 levels were increased after 3 BFRRE sessions and 3 days after the second block of BFRRE. Staining intensity of HSP70 (cytoskeletal-bound) also increased after 3 sessions and 3 days after the second block of BFRRE, but only in type I fibers. Glycogen content was reduced 1h after the first bout in each week, and after 3 BFRRE sessions, but the reduction was larger in type I fibers than type II fibers. Type I fibers also had reduced glycogen content during the rest week (after 5 days of rest). MFA increased significantly in type 1 fibers after 10 days of detraining and the increases were significantly larger than type in II fibers. 1RM increased after 20 days of detraining, but was reduced during the rest week and the reduction was correlated with the reduced glycogen content of type I fibers in the rest period.
CONCLUSION: BFRRE stresses the muscle fibers, causing an activation of HSP70 and translocation of αB-crystallin to cytoskeletal proteins. The HSP responses were more pronounced in type I than type II fibers. The prolonged reduction in glycogen content of type I fibers (≥5 days), suggests impaired glucose uptake and/or elevated energy turnover. Taken together, the fiber type-specific HSP responses, prolonged glycogen depletion and myofiber hypertrophy, strongly indicate that type I fibers were more stressed than type II fibers during low-load BFRRE.
References: 1 Nielsen JL et al. J Physiol 590: 4351-4361, 2012. 2 Cumming KT et al. Acta Physiol 211: 634–646, 2014.
Contact: thomas.bjornsen@uia.no

EFFECTS OF A FAILURE VS. A SUBMAXIMAL PROTOCOL OF FREQUENT BLOOD FLOW RESTRICTED RESISTANCE EXERCISE ON CHANGES IN MAXIMAL STRENGTH

SANDNES, N.V.1, MANGSETH, H.1, GERBI, S.1, LINDBERG, K.1, SØRLI, T.1, VÅRVIK, F.2, WERNBOM, M.3, BERNTSEN, S.1, PAULSEN, G.4, RAASTAD, T.5, BJØRNSEN, T.1

1UNIVERSITY OF AGDER, 2NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY, 3UNIVERSITY OF GOTHENBURG, 4NORWEGIAN OLYMPIC FEDERATION, 5NORWEGIAN SCHOOL OF SPORT SCIENCES

INTRODUCTION: Short-term high-frequency low-load blood flow restricted resistance exercise (BFRRE) has been observed to induce gains in maximal strength with loads as low as 20% of 1 repetition maximum (1RM) (1). However, the responses were delayed and peaked 12 days after the last training session. Therefore, the aim of the present study was to compare the effect of a failure versus submaximal BFRRE protocol on maximal strength.
METHODS: Nineteen untrained men and women (18-45 yrs old) performed BFRRE with four sets to voluntary failure with one leg, and a submaximal protocol with 20, 10, 10 and 10 repetitions with the other leg, using unilateral knee extensions. The intervention consisted of 14 BFRRE sessions distributed equally over two training blocks (5 days), separated by ten days rest. Training load was 20% of 1RM, with a 145mm wide pressure cuff inflated to 100 mmHg to induce partial blood flow restriction. 1RM and maximal voluntary isometric contraction (MVC) was tested at baseline, in the rest week, as well as and 3, 10, 17 and 24 days post BFRRE. Delayed onset muscle soreness (DOMS), rate of perceived exertion (RPE) and pain score (CR10) were also recorded at each session. A linear mixed model with Fishers LSD post-hoc test and independent sample t-tests were used for statistical analysis.
RESULTS: The submaximal leg increased MVC significantly compared to the failure leg over the time course of the study ($p<0.05$). The submaximal leg had significantly higher MVC than the failure leg 3 days post BFRRE, due to a larger initial reduction in MVC during the failure protocol. Compared to baseline, MVC increased by 7.6% (CI: 3.0,12.2, $p<0.001$) in the submaximal leg, while the failure leg tended to increase MVC by 3.8% (CI -0.7, 8.5, $p=0.10$). We did not observe any differences between protocols in 1RM gains over the time course of the study. Both legs increased 1RM by ~15% ($p<0.001$) at 24 days post BFRRE, compared to baseline. Participants reported higher RPE ($p<0.001$) and CR10 ($p<0.001$) levels in the failure than the submaximal leg during both training weeks. The failure protocol induced higher DOMS than the submaximal protocol during the first week of BFRRE ($p<0.05$).

CONCLUSION: The submaximal protocol led to greater gains in MVC, however, we did not observe any group differences in 1RM. Notably, the increases in 1RM and MVC were delayed and peaked at an even later timepoint than the study by Nielsen and co-workers (24- vs. 12 days of detraining) (1). RPE-, CR10- and DOMS scores, as well as the transient decrease in MVC, indicate that the failure protocol was more stressful than the submaximal protocol. Considering the delayed responses after both protocols, future research should investigate if less stressful BFRRE may be even more beneficial for increases in strength during high-frequency low-load BFRRE.
References: 1. Nielsen JL., et al. (2017) Med Sci Sports Exerc 49(6): 1157-1167.

FREQUENT BLOOD FLOW RESTRICTED RESISTANCE EXERCISE IMPROVES MAXIMAL POWER PERFORMANCE

GERBI, S.1, LINDERG, K 1, MANGSETH, H.1, SANDNES, N.V.1, SØRLI, T.1, VÅRVIK, F.2, WERNBOM, M.3, BERNTSEN, S.1, PAULSEN, G.4, RAASTAD, T.5, BJØRNSEN, T.1

1 UNIVERSITY OF AGDER; 2 NTNU; 3 UNIVERSITY OF GOTHENBURG; 4 NORWEGIAN OLYMPIC FEDERATION; 5 NORWEGIAN SCHOOL OF SPORT SCIENCES

INTRODUCTION: High-frequency low-load blood flow restricted resistance exercise (BFRRE) to voluntary failure is shown to increase rapid force-generating capacity and strength (1). Notably, the increase in rapid force-generating capacity was delayed and did not peak before 12 days of detraining. Thus, the aim of the present study is to compare a high-frequent BFRRE protocol to voluntary failure versus a less strenuous submaximal BFRRE protocol on changes in maximal power.
METHODS: Nineteen untrained men and women (23.5±6.1 years) performed BFRRE with four sets to voluntary failure with one leg, and a submaximal (20, 10, 10 and 10 repetitions, respectively) BFRRE protocol with the other leg during unilateral knee extension (20% of 1RM). Participants performed 14 BFRRE sessions divided into two blocks of seven sessions, separated by 10 days of rest. A pneumatic cuff (145mm width) induced partial blood flow restriction with a pressure of 100mmHg. Maximal power was measured during knee extensions at 30% of 1RM. Exertion (Borg 6-20 scale) and pain measures (CR10 scale) were registered directly after each BFRRE bout.
RESULTS: Maximal power increased significantly more over the entire intervention period in the submaximal leg compared to the failure leg (p=0.002). Both the failure and submaximal protocol induced a significant increase in maximal power measured 3 (5% and 14%, respectively), 10 (10% and 15%), 17 (12% and 17%) and 24 days (17% and 20%) after the last training session, compared to baseline (p<0.001). On average, the failure leg performed 27.8±13.7 more repetitions than the submaximal leg during each BFFRE bout, p<0.001. Furthermore, the failure protocol was more strenuous (Failure: 18.9±0.9 vs. Submax: 15.1±0.7, p<0.001) and painful (7.8±0.4 vs. 6.5±0.5, p=0.001) than the submaximal protocol.
CONCLUSION: The submaximal leg increased maximal power more than the failure leg over the course of the study. The submaximal protocol seemed to improve maximal power more rapidly, even though it was performed with fewer repetitions and perceived as less strenuous and painful. The present findings may be of functional importance for athletes, clinical patients or elderly, as submaximal BFRRE may improve power more rapidly and with less discomfort than BFRRE performed to voluntary failure in each set. However, the increases in maximal power did not peak before 24 days of detraining after both protocols, indicating an overreaching effect. To the authors' knowledge, this is the first study to observe a delayed response in maximal power after high-frequency BFFRE. Future studies should further investigate the effect of a less strenuous BFRRE protocol on the changes in maximal power.
1. Nielsen et al., (2017) MEDICINE & SCIENCE IN SPORTS & EXERCISE 49(6):1157-1167

BLOOD FLOW RESTRICTION COMBINED WITH LOW-LOAD RESISTANCE-TYPE EXERCISE INCREASES MYOFIBRILLAR PROTEIN SYNTHESIS RATES IN YOUNG MEN

NYAKAYIRU, J., FUCHS, C.J., SMEETS, J.S.J., GIJSEN, A.P., GOESSENS, J.P.B., VAN LOON, L.J.C., VERDIJK, L.B.

MAASTRICHT UNIVERSITY

INTRODUCTION: Recent observations suggest that blood flow restriction (BFR) performed under resting conditions or when combined with low-load resistance-type exercise (LLRE), can increase muscle mass and strength (1, 2). However, limited data is currently available on the acute effects of blood flow restriction on muscle protein synthesis and anabolic signaling. Therefore, we determined the impact of blood flow restriction with and without concomitant low-load resistance-type exercise on myofibrillar protein synthesis rates in vivo in healthy young men.
METHODS: Twenty healthy young men (age: 24±1 y, BMI: 22.9±0.6 kg/m2) were randomly subjected to two 5 min cycles of single leg blood flow restriction combined with (LLRE-BFR; n=10) or without (REST-BFR; n=10) low-load resistance-type exercise (20%-1RM). Myofibrillar protein synthesis rates were assessed during a 5 h post BFR period, by combining a primed continuous L-[ring-13C6]phenylalanine infusion with the collection of blood samples and muscle biopsies from both the blood flow restricted and control leg of each participant. Phosphorylation status of Acetyl-CoA Carboxylase (ACC), and key anabolic signaling proteins (mTOR pathway) were also determined in the muscle samples collected from both legs. Within subject differences between the BFR and control leg were assessed using paired samples t-tests. Signaling data were analyzed using a two-factor repeated measures ANOVA with time and treatment (BFR vs control leg) as within-subjects factors. Data represent means±SEM.
RESULTS: In resting condition, blood flow restriction (REST-BFR) did not increase myofibrillar protein synthesis rates when compared to the control leg (0.044±0.004 vs 0.043±0.004 %/h, respectively; P=0.683). No changes in ACC or mTOR related signaling were observed with BFR under resting conditions, when compared to the resting control leg. In contrast, when combined with low-load resistance-type exercise, blood flow restriction (LLRE-BFR) increased post-exercise myofibrillar protein synthesis rates by 10±5 % when compared to the LLRE control leg (0.048±0.005 vs 0.043±0.004 %/h, respectively; P=0.042). Furthermore, LLRE-BFR showed a higher level of ACC (P<0.05) and 4E-BP1 (P=0.038) phosphorylation, when compared to LLRE.
CONCLUSION: Blood flow restriction at rest does not increase myofibrillar protein synthesis rates in healthy young men. When combined with low-load resistance-type exercise, blood flow restriction increases myofibrillar protein synthesis rates during post-exercise recovery.
REFERENCES:
1. Martin-Hernandez J, et al. Scand J Med Sci Sports 23: e114-120, 2013.
2. Sudo M, et al. Muscle Nerve 55: p 274–276, 2017.
Supported by a grant from the Dutch Technology Foundation STW
Contact: jean.nyakayiru@maastrichtuniversity.nl

THE COMBINED EFFECT OF SPRINT INTERVAL TRAINING AND BLOOD FLOW RESTRICTION ON CRITICAL POWER, CAPILLARY GROWTH AND MITOCHONDRIAL PROTEINS IN TRAINED CYCLISTS

MITCHELL, E.A., MARTIN, N.R.W., TURNER, M.C., TAYLOR, C.W., FERGUSON, R.A.

LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Sprint interval training (SIT) combined with post-exercise blood-flow restriction (BFR) is a novel method to increase maximal oxygen uptake (V̇O2max) in trained individuals, and also provides a potent acute stimulus for angiogenesis and mitochondrial biogenesis (Taylor et al. 2016). The efficacy to enhance endurance performance has, however, yet to be demonstrated. The aim of the present study, therefore, was to assess whether post-exercise BFR enhances critical power (CP) as well as skeletal muscle capillarity and mitochondrial protein content.
METHODS: With local ethics committee approval eighteen trained male cyclists (V̇O2max; 63.4 ± 3.7 ml.min-1.kg-1) undertook 4 weeks of SIT involving repeated 30 sec maximal sprints with 4.5 min recovery intervals either alone (CON; n = 9) or with 2 min of post-exercise BFR (n = 9). Before and after training (V̇O2max was assessed as well as the power-duration relationship through the performance of 3-5 constant load tests for the determination of CP and W'. Muscle biopsies (vastus lateralis) were also obtained and analysed for skeletal muscle capillarity (capillary density and capillary-to-fibre ratio (C:F)), proliferating endothelial cells (Ki-67 positive) and mitochondrial enzyme protein content (citrate synthase and cytochrome c oxidase subunits II and IV). Data were analysed with two-factor mixed model ANOVAs, and are presented as mean ± SD.
RESULTS: V̇O2max increased by 4.7% following BFR (62.9 ± 3.7 to 65.9 ± 5.0 ml.min-1.kg-1; P = 0.05) but was unchanged after CON (63.9 ± 4.3 vs. 63.1 ± 6.4 ml.min-1.kg-1; P = 0.47). CP increased (P < 0.001) by a similar extent following CON (288 ± 41 W to 298 ± 46 W) and BFR (297 ± 43 W to 310 ± 38 W). W' was unchanged (P = 0.23) following either training intervention. Both skeletal muscle capillary density (CON, 395 ± 66 vs. 386 ± 29 µm-2; BFR, 422 ± 32 vs. 411 ± 40 µm-2; P = 0.31) and C:F (CON, 2.98 ± 0.69 vs. 3.03 ± 0.76; BFR, 2.85 ± 0.74 vs. 3.01 ± 0.86; P = 0.42) were unchanged following either training intervention. There was a trend (P = 0.09) towards an increase in proliferating endothelial cells per fibre following BFR but not CON. Mitochondrial protein content was unchanged following either training intervention.
CONCLUSION: This study further demonstrates the potency of combining BFR with SIT to enhance V̇O2max, compared to SIT alone, in trained individuals. CP increased with SIT, however, this was not enhanced further with BFR. There is a suggestion that BFR may elicit angiogenesis but adaptations may take longer to occur, or require a greater volume of training.
References:
Taylor CW, Ingham SA, Ferguson RA. (2016). Exp Physiol, 101, 143–154.

THE EFFECT OF BLOOD FLOW RESTRICTED RESISTANCE EXERCISE PERFORMED TO FAILURE VS. SUBMAXIMALLY ON CHANGES IN RATE OF FORCE DEVELOPMENT

LINDERG, K.1, GERBI, S.1, MANGSETH, H.1, SANDNES, N.V.1, SØRLI, T.1, VÅRVIK, F.2, BERNTSEN, S.1, WERNBOM, M.3, PAULSEN, G.4, RAASTAD, T.5, BJØRNSEN, T.1

1 UNIVERSITY OF AGDER; 2 NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY; 3 UNIVERSITY OF GOTHENBURG; 4 NORWEGIAN OLYMPIC FEDERATION; 5 NORWEGIAN SCHOOL OF SPORT SCIENCES

INTRODUCTION: High-frequency low-load blood flow restricted resistance exercise (BFRRE) to voluntary failure is shown to induce improvements in rate of force development (RFD) (1). Notably, the increases in RFD were delayed and did not peak before 12 days of detraining. Therefore, the aim of the present study was to compare the effect of a failure protocol to a less strenuous submaximal protocol on the changes in RFD during two blocks of high-frequency BFRRE.
METHODS: Nineteen untrained men and women (23.5±6.1 years) performed BFRRE with four sets to voluntary failure with one leg, and a submaximal (20-, 10-, 10- and 10 repetitions, respectively) BFRRE protocol with the other leg during unilateral knee extension (20% of 1RM). Participants performed 14 BFRRE sessions divided into two blocks of seven sessions, separated by 10 days of rest. A pneumatic cuff (145mm width) induced partial blood flow restriction with a pressure of 100mmHg. RFD was derived from the average slope of the force–time curve at the 0-30 ms, 0-50 ms, 0-100 ms, 0-150 ms, 0-200 ms, 0-250 ms and peakRFD 20 ms intervals during maximal voluntary isometric knee extension (MVC). Pain and exertion scores were registered with Borg CR10 and RPE scale after each BFRRE bout. Statistical analyses were conducted using linear-mixed models with Fisher's LSD post-hoc test.
RESULTS: No group differences were observed in RFD changes over the time course of the study. However, RFD 0-30 ms and RFD 0-50 ms tended (p=0.05-0.10) to decrease in the failure leg 3 days after BFRRE. Compared to the failure leg, the submaximal leg decreased RFD at 0-30 ms (p=0.038), and tended to decrease RFD at 0-50 ms (p=0.06) and 0-100 ms (p=0.07), after 24 days of detraining. Only the submaximal leg increased late phase RFD at 0-250ms (15.8% [1.5, 30]; p=0.03) and MVC (7.62% [3.12, 12.11], p=0.002) significantly from baseline to 24 days post BFRRE. The failure protocol was more strenuous and painful compared to the submaximal protocol (p<0.05).
CONCLUSION: We could not detect any significant group differences in the changes of RFD. However, early phase RFD seemed to be reduced 3 days after BFRRE in the failure leg and subsequently increased after 24 days of detraining. The increases in late phase RFD of the submaximal leg were delayed and did not peak before 24 days of detraining, indicating an overreaching effect. Future studies should further if a less strenuous high-frequent BFRRE protocol can increase RFD.
1. Nielsen et al., (2017) MEDICINE & SCIENCE IN SPORTS & EXERCISE 49(6):1157-1167

Oral presentations

OP-PM02 IRONMAN and ENDURANCE

PEAK FAT OXIDATION RATE IS RELATED TO IRONMAN PERFORMANCE IN WOMEN

VEST, S.D., FRANDSEN, J., LARSEN, S., DELA, F., HELGE, J.W.

UNIVERSITY OF COPENHAGEN

INTRODUCTION: In male triathletes overall Ironman (IM) finish time is significantly and inversely associated with peak fat oxidation rate (PFO) (Frandsen et al. 2017), but if this relationship is similar in female triathletes is unknown, since research on performance parameters

in female IM triathletes is scarce (Knechtle et al. 2010). PFO per kilogram fat free mass (FFM) is higher in women compared with men (Venables et al. 2004), and thus, we hypothesised that the relationship would also exist for female triathletes.
METHODS: 36 female IM athletes (age: 34±1 yrs (mean ± SEM) [range: 21-45 yrs]) with a BMI of 22.1±2.0 kg/m2 [18.8-28.4 kg/m2], percent body fat of 24.8±1.0 % [9.0-37.0%] and a VO2peak of 53.0±1.3 ml/min/kg [36.5-70.5 ml/min/kg] were tested in the laboratory between 28 days and 4 days prior to the IM Copenhagen 2017. Body composition was measured by a DXA-scan and venous blood samples were drawn before an incremental exercise test on cycle ergometer. Indirect calorimetry and pulmonary gas exchange measurements throughout the test were used to determine PFO and VO2peak. Ironman Copenhagen race data was obtained online from the official timing provider. Simple bivariate regression analyses and multiple regressions analyses were performed using SigmaPlot 13.0 and GraphPad Prism 7. The level of significance was defined as <0.05.
RESULTS: Finish time ranged from 9:17:07 to 15:23:48 with mean finish time being 11:57:26 h:min:sec (717 min). Simple bivariate regression analyses found negative correlations between finish time and PFO (r2 = 0.22, p<0.005), VO2peak (r2 = 0.65, p<0.0001) and the relative exercise intensity at PFO (Fatmax) (r2 = 0.35, p=0.0001). Positive correlations were found between finish time and body fat percentage (r2 = 0.44, p<0.0001) and age (r2 = 0.16, p<0.05). By means of multiple regression analyses VO2peak alone explained 64 % of the variation in finish time (adj R2 = 0.64, p<0.001) and no other variables contributed independently.
CONCLUSION: These results demonstrate significant relationships between IM performance, VO2peak, PFO and Fatmax in a heterogeneous group of female athletes, with VO2peak being the only independent race time predictor explaining 64 % of the variation in IM race time. Interestingly, the performance parameters in women showed stronger correlations to IM finish time compared to previously reported data in men (Frandsen et al. 2017).
References: Frandsen, J. et al., 2017. Maximal Fat Oxidation is Related to Performance in an Ironman Triathlon. IJSM 38(13).
Knechtle, B. et al., 2010. Differential Correlations Between Anthropometry, Training Volume, and Performance in Male and Female Ironman Triathletes. JSCR, 24(10), pp.2785–2793.
Venables, M.C. et al., 2004. Determinants of fat oxidation during exercise in healthy men and women: a cross-sectional study. JAP, 98(1), pp.160–167.
Ironman Race Data: http://live.ultimate.dk/desktop/front/index.php?eventid=3737&language=us.

PEAK OXYGEN UPTAKE PREDICTS FINISHING- AND SEGMENT TIME IN A FULL DISTANCE IRONMAN

DANIELSSON, T., CARLSSON, J., AHNESJÖ, J., BERGMAN, P.

LINNAEUS UNIVERSITY

INTRODUCTION: Ironman competitions and other extreme endurance events have spread worldwide attracting thousands of endurance-trained athletes, athletes who differ in anthropometric and training characteristics. The relationship between peak oxygen uptake and finishing- and segment time during a full distance IRONMAN competition (Swim 3.9km, Bike 180km and Run 42.2km) has not been examined thoroughly in non-elite athletes. The aim of the present study was to investigate the relationship between peak oxygen uptake, finishing time and segment time in non-elite athletes.
METHODS: 39 non-elite athletes (10 female; age 41.1 ± 9.7, range 24-70 years) performed a 20 m shuttle run test to assess VO2peak. Association between VO2 and finishing- and segment time was estimated using bivariate correlation tests. Gender specific analysis was also performed.
RESULTS: VO2peak peak was on average 49.9 ± 6.4 O2 ml/kg/minute, range 36.5-63.9 (pooled genders). Finishing time was on average 11h and 52 min. The average times for the different segments were; Swim 1h 21m, Bike 5h 46min and Run 4h 33min. The relationship between VO2peak and finishing time was significant to p<0.001 and r2 0.51. The relationship between segment times were Swim r2 0.19, Bike r2 0.37 and Run r2 0.46 all at p<0.001. Gender specific analyses revealed that the association between VO2peak and finishing time was r2 0.80 for females and r2 0.49 for males.
CONCLUSION: Our results suggest that VO2peak is a good predictor of finishing time (approx. 50%) as well as for segment time with 19%, 37% and 46% for Swim, Bike and Run respectively (pooled genders). For females VO2peak explains as much as 80% of the variation in finishing time.

ECHOCARDIOGRAPHIC FINDINGS AND CARDIAC BIOMARKERS IN NON-ELITE TRIATHLETES – DATA FROM THE KALMAR IRONWOMAN STUDY.

CARLSSON, J., DANIELSSON, T., BERGMAN, P., SCHREYER, H.

LINNAEUS UNIVERSITY

INTRODUCTION: There is an ongoing debate about the impact of endurance exercise on cardiovascular health. Not at least data on cardiac biomarker changes (e.g. troponin T (cTnT), N-terminal prohormone of brain natriuretic peptide (NT-proBNP) and cardiac specific myosin heavy chain-alpha (MHC-α) have raised questions about exercise related cardiac injury.
METHODS: In 52 non-elite athletes (14 female, 38 male; age 41.1 ± 9.7, range 24-70 years; all completed the race) biomarkers were measured by standard laboratory methods 7 days before, directly after, and day 1, 4 and 6 after a full Ironman distance triathlon (Swim 3.9 km, Bike 180 km, Run 42.2 km) . In 19 of these athletes (9 female, 10 male) echocardiography with 30 different standard measurements was performed before and directly after the race.
RESULTS: Only MHC-α [µg/L] showed a two-peaked increase directly after (2.57 ± 0.78) and on day 4 (2.74 ± 0.55). Other biomarkers showed a one-peaked increase with maximal values either directly after the race or at day 1: cTnT 76 ± 80 ng/L (12-440; reference <15), NT-proBNP 776 ± 684 ng/L (92-4700; ref. < 300), CK 68 ± 55 µkat/L (5-280; ref. < 1.9), MG 2088 ± 2350 µg/L (130-17000; ref.< 72), and creatinine 100 ± 20 µmol/L (74-161; ref. < 100), CRP 49 ± 23 mg/L (15-119; ref.< 5). No significant echocardiographic changes were recorded. E.g. left ventricular end diastolic diameter (49.0 ± 4.7 mm before, 47.7 ± 5.0 mm after the race, right ventricular end diastolic diameter (34.3 ± 4.3 mm before, 33.3 ± 5.7 mm after the race), right atrial area (17.5 ± 2.9 cm2 before, 17.7 ± 3.6 cm2 after the race) and left atrial area (18.8 ± 3.7 cm2 before, 17.8 ± 2.2 cm2 after the race) did not show any significant acute changes.
CONCLUSION: While an Ironman leads to remarkable disturbances in biomarkers as e.g. cTnT after the race was in the range of myocardial infarction in 100% of women and 97% of men, these alterations were not correlated to any acute echocardiographic changes in heart size or function. However, the significance of biochemical evidence of cardiac injury on long-term heart function and cardiovascular health remains unclear.

ENERGETICS OF RUNNING IN ULTRA-MARATHONERS: IS IT DIFFERENT FROM TRACK RUNNERS?

SOUSA, A.1,2, PIRES, P.3, COLAÇO, P.4, FERNANDES, R.4

1: RESEARCH CENTER FOR SPORTS, EXERCISE AND HUMAN DEVELOPMENT, UNIVERSITY OF TRÁS-OS-MONTES AND ALTO DOURO, VILA REAL, PORTUGAL, 2: UNIVERSITY INSTITUTE OF MAIA, ISMAI, MAIA, PORTUGAL, 3: ARMADA PORTU

INTRODUCTION: The energetics of human locomotion has been the focus of exercise physiology since 20th century's early decades, with special interest in running performance (di Prampero, 1986). More recently, there has been a growing interest in competing in long running distances, which requires some physiologic characteristics distinct from those typically associated with shorter distances. However, little research has examined the energetics of ultra-marathoners (UM), being scarce the physiological knowledge within these athletes, and/ or how distinct might be from track-runners' (TR) energetics.
METHODS: Ten high level competitive TR) and ten UM (mean ± SD; age: 28.6 ± 1.3, 40.5 ± 0.5 yrs, height: 1.75 ± 0.05, 1.76 ± 0.04 m and body mass: 61.9 ± 2.1 and 71.5 ± 2.1 kg, respectively) performed an intermittent incremental protocol until exhaustion for VO2max and corresponding velocity (vVO2max) assessment (7*800m steps). Cardiopulmonary parameters were assessed breath by breath (averaged 5s) using a portable and telemetric gas analyser (K4b2, Cosmed, Italy). Capillary blood samples were collected during the 30s intervals (Lactate Pro, Japan). The percentage of VO2 (%VO2) and heart rate (%HR) at lactate threshold (LT), and, the percentage at which LT occurred (%LT), were considered for analysis. Energy cost (EC) in each 800m step was determined as the ratio between net metabolic power expenditure and velocity. Comparison between groups was done using Mann-Whitney test ($p \leq 05$).
RESULTS: %VO2 (92.1±4.2 and 90.4±1.8 %) and %HR (95.1±2.4 and 92.7±2.6 %) were not different in-between groups, although VO2max (71.3±1.3 vs. 58.4±1.6 ml.kg-1.min-1, $p<0.001$) and HRmax (185±8 vs. 176±7 bpm, $p=0.03$) were (TR vs. UM, respectively). %LT and LT were significantly higher in TR compared with UM (89.3±3.1 vs. 86.3±3.1 %, $p=0.02$; 3.2±0.5 vs. 2.6±0.6 mmol.L-1, respectively). EC was significantly lower in TR compared with UM (ranging from 0.22 to 0.25 vs. 0.26 to 0.28 kj.m-1, from the 1st to the 5th steps), but differences in-between steps were only found for the TR group.
CONCLUSION: Both LT and %LT being lower in UM suggest that this group is more adapted to lower intensities of aerobic performance, probably as the result of the lower intensities at which competitions typically occur (Savoldelli et al., 2017). EC being independent of velocity in the UM group, suggest that EC does not play an important role in the UM' energetics.
References: di Prampero, P. E. (1986). Int J Sports Med, 7(02), 55-72.
Savoldelli et al. (2017). Front Physiol, 8, 1003.

EFFICACY OF SELF-REPORTED PERCEPTIONS OF SWEATING RATE AND RATE OF SWEAT SODIUM LOSS IN ULTRA-ENDURANCE TRIATHLETES

BARNES, K.B., PAHNKE, M.D., REIMEL, A.J., SOPENA, B.C., RANDELL, R.K., BAKER, L.B.

PEPSICO, INC

INTRODUCTION: Sweat fluid and electrolyte losses in athletes may impact performance and health if not adequately replaced. However, accurate replacement requires understanding of losses, which can be complex and require expensive equipment. The aim of this study was to determine if self-reported subjective classifications of sweating rate (SR) and rate of sweat sodium loss (RSSL) in ultra-endurance triathletes can identify those in greatest need of replacement guidance when compared to traditional methods.
METHODS: SR and sweat [Na+] were measured in 29 ultra-endurance (Ironman© World Championship) athletes (24-71 y) during a 5-mile run (29°C, 56% rh). Sweat [Na+] was analyzed via a patch technique and normalized to whole body sweat [Na+] using published equations (1). SR was the change in pre- to post-exercise body mass, corrected for food/fluid intake. RSSL was the product of whole body sweat [Na+] and SR. After the run, athletes rated self-perceptions of SR and RSSL classifications (LOW, MOD, HIGH) compared with others in their sport. A 100-point visual analog scale was used to assess frequency of salt residue on clothes/skin, taste of salt in sweat, and eye burning from sweat during typical training/competition (SALTINESS). ANOVA and Tukey post hoc analysis were used to compare measured SR and RSSL among LOW, MOD, and HIGH self-classified groups ($\alpha=0.05$).
RESULTS: The mean±SD(range) and tertiles were: SR(L/h) 1.9±0.6(1.0-3.3) and <1.6, 1.6-2.0, >2.0; RSSL(mmol/h) 94±43(47-216) and <69, 69-98, >98. SR(L/h) was greater in self-reported HIGH (2.2±0.6) than MOD (1.5±0.5), but LOW (1.6±0.4) was not different than HIGH or MOD. RSSL(mmol/h) was greater in self-report HIGH (139±50) than LOW (69±24) and MOD (91±34). Athletes with SALTINESS score ≥50% had higher (two sample t-tests) RSSL (113±51 mmol/h) than those with score <50% (75±20 mmol/h). There was a significant relation between SALTINESS and RSSL ($r2=0.23$).
CONCLUSION: Ultra-endurance triathletes who report HIGH sweat fluid and Na+ losses and greater SALTINESS tend to have higher SR and RSSL. Yet, only 48% (SR) and 34% (RSSL) correctly categorized themselves as LOW, MOD, or HIGH. Moreover, their perceived SALTINESS only accounted for ~23% of the RSSL variation . Therefore, self-perceptions of SR and RSSL cannot take the place of direct measurements. However, elite ultra-endurance triathletes may be able to use subjective cues to identify those at greatest risk of high sweat fluid/electrolyte losses and therefore most in need of sweat testing and individualized fluid replacement strategies.
The authors are employed by the Gatorade Sports Science Institute, a division of PepsiCo, Inc. The views expressed in this abstract are those of the authors and do not necessarily reflect the position or policy of PepsiCo, Inc.
1. Baker, L. B., Stofan, J. R., Hamilton, A. A., & Horswill, C. A. (2009). Comparison of regional patch collection vs. whole body washdown for measuring sweat sodium and potassium loss during exercise. Journal of Applied Phys

REPEATED PROLONGED EXERCISE IN YOUNG AND OLD WELL-TRAINED CYCLISTS

FRANDSEN, J., SAHL, R.E., HANSEN, M., RØMER, T., NIELSEN, A.B., LIE-OLSEN, M.M., LARSEN, S., DELA, F., HELGE, J.W.

UNIVERSITY OF COPENHAGEN

INTRODUCTION: Repeated prolonged exercise <14 days, 10 h and 31±37 min/day at 53% of maximal oxygen uptake > has previously been found to decrease VO2max and maximal fat oxidation rate in old men, despite no change in bodyweight. It however, remains unclear whether this finding is age dependent or a general human adaption to repeated prolonged exercise. The aim of this study was to investigate repeated prolonged exercise in both young and old well-trained cyclist. We hypothesized that VO2max and MFO would decrease in old, but remain unchanged in young men
METHODS: Cardiorespiratory fitness and maximal fat oxidation was measured in seven young <29.9±1.9 yrs. > and seven old <65.4±2.2 yrs.> men 3-7 days before departure in Copenhagen and 2 days after arrival in Palermo by indirect calorimetry and gas exchange

measurements. Venous blood samples were drawn immediately before the incremental exercise test. The participants wore heart rate monitors throughout the intervention.
RESULTS: A total distance of 3025±75 km <22500±500 altitude/meters> cycling was performed over 15 days <202±36 km/day>. The young group cycled on average 7.2±0.1 h/day at an exercise intensity of 63% of HRmax, whereas the old group cycled 9.1±0.2 h/day at 65% HRmax, covering 3100 and 2950 km in total. Body weight remained unchanged in both groups throughout the study. Before VO2max were 61.5±0.9 and 46.8±1.7 ml/min/kg in the young and old groups, respectively. 2 day after arrival VO2max was unchanged <63.8±0.8 ml/min/kg> in young but decreased <43.5±3.2 ml/min/kg> in the old group. Plasma hemoglobin concentrations decreased in both groups, from 15.1±0.3 to 14.0±0.2 g/dl in the young group and 15.2±0.2 to 13.3±0.2 g/dl in the old group, and the decrease was more pronounced in the old group.
MFO was decreased in the old group from 0.41±0.04 g/min to 0.35±0.04, but also in the young group from 0.53±0.05 to 0.43±0.06 after exercise. This decrease was probably a reflection of the marked decrease in plasma FFA concentrations in both groups .
CONCLUSION: In conclusion, the observed decrease in VO2max after repeated prolonged exercise is an age dependent adaption which is explained, at least partly, by the markedly decreased plasma hemoglobin concentration. Furthermore, the suppression of maximal fat oxidation rate is an age independent adaptation, which is most likely a consequence of the markedly decreased plasma fatty acid availability

Oral presentations

OP-PM03 NUTRITION and SUPPLEMENTS

BEET ON ALPS: ERGOGENIC EFFECTS OF DIETARY NITRATE SUPPLEMENTATION ON CYCLING AND ARM-CRANKING DURING A PROLONGED EXPOSURE TO HIGH ALTITUDE

RASICA, L., SALVADEGO, D., MRAKIC-SPOSTA, S., GELMINI, F., BERETTA, G., MARZORATI, M., PORCELLI, S.
UNIVERSITÀ DEGLI STUDI DI MILANO

INTRODUCTION: Several studies have shown dietary nitrate supplementation increases nitric oxide bioavailability through nitrate-nitrite-nitric oxide pathway (NO3NO2NO). Since NO is involved in several physiological processes related to muscle function, NO3- supplementation has been utilized to improve sea level exercise performance, especially when type II muscle fibers are recruited. Ergogenic effects of NO3- supplementation have also been investigated in acute hypoxia due to enhanced reduction of NO3- to NO2- by reduced level of PO2. No studies have been carried out in chronic hypoxia, although prolonged permanence at altitude changes NO bioavailability and impairs physical performance. This study aimed to investigate the ergogenic effects of dietary NO3- supplementation on cycling and arm-cranking during a prolonged exposure to high altitude.
METHODS: Fourteen subjects (28±6 yrs) participated in a double-blind randomized crossover study carried out at Casati hut (3269m a.s.l). Following 5 days of acclimatization, an incremental exercise test was carried out in order to assess VO2peak and gas exchange threshold (GET) by cycle- and arm-ergometers. Then, each subject was supplemented for 3 days either with beetroot juice (2x70mL/day, 8.4mmol NO3-/day [BR]) and placebo [PLA]. At the end of each supplementation period, subjects exercised at two different intensities: an 8 min moderate-intensity (80% of GET) constant work rate (MOD) and a severe-intensity (50% of the difference between VO2peak and GET) constant work rate exercise up to exhaustion (SEVERE) were performed. These exercises were conducted by both cycle- and arm-ergometers. Plasma [NO3-] and [NO2-] were measured by chemiluminescence at discrete intervals during acclimatization as well as before and after supplementation periods.
RESULTS: Before supplementation period, plasma [NO3-] and [NO2-] increased from sea level values and they reached a peak value at day 3. After BR, [NO3-] and [NO2-] were significantly higher compared to PLA (309.9±153.7 vs. 25.3±11.9.7 μM, $p<0.001$ and 966.5±386.4 vs. 490.0±150.3 nM, $p<0.01$). In MOD, VO2 was significantly reduced in BR vs. PLA in both cycling (1.776±0.29 vs. 1.875±0.30 L*min-1, $p<0.01$) and arm cranking (0.989±0.22 vs. 1.023±0.24 L*min-1, $p<0.05$). Interestingly, the oxygen cost of exercise was not affected by supplementation in the two subjects with the highest level of aerobic fitness only in cycling. In SEVERE, VO2 was significantly lower in BR (vs. PLA) after 6 min of exercise in both cycling (2.588±0.42 vs. 2.686±0.44 L*min-1, $p<0.01$) and arm cranking (1.905±0.42 vs. 1.989±0.41 L*min-1, $p<0.05$). In BR (vs. PLA), time to exhaustion significantly improved during cycling (9%) and arm cranking (23%).
CONCLUSION: This study shows dietary nitrate supplementation reduces oxygen cost during moderate-intensity exercise and improves severe-intensity exercise tolerance during prolonged exposure to hypobaric hypoxia, independently from the muscle mass involved (cycling and arm-cranking).

COMBINED EFFECTS OF ISOMETRIC PRE-CONDITIONING AND ANTIOXIDANT JUICE CONSUMPTION ON RECOVERY FROM EXERCISE-INDUCED MUSCLE DAMAGE AND CHANGES IN RUNNING ECONOMY FOLLOWING DOWNHILL RUNNING

LIMA, L.C.R., BASSAN, N.M., BARRETO, R.V., SILVEIRA, C., GRECO, C.C., DENADAI, B.S.
CENTRO UNIVERSITÁRIO HERMÍNIO OMETTO

INTRODUCTION: Downhill running (DHR) acutely compromises running economy (RE) and induces muscle damage (MD). Preconditioning with maximal isometric contractions accelerates recovery from DHR-induced MD and consumption of anthocyanin-rich antioxidant juice (AJ) was shown to blunt changes in RE and symptoms of MD following DHR. The aim of this study was to investigate the combined effects of AJ consumption and isometric pre-conditioning on changes in RE and MD symptoms after a DHR bout.
METHODS: Seventy five men (22±2 yrs; 78±9 kg; 177±5 cm) were randomly assigned to one of five groups: control (CON), placebo (PLA), supplementation with AJ (SUP), isometric pre-conditioning (ISO) and combined supplementation and isometric pre-conditioning (COMB). Participants in all groups ran downhill (-15%) for 30 minutes at 70% of their VO2max speed. Participants in SUP consumed AJ twice a day for nine days (1-4 days before, the day of, and 1-4 days after DHR) while participants in PLA consumed an isocaloric and isovolumetric placebo (maltodextrin) at the same time points. Participants in ISO performed 10 maximal isometric contractions on a leg press machine two days before running downhill. Participants in COMB performed a combination of the treatments described for SUP and ISO and participants in CON did not receive any treatment. Oxygen uptake was assessed during 5-minute runs (80% VO2max) performed before, immediately after, and 1-4 days after DHR. Knee extensor isometric peak torque (IPT), countermovement jump height (CMJ), and muscle soreness were assessed at the same time points. Data was compared by ANOVAs with Bonferroni's post-hoc tests.

RESULTS: Group-time interactions were identified for all markers except CMJ. Oxygen uptake increased ($p<0.01$) immediately after the DHR bout for all groups (CON: 19±4 %; PLA: 20±5%; SUP: 8±6%; ISO: 16±4%; COMB: 9±4%) and
remained until two days for CON, PLA and ISO. IPT decreased ($p<0.01$) immediately after downhill running for all groups (CON: 32±4%; PLA: 32±7; SUP: 15±5%; ISO: 21±6%; COMB: 18±5%) and fully recovered two days after for SUP and COMB and three days after for ISO. IPT did not fully recover for CON and PLA during the study. Muscle soreness peaked two days after the DHR bout for all groups (CON: 122±28 mm; PLA: 116±44 m; SUP: 71±29 mm; ISO: 92±38 mm; COMB: 66±14 mm), and fully recovered 4 days after it for SUP and ISO. Muscle soreness was attenuated for SUP and COMB two days after DHR, when compared to CON and PLA.
CONCLUSION: The results confirm that consuming AJ attenuates the magnitude of changes and accelerates the recovery of RE and symptoms of MD following DHR while isometric pre-conditioning accelerates recovery of IPT and muscle soreness. However, the protective effect conferred by consuming the AJ was not enhanced when this strategy was combined with isometric pre-conditioning. Consumption of AJ alone attenuates changes in RE and symptoms of MD following DHR with no additional benefits when combined with isometric pre-conditioning.

SEVEN DAYS HIGH-FAT OVERFEEDING INDUCES FIBRE-SPECIFIC INCREASES IN INTRAMUSCULAR TRIGLYCERIDE CONTENT AND PERILIPIN PROTEIN EXPRESSION IN HUMAN SKELETAL MUSCLE.

WHYTOCK, K.L.1, PARRY, S.A.2, TURNER, M.2, JAMES, L.J.2, FERGUSON, R.A.2, HULSTON, C.J.2, STRAUSS, J.A.1, COCKS, M.1, WAGENMAKERS, A.J.M.1, SHEPHERD, S.O.1

1LIVERPOOL JOHN MOORES UNIVERSITY, 2LOUGHBOROUGH UNIVERSITY

INTRODUCTION: High-fat high-calorie diets can induce whole body insulin resistance (IR) whilst increasing stores of intramuscular triglyceride (IMTG) contained within lipid droplets (LD). Perilipin (PLIN) proteins assist in IMTG storage. Synaptosomal-associated protein (SNAP23) may support LD growth and also direct IMTG-derived fatty acids (FA) to mitochondria for β-oxidation. The aims of this study were: 1) to test the hypothesis that 7 days of high-fat overfeeding increases IMTG content to prevent lipid induced muscle IR and 2) identify changes in PLINs, SNAP23 and mitochondria content and colocalisation of PLINs with LD, and SNAP23 with LD and mitochondria.
METHODS: Muscle biopsies were obtained from the vastus lateralis of thirteen healthy individuals (age: 23±1years, BMI: 24.4±0.7kg.m-2) before (0min) and during (30min) an oral glucose tolerance test (OGTT), pre and post 7-days consuming a high-fat (65% energy) high-calorie (+50% kcal) diet. IMTG, PLIN2, PLIN3, PLIN5, SNAP23 and mitochondria content were measured using (semi)-quantitative confocal immunofluorescence microscopy. PLIN2, PLIN3 and PLIN5 colocalisation to LD was measured using object-based colocalisation analyses. Pearson's correlation coefficient quantified colocalisation between SNAP23 and plasma membrane (PM), mitochondria and LD. Phosphorylation of intermediates of the muscle insulin-signalling cascade (Akt and AS160) were measured at 0 and 30 min of the OGTT before and after the dietary intervention.
RESULTS: Following overfeeding phosphorylation of Akt and AS160 in muscle was not impaired during the OGTT, however Matsuda index of whole-body insulin sensitivity decreased (-23%;$P<0.01$). IMTG content increased in type I fibres (+100%;$P<0.001$) due to both an increase in LD number (+43%;$P<0.001$) and size (+44%;$P<0.001$). Of the PLINs investigated, only PLIN3 content increased (+50%;$P<0.01$) exclusively in type I fibres. PLIN2-associated LD increased (+80%;$P<0.01$) in type I fibres only, whereas PLIN3 and PLIN5-associated LD were unaltered. SNAP23 and mitochondria content did not change, nor did the colocalisation of SNAP23 with the PM, mitochondria or LD.
CONCLUSION: Our data confirm the hypothesis that following high-fat overfeeding IMTG stores increased whilst activation of key muscle insulin signalling components were maintained. The increase in IMTG stores is likely supported by the concurrent increase in total PLIN3 content and a redistribution of existing stores of PLIN2 to the expanded LD pool in type I fibres. To confirm if increased IMTG storage protects muscle from IR future research should determine whether meal-derived FAs are directed to IMTG rather than ceramides and diacylglycerol.

PERSONALISED NUTRITION: THE EFFECT OF AN AGXT2 POLYMORPHISM ON BETA-ALANINE PHARMACOKINETIC RESPONSE

STAUTEMAS, J., HAUTEKIET, A., LEFEVERE, F., BLANCQUAERT, L., EVERAERT, I., DERAVE, W.

GHENT UNIVERSITY

INTRODUCTION: Beta-alanine (BA) is a non-proteinogenic amino acid and the rate-limiting precursor of the dipeptide carnosine (β-alanyl-L-histidine). Chronic oral BA supplementation has ergogenic effects in high-intensity exercise, which results from increased skeletal muscle carnosine concentrations. Carnosine loading shows a large interindividual variability, which is poorly understood at present. Over 90% of the ingested BA is not stored as muscle carnosine and Blancquaert et al. (1) showed that a relevant part is metabolised through the amino transferases 4-aminobutyrate-2-oxoglutarate transaminase (GABA-T: EC 2.6.1.19) and alanine-glyoxylate transaminase (AGXT2: EC 2.6.1.44). Interestingly, about 21% of the population has a malfunctioning AGXT2, due to a polymorphism (rs37369 C/T). The purpose of this study was to elucidate if this polymorphism affects the pharmacokinetic profile of an acute oral BA ingestion and thereby helps to explain the variability in carnosine loading.
METHODS: We recruited 34 healthy subjects (19 males; 15 females), whereof 12 had the reference genotype (CC), 13 were heterozygous (CT) and 9 were homozygous for the rs37369 polymorphism (TT). CC, CT and TT were expected to possess high, intermediate and low AGXT2 activity, respectively. Subjects received a single relative dose of 10 mg.(kg body weight)-1 of BA. A subset (n = 28) also ingested an absolute dose of 1.4g on a separate test day. Blood and urine samples were collected before and at several time points (up to 4h) after BA ingestion and analysed for BA by HPLC. Results were analysed by one-way ANOVA with genotype as between factor, followed by post-hoc Scheffe test.
RESULTS: When receiving 1.4 g BA, urinary BA excretion was 2-fold higher ($p = 0.043$) in TT (50±19mg/4h) compared to CC (25±10mg/4h), but not different from CT (36±24mg/4h) ($p > 0.05$). In contrast, no differences between genotypes were observed for the relative dose ($p > 0.05$). Neither the fasted nor the supplementation-induced plasma BA concentrations and pharmacokinetic profile were different between genotypes following both supplementation protocols.
CONCLUSION: The current findings demonstrate that rs37369 TT-subjects do not present a more pronounced BA plasma profile following BA ingestion, which may indicate that BA degradation is redundantly regulated and GABA-T can compensate for low AGXT2 activity. Although urinary BA excretion was somewhat elevated in TT-subjects, it seems unlikely that the rs37369 polymorphism will affect muscle carnosine loading efficiency and thus represent a novel nutrigenetic predictor.
1. Blancquaert, L et al. Carnosine and anserine homeostasis in skeletal muscle and heart is controlled by β-alanine transamination. J Physiol 2016, 594 (17): 4849 – 4863

INFLUENCE OF A CHRONIC KETOGENIC HIGH FAT DIET ON IRON STATUS AND THE HEPCIDIN RESPONSE IN ELITE ATHLETES

MCKAY, A.1,2,3, PEELING, P.1,2, PYNE, D.3,4, WELVAERT, M.3,4, BURKE, L.3,5

1:UNIVERSITY OF WESTERN AUSTRALIA. 2:WESTERN AUSTRALIAN INSTITUTE OF SPORT. 3: AUSTRALIAN INSTITUTE OF SPORT. 4:UNIVERSITY OF CANBERRA. 5:AUSTRALIAN CATHOLIC UNIVERSITY.

INTRODUCTION: Short-term restriction of carbohydrate (CHO) can augment the post-exercise inflammatory and hepcidin response to exercise. Recently, low CHO/ high fat (LCHF) diets have gained popularity as a purported strategy to improve athletic performance. It is important to understand the impact of chronic CHO restriction on health outcomes in athletes. This study examined the influence of three different approaches to CHO consumption on iron status, inflammation and the hepcidin response.
METHODS: International-level race-walkers (n=50; 7 female, 43 male) were randomly allocated to one of three dietary interventions; i) a high CHO diet (HCHO; n=16), ii) periodised CHO availability (PCHO; n=17) and iii) a LCHF diet (n=17) while completing a periodised training program for 3 weeks. A 19-25 km race-walking protocol was completed at baseline and post-intervention to measure changes in serum ferritin, interleukin-6 (IL-6) and hepcidin concentration.
RESULTS: Resting serum ferritin decreased post-intervention (HCHO: 41%, PCHO: 40%, LCHF: 25%, ($p<0.001$)); with a trend towards a smaller reduction occurring in LCHF ($p=0.055$). The post-exercise increase in IL-6 (17.0±10.8-fold) was very likely higher ($p=0.084$) after 3 weeks of the LCHF diet compared to both HCHO (9.1±5.6-fold) and PCHO (8.4±8.3-fold) groups. Increases in hepcidin concentration occurred 3 h post-exercise, with a greater pre- to post-exercise increase at baseline compared with post-intervention ($p<0.001$). Here, both PCHO (12.4 v 5.9-fold increase) and HCHO (10.2 v 7.7-fold increase) had a moderate attenuation of the 3 h post-exercise hepcidin response post-intervention compared to baseline. In contrast, the 3 h post-exercise change in hepcidin after LCHF (9.0 v 9.4-fold increase) was unclear.
CONCLUSION: Three weeks of dietary manipulation and training modified selected aspects of the iron regulatory response to exercise. The smaller reductions to serum ferritin after the LCHF diet may relate to fluctuations in training quality and subsequently adaptation, likely influencing iron stores. Reductions to the 3 h post-exercise hepcidin response with both HCHO and PCHO diets post-intervention suggest a CHO rich diet may be beneficial for iron regulatory responses in athletes. Further work is required to clarify the implications of the likely deleterious effects of low CHO diets on health outcomes in elite level athletes.

Oral presentations

OP-PM04 ROWING, KAYAKING & CANOEING

RESPONSE TO LONG- VS SHORT-INTERVAL TRAINING IN ROWING: EFFECTS OF AEROBIC CONTRIBUTION

BAUER, A.M., SIEGEL, R., HOPKINS, W.G., AUGHEY, R.J.

VICTORIA UNIVERSITY

INTRODUCTION: Despite high competition intensities, most training programs in rowing involve long, continuous exercise at low to moderate intensities, with interval training often prescribed below race pace. Athletes differ in the relative contributions from the aerobic and anaerobic systems for a given event, but it is unknown how these differences influence training response. The aim of this study was to compare the effect of short-interval training sessions performed near or above race pace with that of current interval training practices in rowing and to determine the modifying effect of differences in aerobic contribution.
METHODS: Competitive rowers (10 females, 14 males) were assigned to a long-interval or short-interval training group before the competition season. The rowers performed a familiarization and pre-intervention 6-min time trial on a Concept-II rowing ergometer. Assignment was balanced for sex and for aerobic contribution, mean power and peak lactate in the time trial. The training intervention consisted of three 4-wk blocks and followed a polarised training model, with two weekly interval-training sessions on the ergometer. The long-interval group performed interval sessions currently adopted in Australian rowing programs (8- to 20-min intervals at 98-103% of second aerobic threshold). The short-interval group performed 30-s to 3.5-min intervals at higher intensities (88% to 150% maximum aerobic power, i.e., generally at or above race pace). The remaining program was the same for both groups and involved five on-water rowing sessions, three strength-training sessions and 2-3 bike sessions per week. Changes in mean power in the time trial after 12 wk were analyzed with a spreadsheet and assessed for practical importance (smallest important change, 1.0%).
RESULTS: Performance improved by 3.7 ± 4.2 % and 2.7 ± 3.1 % in the long- and short-interval groups, respectively. After adjustment for a slight difference in aerobic contribution between the groups (83.0 ± 2.6 % and 82.8 ± 4.4 % respectively), short intervals had a clear, possibly harmful effect on TT performance (-0.9, ±2.5 %; mean, ±90% confidence limits) relative to long intervals. However, aerobic contribution had a substantial modifying effect, such that for rowers with a sufficiently low aerobic contribution (<77.5 %), there was a clear, likely beneficial effect of short vs long intervals using the less conservative approach to practical importance (odds ratio of benefit/harm >66).
CONCLUSION: The inclusion of short-interval training in rowing requires further investigation, but is not recommended in the preseason for most rowers. However, it is potentially beneficially for rowers with a relatively low aerobic contribution to endurance performance.

EXCEEDING THE COACH'S INTENDED TRAINING LOAD IS RELATED TO LESS IMPROVEMENT IN ROWING ENDURANCE PERFORMANCE

OTTER, R.T.A.1,2, VAN BLITTERSWIJK, M.2, BRINK, M.S.2

1: HANZE UNIVERSITY OF APPLIED SCIENCES GRONINGEN 2: UNIVERSITY OF GRONINGEN, UMCG

INTRODUCTION: At the start of the season, rowing coaches aim to improve the endurance performance of their rowers by prescribing a well-balanced training program. It is then assumed that the rowers follow the prescribed training. However, it is shown in many sports that there is a mismatch between the intended training load of the coach (iTL) and the actual training load of the athlete (aTL) (Brink et al., 2014). It has been suggested that a continuous mismatch between iTL and aTL could lead to under- or overtraining and consequently suboptimal performance. Therefore, the aim of this study was to investigate how training load mismatches between rowers and coaches relate to endurance performance.

METHODS: The training programs of 4 coaches and their 11 rowers who competed in national and/or international races were monitored for 6 weeks during preseason (6 male/5 female, age 22.5 ± 1.6 years, rowing experience 3.7 ± 1.8 years). The coaches prescribed an individual training program for each rower, presenting the content and type of each training session. In addition, the coaches filled out session Ratings of Intended Exertion and intended duration. The rowers kept a training log including sRPE and actual duration approximately 30 minutes after each session (Foster et al. 2001). The iTL and aTL were calculated by multiplying intensity by duration. iTL minus aTL represented the mismatch between coach and rower. Before and after the training program, all rowers performed a maximal incremental rowing ergometer test to determine endurance performance.
RESULTS: In total, the coaches prescribed 660 training sessions and the rowers performed 616 sessions of which 530 sessions matched in training content. These were used for further analyses. Reasons for a mismatch in training content were e.g. bad weather or injuries. The difference per training session between intended and actual intensity, duration and training load was 0.8 ± 1.1 AU, 1.9 ± 4.2 min and 97.6 ± 85.4 AU. Only one of the eleven rowers had a lower TL than intended (range –72 to 232 AU). VO2max before and after training was 59.7 ± 4.5 and 64.6 ± 4.7 ml/kg/min for male rowers and 52.5 ± 3.2 and 56.3 ± 6.1 ml/kg/min for female rowers. The rowers improved by 7.7 ± 4.6%. Pearson's correlations revealed a relationship between change in VO2max and the mismatch in duration (r= -.58; p= 0.03) and TL (r= -.62; p=0.02). No relation was found between sRPE mismatch and VO2max (r= -.21; p= 0.27).
CONCLUSION: These findings indicate that improvement in endurance performance of rowers is related to training more than intended. Therefore, it is important that rowers and coaches are aware of intended and actual training duration so that mismatches can be discussed and performance can be optimized.
References: Brink MS et al. (2014) Int J Sports Physiol Perform. 9(3),497-502
Foster C et al. (2001) J strength Cond Res. 15(1),109-115

HIGH VARIABILITY OF MECHANICAL POWER OUTPUT DURING INCREMENTAL ROWING ERGOMETER TESTS IN MALE ELITE ROWERS

TREFF, G.

UNIVERSITY HOSPITAL ULM

INTRODUCTION: On wind braked rowing ergometers, mechanical power output is not externally adjustable but determined by the rower's stroke frequency, -force and -distance. This leads to a currently unknown variation in mechanical power output that might influence physiological variables like [blood lactate]. To this end, we calculated the variation of mechanical power output of submaximal steps during incremental tests in elite rowers.
METHODS: Thirteen male elite rowers (body mass 93.5 ± 6.2 kg; height 191.2 ± 5.7 cm; Power at [blood lactate] 4 mmol/L 393± 6.2 W) performed a stepwise incremental test (200 W + 50W/4 min; 5 – 6 steps) on a rowing ergometer (Concept 2, Morrisville, USA). Steps were separated by a 30-s break. The ergometer was modified with a force sensor and a rotary transducer to allow for exact calculation of power (FES, Berlin, Germany). Power was measured stroke-by-stroke and saved in a log-file. Afterwards all data, excluding the last stroke, were log-transformed and the coefficient of variation (CV) was calculated for each step using a mixed model approach.
RESULTS: The average CV amounted to 4.0 ± 0.3 % (95%CI 3.4 – 4.6%). The CV significantly decreased from stage 1 to 2 ($p < .05$). Highest individual CV was 9.9% at stage 1, corresponding to 20.8 W at an average power of 210 W. CV significantly decreased ($p < .05$), when the first three strokes of each stage were excluded from the analysis, leading to an average CV of 2.9 ± 0.1% (95% CI 2.6 – 3.2 %).
CONCLUSION: Even in elite rowers, mechanical power output varies considerably during 4 min lasting constant load steps. The variation is highest in the lowest steps. Notably, the first three strokes affect the CV of each stage significantly, which is due to an over pacing at the start of each new target load. Taking into account the impact of the first strokes and the extremely high variation of particular athletes, these variations probably affect physiological variables. However, this has not been examined in this study.

ASSESSMENT OF ANAEROBIC LACTATE THRESHOLD IN FLAT-WATER KAYAKERS

PILOTTO, A., RASICA, L., SCALISE, G., PEDRALI, M., LA TORRE, A., MARZORATI, M., PORCELLI, S.

UNIVERSITY OF MILAN

INTRODUCTION: Anaerobic threshold is a physiological parameter widely used to monitor performance and training-induced changes in different sports. Currently, the assessment of anaerobic threshold in kayakers is performed in laboratory by means of specific kayak ergometers. However, laboratory-based tests differ from on-water evaluation due to several factors and, therefore, new methods to assess kayakers' physiological adaptations to exercise are needed. The aim of this study was to propose a new on-water incremental test for the assessment of anaerobic lactate threshold (LT) in flat-water kayakers. Reliability and validity were determined and maximal lactate steady-state test was used as a criterion measurement.
METHODS: Eleven junior (16±2 years) élite flat-water kayakers participated in the study. Each subject performed: i) an incremental cardiopulmonary test (CPT) up to voluntary exhaustion on a stationary kayak ergometer (KP Compact, Kayakpro) to determine peak oxygen uptake (V'O2peak); ii) a 1000m distance trial (T1000) to record best performance time and mean speed; iii) two repetitions of on-water incremental kayaking test (WIK-test), consisting of seven 4 minutes bouts at progressively increasing speeds (determined as percentage of T1000), interspersed with a 1-minute recovery; iv) 4-5 repetitions of on-water constant speed tests (duration: 20 minutes) at different intensities in order to determine maximal lactate steady-state (MLSS). Heart rate (HR) was assessed by chest band (M400, Polar). Global positioning system device (Optimeye B5, Catapult) monitored speed at a sampling rate of 10 Hz. Blood lactate samples were collected during each recovery phase and at discrete intervals at the end of the tests.
RESULTS: During CPT, V'O2peak was 3.361±0.48 L*min-1 (range 38.8-56.2 ml*min-1*kg-1) and peak HR was 193±8 b*min-1 (98% of predicted maximal HR). The best performance time in T1000 was 262±13 seconds, corresponding to a mean speed of 3.82±0.19 m*s-1. In WIK-test, LT was 2.74±1.07 mM. This value corresponded to an HR of 163±9 b*min-1 and a speed of 3.35±0.16 m*s-1. A significant correlation ($R2=0.94$, $p<0.001$) was observed between best performance time in T1000 and speed at LT resulting from WIK-test. Test-retest reliability, calculated on speed at LT, was "excellent" (ICC 0.86-0.98) with a typical error, expressed as CV, of 1.2%. MLSS corresponded to 2.98±0.71 mM. This value corresponded to an HR of 168±9 b*min-1 and a speed of 3.36±0.14 m*s-1. A significant correlation for speed at LT ($R2=0.76$, $p<0.001$) was observed between WIK-test and MLSS test.
CONCLUSION: WIK-test showed good reliability and accuracy for the assessment of anaerobic lactate threshold in flat-water kayakers. Interestingly, the speed value corresponding to anaerobic threshold determined by WIK-test nicely predicted performance on 1000m distance trial. WIK-test could be a useful field-based test to monitor athletic performance over time.

MUSCLE OXYGENATION RESPONSE TO HIGH-INTENSITY INTERVAL TRAINING IN SPRINT CANOE-KAYAK

PAQUETTE, M., BIEUZEN, F., BILLAUT, F.

UNIVERSITÉ LAVAL

INTRODUCTION: Recent data suggests that peripheral adaptations, i.e. the muscle ability to extract and use oxygen, may be a stronger predictor of canoe-kayak sprint performance compared to VO2max or central adaptations. If maximizing the time near VO2max during high-intensity interval training (HIIT) sessions is believed to optimize central adaptations, maximizing the time near maximal levels of muscle desaturation could represent a critical stimulus to optimize peripheral adaptations. Therefore, the purpose of this study was to assess the VO2, muscle oxygenation and cardiac output responses to various HIIT sessions, and to determine which type of HIIT elicits the lowest muscle O2 levels and the longest cumulated time at low muscle O2 saturation.
METHODS: Thirteen well-trained canoe-kayak athletes performed an incremental test to determine VO2max and maximal aerobic power (MAP), and 4 HIIT sessions (A:40x[15sec at 105%MAP, 15sec at 30%MAP]; B:20x[30sec at 105%MAP, 30sec at 30%MAP]; C:6x[30sec all-out, 3min30 rest]; D:6x[1min at 125%MAP, 3min rest]) on a Kayakpro canoe or kayak ergometer. A portable near-infrared spectroscopy (NIRS) monitor (Moxy) was placed on the latissimus dorsi (LD), biceps brachii (BB), and vastus lateralis (VL) during every session to assess changes in muscle O2 saturation (SmO2, % of baseline), and cardiac output (Q) was evaluated using thoracic electrical bioimpedance (Physioflow). A one-way repeated measures analysis of variance with Bonferroni post hoc tests was used to compare physiological response between sessions.
RESULTS: Sessions A and B elicited a longer time at >90%VO2max (A:8.1±6.2min, B:6.8±4.6min), compared to session C (1.7±1.3min, p=0.006 and p=0.035) but not session D (4.1±1.7min). Time at >90%Qmax was greater in session A (5.6±4.4min) compared to sessions C (1.5±1.6min, p=0.023) and D (2.0±1.9min, p=0.048), and not different from session B (4.0±2.9min). Sessions C and D elicited the lowest SmO2 (C:16±6% , D:22±7%) compared to sessions A (31±8%, p<0.001 and p=0.007) and B (30±7%, p<0.001 and p=0.030), and session C produced the longest time at >90% of maximal deoxygenation (0.88±0.50min), compared to sessions A (0.17±0.19min, p<0.001), B (0.33±0.26min, p<0.001) and D (0.41±0.29min, p=0.004).
CONCLUSION: HIIT sessions eliciting the longest time near VO2max and Qmax do not elicit a sustained decrease in muscle O2 saturation. Higher effort intensities appear to be required to maximize muscle deoxygenation during a training session, potentially conducive to greater peripheral adaptations.

ISOKINETIC TESTING AND TRAINING OF TRUNK ROTATORS IN ELITE CANOEISTS

ZINKE, F.1, SONNEMANN, P.1, WARNKE, T.2, ENGLERT, M.2, GRANACHER, U.1

1: UNIVERSITY OF POTSDAM; 2: IAT LEIPZIG

INTRODUCTION: In canoe sprint, the trunk muscles play an important role in stabilizing the body in an unstable environment (boat) and in generating forces that are transmitted through shoulders and arms to the paddle for propulsion of the boat. Isokinetic training is well-suited for sports in which propulsion is generated through water resistance due to similarities in the resistive mode. Thus, the purpose of this study was i) to test the effectiveness of isokinetic training that was added to the regular training regime on maximal trunk rotator torque in elite canoeists and ii) to compute associations between isokinetic torque and canoe specific performance.
METHODS: Nine elite canoeists (7 kayak/2 canoe) who compete on an international/Olympic level participated in this study. Athletes conducted 6 weeks of progressive hypertrophy training (3-5 sets; 8-12 repetitions, 30-60°s-1) and another 2 weeks of power training (7 sets, 15-19 repetitions, 100-140°s-1) during the pre-season. Absolute isokinetic training load (external load [work] x internal load [rate of perceived exertion]) was recorded for every training-session and each participant. Pre- and post-tests included the assessment of maximal isokinetic torque at different velocities in concentric (30&140°s-1) and eccentric (30&90°s-1) mode. Trunk muscle endurance was tested using a plank test (Bourbon test). Additionally, 7 of the included athletes performed a canoe-specific performance test in the flume (1 km at 3.4 m/s). Maximal paddle forces were assessed using a strain gauge which was individually adjusted and connected to each athletes' paddle. After normal data distribution was tested, paired t-tests were conducted to analyze pre-to-post changes. Pearson correlation coefficients were calculated between trunk rotator torque and canoe specific performance.
RESULTS: Significant pre-to-post increases were found for maximal (concentric) torque of the trunk rotators at 30°s-1 (left side pre: 215±65; post: 245±59 Nm; p=.004; d=0.7; right side pre: 216±66; post: 232±55 Nm; p=.047; d=0.4) and 140°s-1 (left side pre: 196±42 and post: 219±48Nm; p=.014; d=0.7). No significant pre-to-post changes were found for eccentric trunk rotator torque (p>.164) and for the plank test (p=.177). Significant moderate-to-high correlations were detected for concentric trunk rotator torque and maximum paddle force, irrespective of the isokinetic movement velocity (30°s-1: r=.920; p=.003 and 140°s-1: r=.886; p=.008). Non-parametric testing (Spearman) resulted in similar outcomes.
CONCLUSION: Our findings indicate that isokinetic trunk rotator torque is associated with canoe-specific performance and that isokinetic training appears to be effective in improving trunk rotator torque at different movement velocities. Future research should examine the long-term effects of isokinetic training on canoe-specific performance.
CONTACT:
Fridolin.zinke@uni-potsdam.de

Oral presentations

OP-BN01 FATIGUE

REWARD IMPROVES MOTOR PERFORMANCE BY MODULATING MOTOR NETWORK ACTIVITY

LEHNER, R., BÄCHINGER, M., HANIMANN, S., GHIDONI, C., BALSTERS, J.H., WENDEROTH, N.

ETH ZURICH, NEURAL CONTROL OF MOVEMENT LAB

INTRODUCTION: Reward can motivate individuals to increase physical effort and thus, invigorate movements. Here we ask whether reward can modulate motor fatigability, tested with a repetitive finger tapping task at maximal speed, and investigate its neurobiological underpinnings by combining behavioural measurements with functional magnetic resonance imaging (fMRI) or electroencephalography (EEG). We report the findings of two experiments where we investigated whether monetary reward attenuates fatigability and which neurophysiological mechanisms might mediate this phenomenon.

METHODS: In both experiments participants performed maximal finger tapping followed by short breaks (40s). In a factorial design, they executed either fatiguing trials (40s) or non-fatiguing trials (10s) while they could either earn a reward or not. We tested twenty-eight volunteers (mean age=26±s.d. 6 years, 64% female, all right-handed) in a fMRI experiment and thirty-four healthy participants (mean age=27±s.d. 7 years, 77% female, all right-handed) in an EEG experiment.
RESULTS: In both experiments participants exhibited significant motor slowing (mixed-effects model, $p<0.001$) compared to non-fatiguing tapping. Importantly, motor fatigability caused by long tapping was significantly attenuated by reward (time*condition $p<0.001$, approx. 23% faster).
Using fMRI, we found that fatiguing tapping caused a significant increase of the blood oxygenation level (BOLD) response in bilateral primary sensory and motor cortices (SM1), secondary sensory areas (S2) and supplementary motor areas (SMA) (whole brain analysis, $pFEW<0.05$). Interestingly, this activity was further increased in rewarded trials and reached statistical significance in bilateral SMA, contralateral SM1 and S2, striatum, thalamus and ipsilateral cerebellum (region of interest analysis, sphere 8 mm, mixed-effects model, time*condition $p<0.025$).
In our EEG experiment we focussed on the recovery period and found that alpha-band power was strongly reduced immediately after tapping but recovered during the break (mixed-effects model, $p<0.001$) for the electrode overlying contralateral SM1. This recovery of the alpha-rhythm was largest for non-fatiguing tapping, at a medium level for fatiguing un-rewarded tapping, and at the lowest for fatiguing rewarded tapping.
CONCLUSION: Our results suggest that reward attenuates fatigability by disinhibiting motor areas and, thus, increasing the neural drive. This is consistent with recent theories proposing that reward has a motivational effect and increases response vigour likely signalled by dopamine. Our findings may prove to be of practical relevance in rehabilitation and sports, where extrinsic rewards could be used to improve motor performance and attenuate fatigue.

NEUROMUSCULAR AND MUSCLE METABOLIC RESPONSES TO EXERCISE FOLLOWING CONTRALATERAL LIMB FATIGUE

MORGAN, P.T., BANKS, R.A., FULFORD, J., VANHATALO, A., BAILEY, S.J., JONES, A.M.

UNIVERSITY OF EXETER

INTRODUCTION: Contralateral fatigue is characterised by impaired performance in a remote non-exercised muscle group following a fatiguing task completed by a contralateral muscle group (Halperin et al. 2015, for review). Although contralateral fatigue has been demonstrated in numerous muscle groups and during different exercise tasks, the mechanistic bases of this effect have yet to be resolved. The purpose of this study was to explore the neuromuscular and muscle metabolic bases of contralateral fatigue during knee extension exercise.
METHODS: Fourteen recreationally active men performed constant-load, single-leg knee extensor exercise to exhaustion (Tlim) at ~95% peak work rate with each leg (Leg1; left and Leg2; right) in an unfatigued condition on two separate laboratory. Subjects also completed knee-extensor exercise to exhaustion (Leg1) followed immediately (within 3 s) by knee-extensor exercise to exhaustion in the contralateral limb (Leg2post). These conditions were administered in a randomised, cross-over, counter-balanced experimental design. During these tests, quadriceps muscle metabolic changes were assessed using 31Phosphorous-magnetic resonance spectroscopy and quadriceps muscle activation was assessed using electromyography (EMG). In all tests, a rating of perceived exertion (RPE) was measured at 2 min intervals from the onset of exercise using the 6-20 Borg scale.
RESULTS: When commenced from rest, Tlim was similar in Leg1 and Leg2 (6.6 ± 1.5 vs. 6.4 ± 1.7 min; $P>0.05$). However, when the identical exercise task was performed with pre-induced quadriceps fatigue in the contralateral leg, Tlim was 19% shorter in the Leg2post condition compared to its single leg control, Leg2 (6.4 ± 1.7 vs. 5.2 ± 1.5 min; $P<0.05$). There were no inter-condition differences in muscle [PCr], [Pi], [ADP] or pH at Tlim ($P>0.05$). However, baseline muscle [PCr] was lower and [Pi] and [ADP] were higher for Leg2post compared to Leg2 ($P<0.05$). The rate of increase in EMG and EMG at Tlim were not different ($P>0.05$), but RPE was 8% higher during Leg2post compared to Leg2 ($P<0.05$).
CONCLUSION: Prior fatigue of the knee-extensor muscles of one limb led to a subsequent reduction in exercise tolerance in the knee-extensor of the contralateral limb. The ergolytic effect of pre-fatiguing the contralateral limb muscles was accompanied by similar levels of muscle activation and muscle metabolic perturbation at Tlim. However, despite an ostensible lack of muscular work, baseline muscle [PCr] was lower, and [ADP] and [Pi] were elevated at the start of the fatiguing knee-extensor exercise in the contralateral limb. These findings suggest that fatigue development is expedited in an unfatigued limb after prior fatigue in the contralateral limb, as baseline muscle metabolic perturbation is augmented and the critical permissible level of intramuscular metabolic disturbance is attained more rapidly.

THE EFFECT OF REPEATED SPRINTS ON HAMSTRING MUSCLE DAMAGE AND RUNNING KINEMATICS: AN INTERDISCIPLINARY STUDY

BAUMERT, P., TEMPLE, S., STEWART, C.E., DRUST, B., LAKE, M.J., ERSKINE, R.M.

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Team sports, such as soccer, are characterised by intermittent repeated sprints that involve potentially damaging eccentric contractions of the hamstrings. Congested fixtures may not allow athletes to fully recover between matches, and insufficient recovery can increase injury risk (1). A short fascicle length (Lf) of the biceps femoris long head (BFLH) has been suggested to increase hamstring strain injury risk, and may lead to greater exercise-induced muscle damage (EIMD), which is often characterised via prolonged strength loss and delayed-onset muscle soreness (DOMS). Using an interdisciplinary approach, we aimed to investigate the physiological and biomechanical factors associated with neuromuscular fatigue and EIMD following repeated sprints. We hypothesised that (i) repeated sprints would induce EIMD in the hamstrings and, consequently, reduce hip flexion and knee extension during the late swing phase of treadmill running (RUN) to decrease the elongation stress on the hamstring muscles; and, (ii) short BFLH Lf would be associated with greater hamstring EIMD.
METHODS: Following BFLH Lf assessment via ultrasound, 20 recreationally active young men (age 20.5 ± 3.0 yrs, mass 74.5 ± 6.4 kg) completed 15 x 30 m sprints. Hamstring maximal voluntary contractions (MVC; via isokinetic dynamometer); involuntary contractions [voluntary muscle activation (VA) via electrical stimulation]; lower limb muscle DOMS (visual analogue scale); and RUN (15 km/h) kinematics of the right leg (8-camera motion capture system), were assessed before (PRE), immediately after (POST) and 48h-POST EIMD.
RESULTS: Hamstring MVC decreased over time (PRE: 142±23 Nm; POST: 124±25 Nm; 48h-POST: 113±31 Nm), while DOMS increased (both $p \leq 0.001$). However, there was no association with BFLH Lf or change in VA (the latter indicating no central fatigue). RUN demonstrated decreases POST EIMD in both peak knee extension (PRE: 7.82±5.98°; POST: 12.03±5.83°; 48h-POST: 6.93±8.89°; 0°=full extension;

p=0.039) during the late swing phase, and peak hip internal rotation (p=0.047) during the stance phase, while all values returned to baseline 48h-POST EIMD.
CONCLUSION: We have demonstrated for the first time that repeated sprints alter hip and knee kinematics. Reduced knee extension while contracting eccentrically in the late swing phase and peak hip internal rotation during stance phase of running might decrease the elongation stress on the hamstring muscles, suggesting a protective mechanism for these muscles POST EIMD. However, kinematic changes were not evident 48h-POST EIMD, although hamstring MVC showed further strength loss 48h-POST EIMD. As BFLH Lf was not associated with hamstring EIMD, future studies should investigate the architecture of other hamstring muscles in contributing towards sprinting-induced EIMD. We conclude that a 48h recovery period following sports incorporating repeated sprints is insufficient, and might increase injury risk.
References Malone et al. (2016). JSAMS

ALTERATIONS IN NEUROMUSCULAR FUNCTION AND FATIGABILITY OF THE KNEE-EXTENSORS ACROSS THE MENSTRUAL CYCLE

ANSDELL, P., BROWNSTEIN, C., ŠKARABOT, J., HICKS, K., SIMOES, D., THOMAS, K., HOWATSON, G., HUNTER, S.K., GOODALL, S.

NORTHUMBRIA UNIVERSITY; MARQUETTE UNIVERSITY

INTRODUCTION: The female menstrual cycle presents cyclical changes in multiple hormones. The interaction of these hormones with neural tissue is known to have excitatory or inhibitory effects , and may also induce changes in skeletal muscle properties . This study aimed to determine the effect of menstrual cycle phase on neuromuscular function and fatigability of the knee-extensors using transcranial magnetic stimulation and electrical nerve stimulation, before and after a fatiguing task.
METHODS: Thirteen eumenorrheic females were tested on day 2 , 14 and 21 of the menstrual cycle. Testing session order was randomised and counterbalanced, and serum 17-ß estradiol and progesterone concentrations were used to confirm menstrual cycle phase. Neuromuscular function was assessed pre- and post- an intermittent, isometric fatiguing task during each session.
RESULTS: All participants presented regular hormonal profiles throughout the testing period. There was no difference in maximum voluntary contraction between MCPs . However, voluntary activation assessed with motor nerve stimulation was greatest during ovulation ; VATMS showed a similar, but nonsignificant trend . Short interval cortical inhibition was modulated by MCP , but cortical silent period was not . Despite a longer time to task failure during the luteal phase , no MCP × fatigue interaction was observed for MVC, twitch, or VA variables, indicating that the magnitude of post-exercise neuromuscular fatigue was consistent across MCP.
CONCLUSION: This study observed that changes in hormone concentrations across the menstrual cycle elicit alterations in neuromuscular function at baseline and the performance of an isometric task. Changes were observed at a supraspinal level, with SICI reflecting alterations in intracortical neuron excitability. VA was greatest during the period of lowest cortical inhibition, however, the causal link between these two variables is unknown. The ~40% increase in time to task failure observed in the luteal phase could be due to a positive effect of progesterone. These findings demonstrate the magnitude of effect that the menstrual cycle can have on neuromuscular function and fatigability.
References: Smith MJ, et al. Menstrual cycle effects on cortical excitability. Neurology. 1999. 53<9>.
Lowe DA, et al. Mechanisms behind Estrogens' Beneficial Effect on muscle Strength in Females. Exerc Sport Sci Rev. 2010. 38<2>.

MOTOR FATIGABILITY IS ASSOCIATED WITH DIS-INHIBITION OF PRIMARY MOTOR CORTEX ACCOMPANIED BY CHANGES IN MESIAL VS. LATERAL PREMOTOR-MOTOR INTERACTIONS

BÄCHINGER, M., LEHNER, R., THOMAS, F., HANIMANN, S., RYF, C., FRÄSSLE, S., BALSTERS, J., WENDEROTH, N.

ETH ZURICH

INTRODUCTION: Motor fatigability describes a performance decrease when tasks are executed for an extended time period. However, the supraspinal mechanisms mediating motor fatigability during submaximal repetitive movements are currently not well understood. Here we tested performance fatigability by instructing participants to do repetitive finger tapping at maximal speed for 30s. This task is characterized by significant reductions in movement frequency or "motor slowing".
METHODS: During a series of three experiments, healthy participants performed either slowing (30s) or non-slowing finger tapping (10s), while we measured functional magnetic resonance imaging (fMRI), applied transcranial magnetic stimulation (TMS) or analyzed electromyography activity (EMG). Supraspinal contributions of motor slowing were assessed by measuring fMRI during blocks of slowing versus non-slowing tapping to identify brain areas involved in motor slowing. Further, we performed dynamic causal modelling (DCM) to identify changes in connection strength across those brain areas. Finally, we used TMS to measure inhibitory activity of M1 circuits in the form of short latency intracortical inhibition (SICI), while participants recovered from slowing versus non-slowing tapping. Additionally, we measured the amount of co-contraction (joint area under the curve) during motor tapping to assess the interplay between antagonistic hand muscles. All experiments were analysed using mixed effects models including the factors tapping (slowing vs. non-slowing) and time (1st, 2nd or 3rd 10s bin).
RESULTS: Participants exhibited significant motor slowing in each experiment ($p<0.05$). Using fMRI, we found an increase in brain activity in primary motor cortex (M1), supplementary motor area (SMA) and cerebellum (Cb) during motor slowing (N=25, time main effect $pFWE<0.05$). The DCM analysis further revealed that the increase in brain activity resulted from a gradual decrease in self-inhibition of M1, accompanied by a decrease in connection strength from SMA to M1, Cb and putamen.
The decrease in self-inhibition of M1 was confirmed by the SICI measures, which showed that motor slowing is accompanied by significant dis-inhibition of M1 (N=13, tapping x time interaction, $p<0.05$). Thus, convergent evidence from fMRI and SICI data indicates that motor fatigability caused by prolonged tapping is associated with dis-inhibiting motor cortex. One explanation for this counterintuitive finding is that slowing results from increased co-activation of antagonistic hand muscles, potentially due to impaired inhibitory control. Indeed, in the final EMG experiment we found that co-contraction significantly increased during motor tapping (N=10, tapping x time interaction, $p<0.05$).
CONCLUSION: Taken together our results suggest that the performance fatigue observed during prolonged repetitive tapping is a supraspinal phenomenon associated with a break-down of the interplay between excitatory and inhibitory motor circuits.

CORTICOSPINAL AND NEUROMUSCULAR CHANGES FOLLOWING UPHILL VERSUS DOWNHILL EXERCISE

GARNIER, Y.M., PAIZIS, C., LEPERS, R.

INSERM UMR 1093-CAPS - UNIVERSITÉ BOURGOGNE FRANCHE-COMTÉ

INTRODUCTION: It has been evidenced that prolonged hilly running (i.e., running with uphill and downhill sections) induced central and peripheral neuromuscular fatigue and increased corticospinal excitability in the knee extensor (KE) muscles. However, little is known regarding to corticospinal changes and neuromuscular fatigue following purely uphill versus downhill exercise. This study aimed to examine corticospinal changes and neuromuscular fatigue of the KE muscles after uphill versus downhill exercise performed at the same heart rate and duration

METHODS: Eleven healthy moderately active volunteers (age: 26 ± 7 years) performed four different sessions. Maximal heart rate and oxygen consumption (VO2max) were assessed during the first visit. Then, subjects performed three 45-min locomotor treadmill exercises on separate days either in a level, uphill (+15%) or downhill (-15%) condition at an intensity corresponding to 75% of their heart rate reserve. Before and immediately after exercise, KE muscles' maximal voluntary contraction (MVC), voluntary activation level (VAL), M-wave amplitude and low to high frequency paired pulse ratio (Dt 10Hz/Dt 100Hz) were assessed using percutaneous femoral nerve stimulation. Changes in the amplitude of the motor evoked potential (MEP) and the duration of the cortical silent period (CSP) were also assessed on the vastus medialis, vastus lateralis and rectus femoris muscles using transcranial magnetic stimulation.

RESULTS: For a similar heart rate (157 ± 3 bpm), VO2 was lower during downhill (48 ± 8 %VO2max) compared to both level and uphill conditions (65 ± 6 % VO2max; p (0.001). Downhill exercise induced a greater loss of MVC torque (-24 ± 10%) compared to level (-12 ± 8%; p (0.001) or uphill exercises (-11 ± 8%; p (0.001). Conversely, VAL was decrease after all exercises (-8 ± 7%; p (0.001) without significant difference between conditions. M-wave amplitude decreased by 5 ± 14% (p = 0.01) after all conditions for the rectus femoris muscle only. The Dt 10Hz/Dt 100Hz ratio was reduced to a greater extent after downhill (-33 ± 11%; p (0.001) compared to uphill condition (-8± 7%; p = 0.02), but remained unchanged after level condition (-3± 10%; p = 0.42). MEP amplitude of vastus medialis and vastus lateralis muscles were increased after downhill condition only (+68 ± 56%; p (0.006), while CSP duration was shortened after downhill for the three muscles (-35 ± 21%; p (0.003).

CONCLUSION: The greater loss of maximal force capacity of the KE muscles observed after the downhill exercise compared to level and uphill conditions resulted from a greater impairment of the excitation-contraction coupling process. The increase of the corticospinal excitability and the decrease of the intracortical inhibition in the KE muscles observed after the downhill exercise only could be explained by the predominant eccentric mode of contraction of these muscles during downhill locomotion.

Oral presentations

OP-MI01 PSYCHOLOGY - COGNITIVE FUNCTION

TRANSFORMATIONAL LEADERSHIP MODERATES THE RELATIONSHIP BETWEEN ATHLETE PERSONALITY AND TRAINING BEHAVIORS

ZHANG, S., BEATTIE, S.

BANGOR UNIVERSITY

Introduction: The ultimate goal of any athlete is to strive for peak performance in competitive environments. It is not only the quantity of training but also the quality of training that allows athletes to prepare for peak performance states. Therefore, the attainment of peak performance at the competitive end may fail without desirable training behaviours. However, recent research has highlighted that athlete's personalities such as extroversion and neuroticism can be debilitative to effective training. The aim of the current research was to examine if certain transformational leadership delivered by the coach would moderate the potential negative impacts of athlete's extraversion and neuroticism upon training behaviours.

Methods: We conducted two studies that covered samples from both university and professional sport teams. In study 1, ninety-nine athletes from five University teams completed a set of questionnaires assessing their own personality and training behaviours, and their coach's transformational leadership. In study 2, eighty-four high level athletes from six professional sport teams completed the same personality and transformational leadership questionnaires from study 1. However, in study 2, we asked the head coach of each participating team to assess athletes' training behaviours.

Results: Moderated hierarchical regression analysis in both studies found that: 1> the association between extraversion and distractibility was moderated when the coach provided high performance expectations; and 2> the impairing effect of neuroticism on coping with adversity was moderated when the coach provided inspirational motivation.

Discussion: Our findings highlight that individual differences in personality can contribute to poor training behaviours, but that this negative influence can be buffered if coach demonstrates certain transformational leadership.

CHALLENGE AND THREAT STATES IN COMPETITIVE TRAMPOLINING

HASE, A.1, KORTE, I.2, DOKTER, M.3, SCHIPHOF-GODART, L.2, FREEMAN, P.1

1: UOE , 2: RUG , 3: VUA

INTRODUCTION: Performance under pressure is key to success in competitive sport. The biopsychosocial model of challenge and threat (Blascovich, 2008) specifies that in a highly pressurised competition, individuals who exhibit a challenge state outperform those who exhibit a threat state. Though research has supported the superiority of a challenge over a threat state in predicting season baseball and softball performance statistics (cardiovascular challenge and threat measure; Blascovich et al., 2004) and same-day single golf competition performance (cognitive measure; Moore et al., 2013), no study has used a prospective design to examine the association between challenge and threat states and performance at an important competition. The purpose of this study was thus to examine whether cardiovascular and cognitive measures of challenge and threat states at the beginning of the season predict performance at a specific and highly pressurised upcoming competition.

METHODS: The sample comprised 41 trampoline athletes (17 males, Mean age = 16.0 years, SD = 4.2) competing at national and international level. At the beginning of the season, athletes reported their most important competition of the upcoming season, imagined performing at this competition while cardiovascular data were recorded, and provided cognitive demand-resource evaluations for this

competition. A difference score of demand-resource evaluations and a sum score of changes in cardiac output and total peripheral resistance were used as cognitive and cardiovascular indicators of challenge and threat states, respectively. Official performance scores were obtained for the respective competition named by each athlete.
RESULTS: In hierarchical linear regression analyses, a cardiovascular challenge state was associated with better performance at the most important competition than a cardiovascular threat state ($\beta = 0.55$, $p = .02$, $sr^2 = .27$). Cognitive challenge and threat evaluations were not associated with performance. These results persisted when controlling for task engagement, age, and sex.
CONCLUSION: The results indicate that cardiovascular challenge and threat states at the beginning of the season predicted performance in a single highly pressurised competition. The findings encourage the adoption of diagnostic methods before important competitions to identify threat states, provide early support for threatened athletes, and thereby optimise performance.
References: Blascovich J. (2008). Handbook of approach and avoidance motivation, 431-445. Psychology Press, New York.
Blascovich J, Seery MD, Mugridge CA, Norris RK, Weisbuch M. (2004). J Exp Soc Psychol, 40, 683–688.
Moore LJ, Wilson MR, Vine SJ, Coussens AH, Freeman P. (2013). J Sport Exerc Psychol, 35, 551-562.
Contact: ahase@essex.ac.uk

12 WEEKS OF INTENSIVE RESISTANCE TRAINING MAY IMPROVE COGNITIVE PERFORMANCE IN OLDER ADULTS

MARSTON, K.J.1, BROWN, B.M.1, RAINEY-SMITH, S.R.2, GORDON, N.1, TEO, S.Y.1, SOHRABI, H.R.2, MARTINS, R.N.2, PEIFFER, J.J.1

1: MURDOCH UNIVERSITY , 2: EDITH COWAN UNIVERSITY

INTRODUCTION: Mechanisms responsible for age-related cognitive decline and late-life Alzheimer's disease (AD) likely start decades prior to measurable symptoms. Resistance exercise (Liu-Ambrose, 2008) has been shown to slow age-related cognitive decline in what is likely an intensity-dependent manner and represents a possible preventative strategy for late life AD. Indeed, decreased homocysteine levels, an amino acid that promotes oxidative stress and neural tissue damage have been observed following 6 months of intensive resistance training (Tsai, 2015); however, more research is needed which simultaneously examines physiological and cognitive outcomes. This study examined the influence of 12 weeks (2 sessions per week) of intensive resistance training in older adults on homocysteine levels and cognitive performance.
METHODS: 45 participants (male: n=9, age=58.8 ± 6.0yr; female n=36, age=57.2 ± 6.9yr) were recruited and randomised into a non-exercising control group (CON), or one of two volume matched intensive resistance training programs: a) high load (HL; 5 sets, 5 repetitions at 85% of 1 repetition maximum [RM]), or b) high repetitions (HR; 3 sets, 10 repetitions at 70% of 1RM). Fasting blood samples were taken at baseline and immediately post-intervention and analysed for serum homocysteine. At baseline and during the final week of the intervention, participants completed the International Shopping List Task (ISL) to assess cognition. Pre/Post changes in homocysteine and ISL were analysed between groups a one-way ANOVA and Hedge's g effect sizes with 95% confidence intervals (CI) were calculated.
RESULTS: There was no significant change in homocysteine between groups (p=0.097). Effect sizes for homocysteine change were small between HR/CON (g=0.442, 95% CI:−0.012-0.896) and HL/HR (g=0.386, 95% CI:−0.095-0.867) groups, and large between HL/CON groups (g=0.802, 95% CI:0.313-1.291). Although not significantly different between groups (p=0.107), moderate to large effect sizes were observed in changes in the number of correct answers during ISL recall between HL/CON (g=0.674, 95% CI:0.065-1.283) and HR/CON (g=0.799, 95% CI:0.237-1.361).
CONCLUSION: This study indicates that 24 sessions (12 weeks, 2 sessions per week) of intensive resistance training is likely to influence cognitive function and physiological mechanisms associated with cognitive decline. Although more research is needed to confirm our findings, practitioners should consider intense resistance training within an ageing population to maintain cognitive health.
References: Liu-Ambrose T, et al. (2008). J Am Geriatr Soc, 56(10), 1821-1830.
Tsai CL, et al. (2015). Front Behav Neurosci, 9, 23.
Contact: K.Marston@murdoch.edu.au

INVESTIGATING THE PSYCHOSOCIAL AND HEALTH-RELATED CORRELATES OF SEDENTARY BEHAVIOUR AMONG PEOPLE LIVING WITH RHEUMATOID ARTHRITIS: A CROSS-SECTIONAL STUDY

OBRIEN, C., DUDA, J., KITAS, G., VELDHUIJZEN VAN ZANTEN, J., METSIOS, G., FENTON, S.

UNIVERSITY OF BIRMINGHAM

INTRODUCTION: Rheumatoid Arthritis (RA) is a systemic inflammatory autoimmune disease. Common debilitating symptoms of RA include fatigue and pain. People with RA typically spend large proportions of the day engaged in sedentary behaviour (SB), which is proposed to exacerbate inflammatory disease activity and contribute to the progression of RA outcomes. Interventions to reduce SB may therefore improve health in these patients. However, prior to developing such interventions, studies must establish: 1) the role of SB for RA outcomes and 2) modifiable determinants of SB that can be targeted in interventions.
Aim: To investigate the cross-sectional associations of objectively assessed SB patterns with: 1) RA disease activity, fatigue and pain (RA outcomes), and 2) self-determined motivation for reducing SB (determinants of SB).
METHODS: People with RA (n=64) completed the Multidimensional Assessment of Fatigue Scale and McGill Pain Questionnaire, assessing global fatigue and pain respectively. RA disease activity was determined via a blood sample and 28 swollen-and-tender joint count (Disease-Activity Score-28 [DAS-28]). The Behavioural Regulation in Exercise Questionnaire-2 (adapted for 'reducing SB') assessed autonomous and controlled motivation to reduce SB. Participants wore an activPAL for 7 days to measure their SB patterns (sitting/lying, standing and stepping [hours/day]).
RESULTS: RA outcomes: Regression analysis (beta coefficient = B) demonstrated hours/day sitting/lying significantly positively predicted DAS-28 (B=.37, p<.01), global fatigue (B=.36, p<.01) and affective pain (B=.30, p<.05). Standing was significantly negatively related to DAS-28 (B=-.31, p<.05). Stepping was significantly negatively related to all outcomes (DAS-28, B=-.38, p<.01; global fatigue, B=-.46, p<.01; sensory pain, B=-.40, p<.01; affective pain, B=-.35, p<.01).
Determinants of SB: No significant associations between autonomous motivation for reducing SB and SB patterns were identified. However, intrinsic motivation (the quintessential form of autonomous motivation) for reducing SB was significantly negatively related to sitting/lying (B=-.26, p<.05) and significantly positively linked to stepping (B=.27, p<.05). Controlled motivation for reducing SB significantly positively predicted sitting/lying (B=.27, p<.05) and significantly negatively predicted stepping (B=-.36, p<.01).
Continued data collection (n=100) will enable the sequential associations between self-determined motivation to reduce SB, objectively assessed SB patterns and RA outcomes to be examined at the multivariate level (i.e., via path analysis).

CONCLUSION: SB patterns are associated with pertinent RA outcomes. Additionally, quality of motivation to reduce SB is linked to SB patterns in this patient group. Thus, Self-Determination Theory may serve as a basis for SB change interventions among people with RA, which may subsequently improve their health. Longitudinal and experimental studies are required to confirm the present findings.

AUTOMATICITY IN RELATION TO SEDENTARY SCREEN TIME AND ACTIVE MODES OF TRANSPORT WITH OBJECTIVE MEASURES.

MARCHANT, G.1,2, BOICHÉ, J.1, NICAISE, V.2

1. MONTPELLIER UNIVERSITY, 2. CLAUDE BERNARD UNIVERSITY LYON 1

Reducing Sedentary Screen Time and adopting an Active Modes of Transport are jointly associated with health benefits. To obtain maximum benefits, they must be performed in an automatic fashion to improve the chances of regular involvement. Automaticity is considered to be a better indicator of habit strength than frequency of behaviour . For that reason, to be consistent with Bargh's <1994> assumption that automaticity is multidimensional and embraces several facets. The Generic Multidimensional Automaticity Scale was developed and validated to capture three of the facets: a> lack of intentionality ; b> low degree of control ; and c> efficiency . This study aims to evaluate the links between automaticity - and its facets - and the objectively measured behaviours. 126 adults <55% women> completed the GMAS, in relation to SST and AMT. Behaviours were assessed objectively by accelerometers worn for 7 days. Bivariate correlations were calculated to examine the associations between automaticity - and its facets - scores and objective measures of SST and AMT. The scores for Loi , Loc and the GMAS score for AMT were significantly and positively correlated with moderate-to-vigorous physical activity minutes for the objective criterion measure. In the case of SST, only the Eff facet was significantly associated with sedentary time . The present research suggests that different facets of automaticity would be associated with physical activity and sedentary behaviour. This study constitutes an alternative approach to be developed, given that it is the first in which automaticity is measured as multidimensional. Furthermore, Automaticity's facets could be included in research to improve theoretical models to understand the adoption of SST and physical activity behaviours.

References: Bargh, J. A. <1994>. The Four Horsemen of automaticity: Awareness, efficiency, intention, and control in social cognition. En R. S. Wyer, Jr., & T. K. Srull ,

Handbook of social cognition <2nd ed., pp. 1-40>. Hillsdale, NJ: Erlbaum.

Gardner, B., Abraham, C., Lally, P., & de Bruijn, G. J. <2012>. Towards parsimony in habit measurement: Testing the convergent and predictive validity of an automaticity subscale of the Self-Report Habit Index. International Journal of Behavioral Nutrition and Physical Activity, 9<1>, 102. doi: 10.1186/1479-5868-9-102

Boiché, J., Marchant, G., Nicaise, V., & Bison, A. <2016>. Development of the Generic Multifaceted Automaticity Scale and preliminary validation for physical activity. Psychology of Sport and Exercise, 25, 60-67. doi: 10.1016/j.psychsport.2016.03.003

Epsylon, Univ Montpellier, Univ Paul Valéry Montpellier 3, F34000, Montpellier, France Univ Lyon. Université Claude Bernard Lyon 1. L-ViS. F-69622. Lyon. France

INTERACTING EFFECTS OF EXERCISE AND BREAKS IN SITTING ON COGNITION IN OLDER ADULTS.

WHEELER, M.J.1,2, HEINONEN, I.1, ELLIS, K.A.4, CERIN, E.3, LEWIS, J.1, GREEN, D.J.1, DUNSTAN, D.W.1,2,3

1: THE UNIVERSITY OF WESTERN AUSTRALIA, 2: THE BAKER HEART AND DIABETES INSTITUTE, 3: AUSTRALIAN CATHOLIC UNIVERSITY, 4: THE UNIVERSITY OF MELBOURNE

INTRODUCTION: Cognitive function is an important component of health and quality of life, especially for older adults. Sedentary behaviour may be associated with lower cognitive function (Falck et al., 2016). Conversely, an exercise bout can acutely improve cognition. However, the time course of such improvements in the context of subsequent prolonged sitting is not known. Furthermore, it is unknown whether the improvement in cognition can be amplified when combined with frequent short activity breaks post-exercise. We aimed to investigate the acute effects of a single bout of moderate-intensity exercise, with and without light-intensity breaks from prolonged sitting on cognition in older adults. We hypothesised; 1) A morning bout of exercise would improve cognition over the span of eight hours, relative to prolonged sitting and; 2) The magnitude of improvement would be greater when exercise was followed by breaks in sitting.

METHODS: In a randomised crossover trial, inactive adults (n= 65; aged 55-80 years), completed 3 acute conditions (6 day washout): 1) SIT: uninterrupted sitting (8 hours, control); 2) EXERCISE: sitting (1 hour), moderate intensity walking (30 minutes) followed by uninterrupted sitting (6.5 hours); 3) EXERCISE+BREAKS: sitting (1 hour), moderate intensity walking (30 minutes) followed by sitting (6.5 hours) interrupted every 30 minutes with 3 minutes of light intensity walking. Cognitive function was measured using the Cogstate brief battery and Groton Maze Learning Task which were administered at baseline and at 3 subsequent time points. Domains of cognitive function assessed were; 1) Psychomotor function; 2) Attention; 3) Executive function; 4) Visual learning and; 5) Working memory. Participants were familiarised with all tasks prior to testing. Standardised z-scores were calculated for each task relative to baseline values. A cognitive composite score was calculated at each time point by averaging all z-scores. Results are displayed as the mean (SEM) z-score across all time points.

RESULTS: Relative to SIT, the mean composite z-score was improved for both EXERCISE [0.06 (0.03)] and EXERCISE+BREAKS [0.06 (0.03); all $p<0.05$ vs. SIT]. Relative to SIT, the mean z-score for the working memory subset was improved for both EXERCISE [0.12 (0.05)] and EXERCISE+BREAKS [0.12 (0.05); all $p<0.05$ vs. SIT]. There were no significant differences between conditions for any other cognitive domain subset.

CONCLUSION: In support of hypothesis 1, a morning bout of exercise improved cognition over 8 hours, relative to prolonged uninterrupted sitting. Hypothesis 2 was not supported by the data. These findings support current recommendations to undertake regular daily exercise and avoid sustained periods of uninterrupted sitting.

REFERENCES: Falck, RS, Davis, JC, Lui-Ambrose, T. (2016). Br J Sports Med, 51(10):800-811

CONTACT: michael.wheeler@research.uwa.edu.au

Oral presentations

OP-BN32 Jumping performance in team sports

IDENTIFICATION AND COMPARISON OF MOVEMENT STRATEGIES OF THE SPIKE JUMP IN DIFFERENT PERFORMANCE LEVELS IN FEMALE VOLLEYBALL

DIETZSCH, M., BRAUN, C., VINCENT, A., POTTHAST, W., DAVID, S.

GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: The spike jump is one of the most frequently performed actions by attacking volleyball players. Higher jumps lift the point of attack, enabling the player to attack in steeper angles and offering him more opportunities as he is less affected by the opponents block. The technical execution of the complex and asymmetric movement appears to have a major impact on jump height and therefore the success of action. The aim of this study was to examine and compare the kinetics and muscle activation patterns of the spike jump in different performance levels.
METHODS: 27 female players from 2nd (Div2) and 8th (Div8) division were investigated using a 3D movement analysis setup. Subjects performed 10 spike jumps with a 3 step approach, attacking a suspended stationary volleyball on their individually preferred height. Ground reaction forces (GRF) for each leg were recorded by two force plates. Muscle activation of knee and ankle extensors and flexors were measured bilaterally via EMG surface electrodes. For data analysis GRF (peak, integrals and timeseries) and EMG (integrals, timeseries) were calculated during ground contact. Discrete parameters were compared using Matlabs Wilcoxon's tests while timeseries were compared using t-tests of statistical parametric mapping (SPM). The alpha level was set to 0.05 for all tests.
RESULTS: Div8 generated a significantly higher vertical peak GRF (pGRFz) in the second step (step2) ($p=.027$) compared to the third step (step3), whereas Div2 revealed no significant side difference. Comparing both groups, Div2 generated a higher impulse of step3 ($p<.001$) and of both steps together ($p=.035$). SPM displayed a significantly higher GRFz for step3 in the second half of ground contact for Div2 ($p=.010$), as well as higher breaking forces for step3 in Div8 ($p=.010$). Moreover, significantly higher EMG integrals of the m. Soleus (step3) ($p=.049$) and m. Vastus Lateralis (step3) ($p=.012$) were found for Div2. First results also show higher knee flexion angles in Div2.
CONCLUSION: Div2 players are able to generate a higher vertical GRF impulse in step3 and in step 2 and 3 together by generating higher GRFz during the second half of stance of step3. This is important as the generation of GRFz is known to be the performance-limiting factor of jump height. The generation of pGRFz is also more balanced in Div2 players which supports a two legged jump, while Div8 players showed significant differences between step2 and step3. Moreover, Div2 showed higher activations of ankle- and knee extensors in step 3. Increased knee flexion angles and the position of the Center of Mass more centrally over the feet are therefore advantageous to Div2 for generating greater GRFz, whereas Div8 experienced a higher breaking force which counteracts the generation of GRFz.

STRENGTH DETERMINANTS OF JUMP HEIGHT IN THE JUMP THROW MOVEMENT IN WOMEN HANDBALL PLAYERS

MCGHIE, D., ØSTERÅS, S., ETTEMA, G., PAULSEN, G., SANDBAKK, Ø.

NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

INTRODUCTION: In professional handball, the jump throw represents >70% of all throws (Wagner et al., 2008). Jump height is a potential performance factor, with greater height affording players more throwing opportunities as a function of position or time in the air. In game situations, the jump throw necessitates rapid force production. Still, vertical jumping ability in handball players is routinely tested using the countermovement jump (CMJ), also when assessing training interventions (e.g., Marques & González-Badillo, 2006; Vila et al., 2012), despite its typically longer execution time (e.g., Bobbert et al., 1986; Rousanoglou et al., 2014). The aim of the study was to examine the associations between jump height in a jump throw jump (JTJ) and lower-body maximum strength and impulse in handball players, as well as whether the associations between jump height and strength differed between the JTJ and the CMJ.
METHODS: Twenty women handball players from a Norwegian top division club participated in the study (mean ± SD age 19.5±2.7 yrs, body mass 70.9±9.8 kg, height 174.1±5.7 cm). Jump height was measured in the JTJ and in unilateral and bilateral CMJ. Lower-body strength (maximum isometric force, one-repetition maximum (1-RM), impulse at 60% and 35% 1-RM) was measured in seated leg press. The association between jump height and strength was assessed with correlation analyses and t-tests of dependent r's (Chen & Popovich, 2002) were performed to determine if the correlations differed between jump tests.
RESULTS: Only impulse at 35% 1-RM correlated significantly with JTJ height ($r = .52$, $p = .02$), while all strength measures correlated significantly with jump height in both CMJ tests ($r = .76 – .85$, all $p < .001$). The association between jump height and strength was significantly weaker in the JTJ than in both CMJ tests for all strength measures ($p = .001 – .023$).
CONCLUSION: Maximum strength and impulse at 60% 1-RM did not seem to sufficiently capture the capabilities associated with jump height in the JTJ, highlighting the importance of testing rapid force production capability, at loads representative of the jump throw, when assessing throw-related vertical jumping ability in handball players. In contrast, CMJ height seemed to represent a wider range of strength capabilities and care should be taken when using it as a proxy for handball-specific movements.
REFERENCES:
Bobbert MF, Mackay M, Schinkelshoek D, Huijing PA, van Ingen Schenau GJ. (1986). Eur J Appl Physiol, 54, 566-573.
Chen PY, Popovich PM. (2002). Correlation: Parametric and Nonparametric Measures. Sage Publications, California.
Marques MAC, González-Badillo JJ. (2006). J Strength Cond Res, 20 (3), 563-571.
Rousanoglou E, Noutsos K, Bayios I, Boudolos K. (2014). J Hum Kinet, 40, 49-55.
Vila H, Manchado C, Rodriguez N, Abraldes JA, Alcaraz PE, Ferragut C. (2012). J Strength Cond Res, 26 (8), 2146-2155.
Wagner H, Kainrath S, Müller E. (2008). In: Book of abstracts, 13th Annual Congress of the ECSS, Estoril, Portugal. pp. 502.

EFFECTS OF BAREFOOT INTERVENTION ON LANDING SHOCK ATTENUATION AND IMPACT PEAK ACCELERATION OF NETBALL PLAYERS

JAIYESIMI, B.G.

STELLENBOSCH UNIVERSITY

INTRODUCTION: The mechanical disposition of the body during landing from a vertical jump involves the gradual descent of the lower limb, involving the ankle followed by the knee, hip and trunk (Gross, 1988) for shock attenuation to avoid risk of injury (Fong Yan, Sinclair,

Hiller, Wegener & Smith, 2013). Landing is a fundamental skill of many movements performed during netball (Mothersole, Cronin & Harris, 2013). It involves unilateral and bilateral coordination of the lower extremities to maintain balance and efficient kinetics and kinematics functioning of the body. When landing is out of control, joint tissues of the lower limbs are strained which could result in falling or injury (Louw & Grimmer, 2006). The aim of this study was to analyse shock attenuation and impact peak acceleration during landing performance in netball players.
METHODS: Thirty netball players (aged 20±1years) were recruited for the study. They were randomly and equally allocated into an experimental (barefoot= BF) and a control group (shod=SH). The intervention program involved warm up and netball specific drills performed in barefoot condition. The barefoot activity was introduced progressively with surface variations. The SH group followed the same other of activity in shod condition. The intervention program lasted for 18 sessions. Each participants performed three valid trials of four different jump landing tasks. Data were captured with myoMotion sensors and generated with user-friendly myoMotion software. The signal processing was set to low-pass Butterworth 4th zero-lag at 60Hz cut off frequency (Zhang, Derrick, Evans & Yu, 2008). The acceleration measurements from the sensors were expressed in multiples of gravitational acceleration. Shock attenuation % = [1 – (peak pelvis acceleration / peak thigh acceleration) × 100] was modified to generate shock attenuation values for the joint of the lower extremities (Sinclair, 2017).
RESULTS: There was a significant difference in impact peak acceleration for the pelvis and thigh between the BF and SH group ($p<0.05$). Pelvis impact peak reduced by 29% in BF group compared 16% in SH group. Hip shock attenuation was significantly higher in BF compared to SH ($p<0.05$), while the knee was lower. The effect sizes were very large for both group.
CONCLUSION: The impact peak acceleration and shock attenuation mean values reduced across the lower limbs in both experimental and control group especially with hip and which showed better control of the body during the landing tasks. The values reported by this study for acceleration and shock attenuation in both groups were consistent with the study of Zhang et al., (2008); Sinclair, (2017). According to Sinclair, (2017) increase in shock transmission from the tibial to the sacrum signals potential damage for passive anatomical structure placed under greater stress. It is therefore concluded that barefoot intervention could be a useful tool for better and safer landing mechanics.

MOVEMENT CHARACTERISTICS DETERMINING VOLLEYBALL SPIKE JUMP PERFORMANCE IN FEMALES

FUCHS, P.X., FUSCO, A., CORTIS, C., VON DUVILLARD, S.P., WAGNER, H.

UNIVERSITY OF SALZBURG

INTRODUCTION: Jump height and ball velocity are most essential for successful volleyball spike jumps. Performance determining factors were investigated in males only (Wagner et al., 2014) despite technical differences between sexes (Fuchs et al., under review). In absence of clarified performance determining factors in females, optimised specific training is not achievable. The purpose of this study was to identify movement characteristics that correlate with jump height and ball velocity in females' spike jump.
METHODS: Fifteen elite female volleyball players spiked a ball at maximal jump height and ball velocity. Anthropometrics, kinematics (e.g. segment positions, joint velocities, range of motion), and kinetics (e.g. ground reaction forces, impulses, rates of force development) were obtained by twelve MX13 Vicon cameras (250 Hz) and two AMTI force plates (2000 Hz) and managed via Visual3D. Stepwise regression analyses were performed using significant ($p < .05$) correlations, excluding the co-linearity.
RESULTS: Jump height correlated with 10 out of 42 variables ($p < .05$; $|.59| \leq r \leq |.85|$). Correlations represented aspects of non-spiking arm's backswing and velocity, range of motion and extension velocity of the ankles and knees, and orientation step length. Jump height was most successfully predicted by the regression formula: $-0.21 + 4.49 \times 10\text{-}4 \times$ maximal dominant knee velocity $+ 0.20 \times$ orientation step length ($R^2 = .82$, $p < .001$).
For ball velocity, none of 22 variables correlated significantly. Strongest correlations ($p < .1$; $.49 \leq r \leq .52$) were found in upper and lower arm length and maximal angular velocity of pelvis rotation and elbow extension.
CONCLUSION: For jump height, the results support the importance of 1) a wide and dynamic use of the non-spiking arm, 2) a distinct countermovement and thus increased acceleration paths through increased range of motion in ankles and knees, and 3) great angular velocities in leg extension during push-off. The data indicate that an optimal approach strategy has an integral role in increasing jump height. The findings contribute to specific adaptation of technical training and also indicate that strength training needs to implement lower extremity extension in full range of motion.
The regression and correlation results for ball velocity are lacking. We assert that ball velocity is affected too much by the complex interaction of variables (e.g. coordination) to be predictable by any number of simple variables alone. Another adversity could be the variance of striking techniques prioritising different variables (Seminati et al., 2015). The data support that joint velocities in the upper body and extremities may be influential.
REFERENCES: Fuchs PX, Menzel HJ, Guidotti F, Bell J, von Duvillard SP, Wagner H. (under review). Eur J Sport Sci.
Wagner H, Tilp M, von Duvillard SP, Müller E. (2009). Int J Sports Med, 30(10), 760-765.
Seminati E, Marzari A, Vacondio O, Minetti AE. (2015). Sport Biomech, 14(2), 216-231.
CONTACT: Philip.Fuchs@sbg.ac.at

ANKLE PLANTAR FLEXOR WORK DIFFERS BETWEEN VOLLEYBALL AND ICE HOCKEY PLAYERS DURING JUMPING, BUT NOT LANDING

DÆHLIN, T.E., CHIU, L.Z.F.

UNIVERSITY OF ALBERTA

INTRODUCTION: In a recent investigation, we observed that landing mechanics differ between jumps performed with forefoot versus heel take-off strategies. Specifically, a forefoot take-off, requiring greater ankle plantar flexor work compared to heel take-off, leads to greater ankle plantar flexor contribution to energy absorption during landing. It is possible that similar differences manifest between athletes who engage in sports where ankle plantar flexion is free versus restricted, due to the specificity of muscle adaptions to the activity performed. The purpose of the present study was to compare the jumping and landing mechanics of athletes engaging in sports with free (volleyball) and restricted (ice hockey) ankle plantar flexion.
METHODS: Competitive female volleyball ($n = 16$) and ice hockey ($n = 19$) players performed six maximal countermovement vertical jumps (CMJ). Trajectories of 27 reflective markers affixed to the lower extremity and ground reaction forces were measured using 7 optoelectronic cameras and two force platforms. A rigid-link model was used to calculate jump height, foot, leg, thigh and pelvis segment angles, and ankle, knee, and hip net joint moment (NJM) and work. These were compared between volleyball and ice hockey players using uni- and multivariate ANOVAs.

RESULTS: The volleyball players jumped 0.41± 0.05 m, whereas the ice hockey players jumped 0.38 ± 0.05 m (p = 0.085). During the propulsion phase, volleyball players performed more ankle plantar flexor (1.53 ± 0.25 J/kg) and knee extensor work (0.86 ± 0.40 J/kg), and exerted greater ankle plantar flexor (−2.68 ± 0.26 Nm/kg) and hip extensor (−4.07 ± 0.68 Nm/kg) NJMs, compared to the ice hockey players (1.40 ± 0.15 J/kg, 0.60 ± 0.28 J/kg, −2.44 ± 0.21 Nm/kg, and −3.61 ± 0.62 Nm/kg, respectively; p < 0.05). From initial foot contact to foot flat and from foot flat to peak knee flexion, hip extensor work (−0.21 ± 0.27 J/kg) and NJM (−1.52 ± 0.71 Nm/kg), and hip extensor NJM (−3.11 ± 0.65 Nm/kg) were greater in volleyball compared to ice hockey players (−0.05 ± 0.16 J/kg, −0.86 ± 0.50 Nm/kg, and −2.12 ± 1.14 Nm/kg, respectively; p < 0.05), respectively.
CONCLUSION: Volleyball players performed more ankle plantar flexor work and exerted greater ankle plantar flexor NJM than ice hockey players during the propulsion phase, contributing to a greater jump height. This supports the hypothesis that athletes engaging in sports with free ankle plantar flexion may utilize their ankle plantar flexors more during vertical jumping. However, ankle plantar flexor work and NJM did not differ between groups during landing. Volleyball players did perform more hip extensor work to absorb the greater impact energy present during landing. These data suggest there is a finite capacity to absorb energy using the ankle plantar flexors and knee extensors during landing.
ACKNOWLEDGEMENTS:
Vanier Canada Graduate Scholarships

EFFECTS OF DROP HEIGHT ON JUMP PERFORMANCE IN ELITE MALE AND FEMALE ADOLESCENT HANDBALL PLAYERS

PRIESKE, O.1, CHAABENE, H.1, LESINSKI, M.1, HANSCHEL, F.2, PUTA, C.2, BEHM, D.G.3, BÜSCH, D.4, GRANACHER, U.1
1: UP , 2: FSU , 3: MUN , 4: CVO

INTRODUCTION: Reactive strength training is an effective training regime to improve physical fitness (e.g., vertical jumping, linear sprinting) in young athletes (Lesinski et al., 2016). However, drop height during reactive strength exercises (i.e., drop jumps [DJ]) may significantly affect subsequent jump performances (Taube et al., 2012). Thus, the purpose of the present study was to examine the effects of various drop heights on DJ performance and its associations with sprint performance in healthy adolescent handball players.
METHODS: Elite male (n = 119, age = 15.5±0.4 yrs, 2.5±0.6 yrs after peak height velocity [PHV]) and female (n = 120, age = 14.5±0.5 yrs, 2.5±0.5 yrs after PHV) adolescent handball players performed DJs in a randomized order using 3 drop heights (i.e., 20, 35, and 50 cm). DJ performance (i.e., jump height, contact time, reactive strength index [RSI]) was analyzed using an optoelectronic device and repeated measures ANOVA. Additionally, participants were tested for their 20 m linear sprint and 5 and 10 m split time performance. Pearson's product-moment correlation was used to analyze associations between DJ performance measures and sprint times.
RESULTS: The statistical analyses revealed a significant, small-sized interaction effect for the factors drop height and sex on DJ contact time (p = .048, Cohen's d = 0.23). Post-hoc tests indicated shorter contact times in males compared with females in the 20 cm drop height condition only (p = .021, d = 0.30). Additionally, medium-sized main effects of drop height were found for DJ height and RSI (p < .001, 0.63 ≤ d ≤ 0.71). Post-hoc tests indicated larger DJ heights from 20 to 35, and from 35 to 50 cm (p ≤ .031, 0.33 ≤ d ≤ 0.71) and better RSI from 20 to 35 cm drop height (p < .001, d = 0.77). Irrespective of drop height, associations of DJ performance were small with 5 m split time (-.27 ≤ r ≤ .05), small-to-medium with 10 m split time (-.44 ≤ r ≤ .14), and small-to-large with 20 m sprint time (-.57 ≤ r ≤ .22).
CONCLUSION: The present findings indicate that a 35 cm drop height is sufficient to induce rapid and powerful DJ performance (i.e., RSI) in elite adolescent handball players, irrespective of sex. Moreover, it appears that gains in DJ performance may at least partly translate to gains in longer sprint distances (i.e., ≥20 m) and/or vice versa in male and female young athletes.
REFERENCES:
Lesinski, M., Prieske, O., Granacher, U. (2016). Br J Sports Med, 50, 781-795.
Taube, W., Leukel, C., Lauber, B., Gollhofer, A. (2012). Scand J Med Sci Sports, 22, 671-683.

Oral presentations

OP-BN33 Skill acquisition and expertise

INFORMATION PROCESSING SPEED IN SPECIFIC FENCING SITUATIONS COULD BE DEPENDENT ON EXPERTISE LEVEL

NEDELJKOVIC, A.1, MILIC, M.1, CUK, I.2, MUDRIC, M.1, JARIC, S.1,3,4
1: UB-FSFV , 2: US-FFKMS 3: DKAP&BMS-GPB , 4: DHMB-JKAPE

INTRODUCTION: The information processing speed (IPS) is a measure of the efficiency of cognitive function. Specific situations in many sports require high IPS to respond quickly and accurately to an opponent action. The measurement of reaction time (RT) is a common method to assess IPS. It is well known that RT depends on the number of stimulus–response alternatives where the selection of proper response requires more time when there is a larger number of response alternatives [i.e., Hick's law; (Hick, 1952)]. The aim of the present study was to investigate the IPS in fencers of different level of expertise.
METHODS: RT of expert fencers and age matched beginners was tested in four specific fencing situations (i.e., high and low attack, high and low defense). To maximize the ecological validity of experimental set-up, we used our recently evaluated Video-based method (Mudric et al., 2015). In short, RT was calculated from the kinematic parameters recorded on either offensive or defensive action stimuli, as well as on corresponding action responses. RT in each specific fencing situations was calculated under three different experimental conditions regarding the predictability of stimulus-response paradigm (i.e., Simple RT - the stimulus and, consequently, the proper response are known in advance; 2Choice RT, or 4Choice RT - the stimulus is unknown in advance and, therefore, requires both a quick and properly selected response). RTs obtained across different experimental conditions have been plotted against the number of choices (i.e., 1, 2, or 4) and linear regression analyses were applied. The slopes of the linear regressions as a dependent variable indicate the IPS.
RESULTS: In all four specific fencing situations, subjects of both tested groups reacted quicker in Simple RT condition than in either 2Choice RT or 4Choice RT conditions, whereas 2Choice RT was faster than 4Choice RT (p < 0.05). The expert fencers reacted quicker than beginners under the same experimental conditions (p < 0.05). Finally, the regression slopes of the beginners were consistently higher than the slopes obtained from the expert fencers suggesting faster processing of stimulus-response alternatives (p < 0.05).
CONCLUSION: The obtained findings suggest that recently evaluated Video-based method could be routinely used for testing RT in specific sport situations and possibly in diagnostic of various neurological diseases. Moreover, the novel method provides the data that con-

firmed the application of Hicks law when the information is processed within specific sport situations. Finally, it could be concluded that regular fencing practice improves IPS in specific fencing situations.
REFERENCES:
Hick WE. (1952). Q J Exp Psychol. 4: 11-26.
Mudric M, Cuk I, Nedeljkovic A, Jovanovic S, Jaric S. (2015). Int J Perform Anal Sport. 15: 1077-1089
CONTACT:
aleksandar.nedeljkovic@fsfv.bg.ac.rs

RESEARCH ON THE NEUROBIOLOGICAL FEATURES OF THE CHINESE ELITE WOMAN TABLE TENNIS PLAYERS

ZHOU, W.

CHINA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: The aim of this study was to explore the brain functional state and the brain neurotransmitters of the Chinese elite woman table tennis players.
METHODS: By means of EEG and Encephalofluctuograph , 8 key players in the Chinese Woman Team were monitored in 2014 to 2016. Their average age was 23.33±2.58.
The testing instrument was the QDBS1018 Electroencephalography .
The tested indexes included: brain arousal index, brain power energy ratio（brain energy ratio）, intelligence entropy , brain coordination parameters, and brain neurotransmitters: NE , GABA <γ-aminobutyric acid>, 5-HT , OPI , Glu , DA , and ACH .
RESULTS: <1> The brain arousal index level of a world champion, which reflected the state of brain excitability, was between 48% and 50%. If the arousal index was more than 50%, the statement of the brain would be in the "Critical", that it could be reversed by "inhibition" from "excitement", and even emergence of "the exercise central fatigue".
The Index values of the 8 players in the 5 tests were more than 48%.The brain energy ratio of the world champion, reflecting the exercise the brain endured, was more than 1.95, and its critical value was 2. The ratio values of the 6 players were more than 1.95.
<2> Various neurotransmitters both played different physiological functions in the brain, and controlled a variety of activities to the body. For example, opioid peptides associated with the transfer of excitatory, DA involved in the control of movement and emotional function, ACH concerned with excitability in all parts of the brain and directly involved in memory, 5-HT was inseparable to central fatigue and so on. The values of these neurotransmitters in the brain of the 6 players were in normal range.
<3> The comprehensive indexes: The intelligence entropy reflected the comprehensive intelligence of athletes. The eIQ of the table tennis players was usually between 60 and 75. The brain coordination parameters reflected the degree of the synchronization in the brain activity.
CONCLUSION: In the 5 tests in 2014 to 2016, the most of the brain function states of the 6 key players in the China Womens Table Tennis Team were in good or the best.

THE ROLE OF INSTRUCTIONAL PREFERENCE ON MOTOR LEARNING BY ANALOGY

VAN DUIJN, T.1, MASTERS, R.S.W.1,2

1: UNIVERSITY OF WAIKATO , 2: UNIVERSITY OF HONG KONG

INTRODUCTION: During skill learning, analogy instructions impart knowledge about how to move by way of comparison with a similar, well-known concept. This reduces the number of verbal instructions or rules that need to be given to the learner. It has been argued that analogy reduces reliance on verbal information processes during motor planning (Masters 2000; Liao & Masters, 2001), which may be reflected by reduced verbal activity in the brain (measured by EEG alpha power at the temporal region, T7) as well as reduced verbal-motor cross-communication (EEG T7-Fz coherence) during the preparation phase of a movement.
METHODS: Preference for using verbal or visual instructions is likely to influence the efficacy of analogy instructions. This study investigated whether preference for verbal instructions was related to changes in performance and neural activity related to information processing during performance (preparatory phase) of an adapted basketball task after instruction by analogy.
RESULTS: While electro-cortical measurements at pre-test did not differ significantly, people with a preference for verbal instructions showed a decrease in activation of verbal regions when they used the analogy (high-alpha power). People with low verbal preference did not show a significant decrease in activation of verbal regions, and their performance deteriorated significantly after introduction of the analogy instruction, whereas people with high verbal preference remained stable. Further investigation of performance scores revealed that all participants performed worse in the first 10 trials immediately after analogy, but those with high verbal preference recovered in the next 10 trials, whereas those with low verbal preference did not.
CONCLUSION: Results generally support our hypothesis that analogy reduces verbal processing demands. It is likely that both cognitive and performance changes after analogy instruction depend on personal aspects of information processing, such as verbal preference.
REFERENCES:
Masters, R. S. W. (2000). Theoretical aspects of implicit learning in sport. International Journal of Sport Psychology, 31(4), 530–541.
Liao, C. M., & Masters, R. S. W. (2001

ERRORS IN MOTOR LEARNING: BENEFICIAL

BECKMANN, H., AZEVEDO CANEIRO, N., CALMANO, J., ZENTGRAF, L., HORST, F., SCHÖLLHORN, W.I.

JOHANNES GUTENBERG-UNIVERSITY MAINZ

INTRODUCTION: Different theories exist about the role of errors in skill acquisition. Two representatives are the errorless-learning paradigm [1] or the differencial learning approach [2]. The objective of this study was to determine whether the number of errors made during practice (regardless of their origin) influences learning of a golf putting task.
METHODS: Fourty golf novices (undergraduate sport science students, 18 female, 22 male, M=23.0 years, SD=2.0) were randomly assigned to one of four practice conditions: errorless, errorful, random [1] and differencial learning [2]. On the first day all subjects performed seven blocks of 20 golf putting trials from seven distances (0.25, 0.50,…, 1.75m) with a standard golf putter on an indoor putting green towards a standard golf hole of 0.11 m. The measure for errors was the number of missed holes. The errorless group performed the first block from the shortest distance and moved progressively back through each distance until they reached the furthest distance on the final block. The errorful group performed blocks in the reverse order of distances. The random group performed all blocks in a random order

of distances; so did the differencial group but in this group additional movement variations were applied [2]. Fourty-eight hours later subjects returned for a retention (2.00 m distance) and transfer test (2.00 m distance on an uneven surface) with 20 trials each.
RESULTS: The total number of errors during practice differed statistically significant between groups (H(3)=14.766, p=.002). The highest number of errors occurred in differencial learning (MD=51, IQR=18.25) followed by errorful (MD=38, IQR=18.25), errorless (MD=26, IQR=7.25) and random learning (MD=23.5, IQR=14.5). Dunn-Bonferroni post-hoc-tests revealed statistically significant higher number of errors only in differencial learning compared to errorless (z=-3.063, p=.013, r=.68) and random learning (z=-3.274, p=.006, r=.73).
A non-parametric ANCOVA [3] showed neither a significant effect for groups in the retention (F(3,36)=1.318, p=.284, part. η^2=.099) nor in the transfer performance (F(3,36)=0.799, p=.502, part. η^2=.062) after controlling for the number of errors during practice.
CONCLUSION: Surprisingly, there was no statistical difference in the number of errors during practice between errorful and errorless learning. Furthermore, the number of errors and the way they were provoked did not show statistical influence on the performance in the retention and the transfer test.
REFERENCES:
[1] Maxwell JP et al. Q J Exp Psychol. 2001;54:1049-1068.
[2] Schöllhorn WI. Leistungssport. 1999;29,2:7-12.
[3] Quade D. J Am Stat Assoc. 1967;62: 1187-1200.
CONTACT:
hendrik.beckmann@uni-mainz.de

INCREASED EEG ALPHA ACTIVITY IN A STROOP-LIKE GROSS-MOTOR TASK OF RIDING AN INVERSE STEERING BICYCLE

BIRKLBAUER, J.1, SHELEMBE, F.2, RIGLER, S.2, BOTHE, K.2, EDFELDER, J.1, WIESINGER, H.P.1, MÜLLER, E.1, HÖDLMOSER, K.2
1: DEP SPO SCI & KIN , 2: LAB SLEEP & CONSCI RES

INTRODUCTION: Relearning of highly automated movement patterns is a key aspect in everyday training not only for competitive athletes. In order to avoid falling back into an old movement routine, one has to suppress the retrieval of the previously learned and interfering motor memory traces that in turn are thought to rely on top-down, inhibitory control processes (Klimesch et al. 2007). A paradigmatic example in a cognitive setting is the Stroop task in which alpha oscillations were found to increase amplitudes in prefrontal regions as a function of the degree of interference (Hanslmayr et al. 2008). The aim of our study was to test whether oscillatory alpha activity also amplifies in a relearned gross-motor skill of riding an inverse steering bike.
METHODS: 15 right-handed males (age: 28±7) who had become familiar with an inverse-steering bicycle such that they dare to ride the bicycle in normal road traffic performed two different riding conditions: 10 x 30m straight-line riding and 10 x 30m slalom riding. Both conditions were executed twice with both the inverse-steering bicycle and a structurally identical but normal-steering bicycle in a randomized order. EEG data were recorded from 16 electrodes throughout all rides and a 3-min resting condition with eyes open. Riding performance was quantified by steering angle and riding time.
RESULTS: Significant differences were found between straight-line and slalom riding ($p<.05$, $etap^2>.34$) as well as between the inverse and normal-steering condition ($p<.01$, $etap^2>.41$). Task related alpha power changes were significantly more prominent in frontal and occipital regions throughout riding the inverse-steering bicycle compared to the normal bicycle. In relation to the straight-line condition alpha power changes were significantly enhanced at frontal sites during slalom riding. Most importantly, smaller differences between normal and inverse riding performance correlated with an increase in alpha synchronisation ($p<.05$, $r>.59$).
CONCLUSION: We interpret the hypothesized EEG alpha power synchronization during inverse steering as a cortical correlate of top-down control to inhibit the retrieval of the habitual and dominant motor memory traces of normal steering. The difference in alpha activity between slalom and straight-line riding may reflect the higher challenge of the slalom task imposing a more intense cognitive load to control the bicycle through the slalom course. The results also confirm that it is feasible to successfully investigate brain activity accompanying gross-motor learning, and thus to validate sophisticated neural approaches in everyday and sport-related gross-motor skills.
REFERENCES:
Hanslmayr et al. (2008). Cogn Neurosci, 20(2), 215-25.
Klimesch et al. (2007). Brain Res Rev, 53(1), 63-88.
Funded by the AUSTRIAN SCIENCE FUND (FWF)

Oral presentations

OP-BN36 Balance and Stability

BALANCE CONTROL IN VESTIBULAR LOSS SUBJECTS - A SYSTEM IDENTIFICATION APPROACH

ASSLÄNDER, L., HETTICH, G., GRUBER, M., MERGNER, T.
UNIVERSITÄT KONSTANZ

INTRODUCTION: Subjects with absent vestibular function (AVF subjects) typically show no major balance problems as long as visual cues are available. Only in demanding situations, such as walking on soft ground in the dark, does the sensory deficit become evident. In the present study we investigate multisensory integration in the control of standing balance using a system identification approach. The study explored whether AVF subjects' sway responses to surface tilt stimuli can be explained by a model developed for subjects with normal vestibular function (NVF subjects) [1,2].
METHODS: 5 AVF subjects (18.8 +/- 0.8 yrs, 2 female) and in 7 NVF subjects (4 female, 27.1 +/- 3.6 yrs) participated in this study. A pseudo-randomized sequence was applied at 4 angular amplitudes in eyes closed and eyes open conditions. Hip and shoulder sway was measured opto-electronically and whole body center of mass (COM) motion was calculated thereof. Six consecutive cycles of the stimulus were measured twice in each condition and averaged across cycles to provide an estimate of the sway response to the stimulus. Model simulations including parameter estimation were conducted to extract a model of human balance control without vestibular function.
RESULTS: With eyes open, AVF subjects showed sway responses that indicated normal sensory reweighting, but response amplitudes were abnormally large, being comparable to those of NVF subjects with eyes closed. Sway response amplitudes of AVF subjects further increased with eyes closed, restricting successful balancing to small tilt amplitudes. The reweighting effect was strongly diminished, yet

still present. Model simulations suggest that AVF subjects integrate low-pass filtered center of pressure (COP) cues as a substitute for the missing vestibular cues, with COM sway reductions at low tilt frequencies.
CONCLUSION: The sway responses of our AVF subjects showed a small reweighting effect during eyes closed conditions, which has received little attention so far. Since only the proprioceptive reference to the floor is available in such conditions, the integration of ground reaction force cues was explored as a potential explanation and confirmed in model simulations. Reweighting of AVL subjects with eyes open was reproduced within the control framework proposed for NVF subjects, while eyes closed results required an extension of the model.

PLAYING EXPERIENCE RATHER THAN CHRONOLOGICAL AGE DETERMINES BALANCE CONTROL IN OLDER AGED LAWN BOWLERS

SAYERS, M.

UNIVERSITY OF THE SUNSHINE COAST

INTRODUCTION: Lawn bowls is a target sport that is popular throughout Commonwealth countries. The delivery action involves a degree of dynamic balance control and requires participants (standing on a mat) to step forward and roll each bowl smoothly along the ground, so that it stops as close as possible to a small target positioned between 23 m to 37 m away. Although high performance lawn bowlers are typically under 40 years of age, the sport is very popular within the older aged groups. Accordingly, this project assessed whether regular participation in this sport influences dynamic balance and stability ability during the delivery stride in a cohort of older aged lawn bowlers (n=30) who play lawn bowls at least once per week on a year-round basis.
METHODS: Participants were divided into two equal groups, with the first composed of lawn bowlers aged =65 years (mean age 61.0 ±3.8 yrs, playing experience 8.0 ±6.7 yrs), and the second group consisting bowlers aged)65 years (mean age 71.6 ±4.6 yrs, playing experience 12.6 ±8.4 yrs). Prior to testing low mass, retro-reflective markers were attached to well-established landmarks on both feet, upper and lower legs and arms, and on the head, thorax, and pelvis and tracked using a 10-camera motion capture system (Qualisys AB, Gothenburg, Sweden) sampling at 200 Hz. Each participant performed 10 bowls at a target positioned 23 m away while standing on two force platforms (Bertec Corporation, Columbus, USA) that were sampling at 600 Hz. Captured marker trajectories were modelled using standard biomechanical software (Visual3D; C-Motion, Inc., USA) and smoothed using a 2nd order low-pass digital filter (25 Hz for force platform data and 4 Hz for the kinematic data) before the construction of a whole-body 20 segment rigid body model. Standard balance-based centre of pressure (CoP) and ground reaction force variables were recorded and a Dynamic Postural Stability Index (DPSI) calculated for each delivery. The relative height of the centre of mass at bowl release (recorded as a function of standing height) was also calculated from the kinematic data. The potential interrelationships between age and years of bowling experience meant that the latter was entered as a covariate when testing for significant differences in balance variables between age groups via one-way analysis of covariance (ANCOVA).
RESULTS: None of the balance variables correlated significantly with age although years of bowling experience correlated moderately with DPSI scores ($r = -.42$, $P = .019$). The over 65 group had greater variance in the mediolateral CoP movements ($P = .012$),with no other significant differences in balance or postural stability variables between groups. Analysis of covariance indicated that the DPSI data were influenced significantly by bowling experience regardless of age group.
CONCLUSION: It was concluded that in the older aged lawn bowlers, playing experience and not age was the key determinant of balance control during the lawn bowls delivery action.

LIMB DIFFERENCES IN UNIPEDAL BALANCE PERFORMANCE IN YOUNG MALE SOCCER PLAYERS AT DIFFERENT LEVELS OF PLAYING EXPERIENCE

MUEHLBAUER, T.1, SCHWIERTZ, G.1, BRUECKNER, D.1, KISS, R.2, PANZER, S.3

1:UNIVERSITY OF DUISBURG-ESSEN; 2:UNIVERSITY OF APPLIED SCIENCES BIELEFELD, 3:SAARLAND UNIVERSITY

INTRODUCTION: Passing and kicking are commonly used playing techniques in soccer that are preferably performed with the dominant leg while the non-dominant leg is used as standing leg. Consequently, balance performance might be better using the non-dominant compared to the dominant leg. This leg difference (asymmetry) might be further enhanced based on players' level of playing experience (i.e., training/competition exposure). From a health perspective, leg asymmetry in balance performance of athletes is associated with an increased risk of non-contact injuries (Smith et al., 2015). Thus, our study evaluated leg asymmetry in balance performance of young male soccer players at different levels of playing experience.
METHODS: Maximal reach distance for all three reach directions (i.e., anterior [ANT], posteromedial [PM], posterolateral [PL]) in the Lower Quarter Y Balance Test (YBT-LQ) of the dominant and non-dominant leg as well as anthropometric characteristics (i.e., leg length) were assessed in 76 young male soccer players (under-13 [U13]: n=19, U15: n=14, U17: n=21, U19: n=22). Relative maximal reach distances (% leg length) for each reach direction and composite reach scores ($CS = <(ANT + PM + PL) / (LL \times 3)) \times 100$) were used as outcome measures. An analysis of variance was used to detect differences between legs across levels of playing experience.
RESULTS: Irrespective of parameter considered, we did not find significant main effects of leg (all $p > 0.05$, Cohen's $f = 0.03$-0.13) nor significant Leg × Level of playing experience interactions (all $p > 0.05$, $f = 0.18$-0.31). However, significant main effects of level of playing experience were found for all measures (all $p < 0.05$, $f = 0.36$-0.59). For the ANT ($p = 0.030$) and the PM ($p = 0.033$) direction, post hoc analysis revealed that U15 players achieved significantly shorter reach distances compared to U19 players. Concerning the PL direction and the CS, post hoc analysis showed that U15 players achieved significantly shorter reach distances compared to U13 (PL: $p < 0.001$; CS: $p = 0.005$) and U19 (PL: $p < 0.001$; CS: $p < 0.001$) players.
CONCLUSION: Irrespective of playing experience, no significant limb differences in unipedal balance performance were found. However, with increasing level of playing experience, improved YBT-LQ performance was observed (except for U15 players). This is indicative for balance as an important requisite in soccer players. Additionally, non-uniform growth of lower and upper body parts and maturation changes during adolescence may be responsible for the lesser balance performances in U15 than in U13 players.
Reference
Smith CA, Chimera NJ, Warren M. (2015). Med Sci Sports Exerc, 47, 136–141.

INTER-RATER RELIABILITY OF THE DYNAMIC LEAP AND BALANCE TEST (DLBT), A NOVEL DYNAMIC BALANCE ASSESSMENT TEST.

JAFFRI, A.

UNIVERSITY OF VIRGINIA

INTRODUCTION: Dynamic postural control assessment is becoming more of an interest to the clinicians than static postural control assessment. Most of the sporting and functional activities like walking, running, jogging etc. are dynamic in nature. It has been reported that dynamic activities result in the activation of the fast mechanoreceptors as compared to quiet standing that requires the activation of slow adapting mechanoreceptors. There is a need of dynamic balance assessment tool that incorporates the functional movement patterns so that it can mimic functional movements. Dynamic Leap and Balance Test (DLBT) is a novel testing method that is clinician-friendly, easy to use and is functional. Although, DLBT has shown to have excellent within tester test-retest reliability, interrater reliability is not determined. The purpose of this study was to examine the interrater reliability of the DLBT between two investigators.
METHODS: Fifteen healthy college-aged (7 men and 8 women; height=169.32 ± 6.89; mass=63.56 ± 8.06) subjects participated in this study. Participants performed serial leaping movements in particular directions, characteristic to the DLBT test. Time taken by the participants to complete these 20 leaps was taken as the dependent measure of balance. Participants had to stabilize themselves in the central target while performing these quick movements. Stability was assessed using a selective criterion derived from Balance Error Scoring System. Participants were assessed by two different investigators, separately. Both limbs were assessed for the errors and time taken during the test.
RESULTS: The ICC for average measures of interrater reliability for the time taken to complete the task were 0.82 and 0.84 for right and left limb, respectively. The ICC for the average measures of interrater reliability for errors made in the task ranged from 0.70 to 0.90 from right to left limb, respectively.
CONCLUSION: The DLBT has shown very good interrater reliability. The DLBT is a cost-effective and clinician-friendly tool that can be a valuable addition to dynamic balance assessment toolkit in sports medicine clinics.
Reference:
Jaffri, Abbis H., et al. "THE DYNAMIC LEAP AND BALANCE TEST (DLBT): A TEST-RETEST RELIABILITY STUDY." International journal of sports physical therapy 12.4 (2017): 512

CHANGES IN POSTURAL SWAY AND GAIT CHARACTERISTICS AS A CONSEQUENCE OF ANTERIOR LOAD CARRIAGE

HILL, M.1, ROBERTS, M.2, TALBOT, C.2, KAY, A.2, PRICE, M.1

1COVENTRY UNIVERSITY 2UNIVERSITY OF NORTHAMPTON

INTRODUCTION: Previous research has indicated that carrying a backpack elicits an increase in postural sway during quiet standing (Heller et al. 2009) and stride-to-stride gait variability during walking (Qu and Yeo, 20011). Despite these initial enquires into the effects of carrying external loads on postural stability, little research has examined the effects of anterior load carriage. This gap in the literature is important because many daily (e.g. carrying a laundry basket) and occupational (e.g. courier delivery) activities require loads to be carried in front of the body. Within this context, to further develop the external load-postural stability database we examined the effects of increasing loads carried anteriorly on postural sway and gait parameters in healthy adults.
METHODS: Twenty-nine subjects (19 males, 10 females, age = 33.8 ± 12.7 years, height = 1.73 ± 0.07 m, mass = 75.1 ± 13.7 kg) were assessed in four conditions; (1) carrying no load (CON), (2) carrying a load with no added weight (i.e. empty box), (3) carrying a load with 5% body mass, and (4) carrying a load with 10% body mass. Anteroposterior and mediolateral centre of pressure (COP) displacement (cm) and the mean COP velocity (cm·s-1) were used to characterise postural sway. Coefficient of variation of the stride length, stride time and double support time were calculated from 1 min of treadmill walking at a preferred pace for gait assessment.
RESULTS: When compared to CON, anteroposterior COP displacement increased with the addition of a 5% ($P < 0.001$, $d = 0.74$) and 10% ($P < 0.001$, $d = 1.59$) load. The anteroposterior COP displacement also increased from the 5% to the 10% load ($P < 0.001$, $d = 0.75$). The addition of the 10% load increased stride time ($d = 1.71$) and stride length ($d = 1.20$) variability when compared to CON ($P < 0.001$). Additionally, stride length variability was significantly greater during 10% compared to 0% ($P = 0.004$, $d = 1.08$) and 5% ($P = 0.001$, $d = 1.01$) conditions.
CONCLUSION: In summary, the increase in postural sway and gait variability with added weight is dependent on the magnitude of the load, where the greater the load, the greater the effect on static and dynamic stability. Changes in the mass-inertia characteristics of the body is one of several mechanisms that have been offered to explain the increased postural sway and gait variability when holding an external load. Given that increased postural sway (Johansson et al. 2017) and gait variability (Verghese et al. 2009) are indicators of increased fall-risk, it can be inferred from the present findings that carrying heavy loads in front of the body increases the likelihood of fall-related incidents.
REFERENCES:
1. Heller MF, Challis JH, Sharkey NA. (2009). Gait Posture, 30(1), 115-117
2. Qu X, Yeo JC. (2011). J Biomech, 44(7), 1259-1263
3. Johansson J, Nordstrom A, Gustafson Y, Westling G, Nordstrom P. (2017). Age Ageing, 46(6), 964-970
4. Verghese J, Holtze R, Lipton RB, Wang C. (2009). J Gerontol A Biol Sci Med Sci, 64(8), 896-901.

EFFECTS OF INCREASING BALANCE TASK COMPLEXITY ON POSTURAL SWAY AND MUSCLE ACTIVATION IN ADOLESCENTS

GEBEL, A., GRANACHER, U.

UNIVERSITY OF POTSDAM

INTRODUCTION: Balance is an important prerequisite for motor skill acquisition in youth. Balance training has the potential to improve motor skills, balance, and sport-specific performance (Yaggie et al., 2006). However, there is no psychometrically validated tool or parameter available that controls for balance exercise intensity and/or complexity (Farlie et al., 2013). Thus, the purpose of this study was to examine the effects of increasing balance task complexity on postural sway and muscle activity in youth.
METHODS: Twelve healthy male and female adolescents aged 16.9±0.5 years were enrolled in this study. All par-ticipants performed six balance tasks with increasing task complexity on a balance board (Wob-blesmart, Artzt GmbH). An increase in task complexity was accomplished through a mechanically adjustable pivot integrated in the balance board that continuously reduced the base of support.

Pos-tural sway (center of pressure displacements) was assessed using two measuring sensor mats (novel GmbH) that were placed on the balance board. Muscle activity of ankle (m. tibialis anterior, medial gastrocnemius, peroneus longus) and thigh (m. vastus medialis, biceps femoris) muscles was tested using surface electromyography (sEMG) according to SENIAM guidelines. Further, muscle co-activation was computed for m. soleus and tibialis anterior as well as for m. vastus medialis and biceps femoris from filtered, rectified, and smoothed mean sEMG amplitude. Therefore, the co-activation index was computed by dividing mean sEMG amplitude of the less active muscle with mean sEMG amplitude of the more active muscle.
RESULTS: Friedman two way ANOVA on ranks for paired samples revealed significant increases in postural sway ($p<0.0001$, $\chi^2=56.762$) with increasing task complexity which was accompanied by enhanced co-activation of muscles encompassing the ankle ($p<0.0001$, $\chi^2=16.719$) and knee joint ($p<0.0001$, $\chi^2=17.716$). Post hoc Dunn-Bonferroni tests showed significant task-related increases in postural sway ($0.0001 \leq p \leq 0.034$) and muscle co-activation ($0.007 \leq p \leq 0.048$) between lower (1-3) and higher levels of task complexity (4-6).
CONCLUSION: An increase in balance task complexity resulted in augmented postural sway and lower limb muscle co-activation. These findings indicate that the tested balance board can be used to progressively increase balance task complexity in balance training.

DEFINING AND ASSESSING CORE STABILITY: A SYSTEMATIC REVIEW

VERHAVERT, Y.

VRIJE UNIVERSITEIT BRUSSEL

INTRODUCTION: Although core stability is a popular concept in sports and medicine and it is frequently incorporated in training and rehabilitation programs, there is no single clear definition and assessment method of core stability. To get more insight into this, an overview of all existing definitions and assessment methods is needed, which, to the best of our knowledge, is not done yet in current reviews.
METHODS: A systematic literature search was conducted following the PRISMA guidelines. PubMed, Web of Science, SportDiscus and Embase were searched for relevant articles. Results were limited to original English written articles published in full-text format in peer reviewed journals between January 2000 and January 2017, defining and measuring core stability.
RESULTS: Fifty-five articles were included in the qualitative synthesis. Fifty-one studies mentioned and/or investigated assessment methods of core stability, only three of the 51 studies mentioned a self-developed definition. Another four studies also mentioned a self-developed definition of core stability. In total, six different definitions of core stability and 64 different assessment methods measuring components of core stability were found.
CONCLUSION: There is a need to develop a single universally accepted definition and assessment method of core stability, evaluating core stability as a whole. After developing and validating the assessment method, future research will be able to investigate the role of core stability in sport performance, injury prevention and daily life conditions.

Oral presentations

OP-PM70 Fitness and health

BEING FIT MATTERS: FITNESS IS IMPORTANT TO POSTPONE DISABILITY AND MORTALITY IN OLDER ADULTS WITH INTELLECTUAL DISABILITIES

OPPEWAL, A., HILGENKAMP, T.I.M.

ERASMUS MC, UNIVERSITY MEDICAL CENTER ROTTERDAM

INTRODUCTION: The life expectancy of people with intellectual disabilities (ID) is increasing. However, the very low physical fitness levels of older adults with ID may negatively impact their life expectancy, along with their quality of life. Previously we found that physical fitness was indeed predictive for a decline in daily functioning and mobility (1, 2). The relationship between physical fitness and mortality has not yet been studied in people with ID. Therefore, the aim of this study was to investigate the relationship between physical fitness and survival in older adults with ID.
METHODS: In the Healthy Ageing and Intellectual Disabilities study, we measured physical fitness levels of 900 older adults with ID (61.5 ± 8.1 years) at baseline. We collected mortality data over a 5-year follow-up period. We used Cox proportional hazard models to determine the association between each physical fitness test and mortality, adjusted for age, sex, level of ID, and Down syndrome.
RESULTS: Over the follow-up period, 172 (19.1%) participants died. Better manual dexterity (HR=0.96 [0.94-0.98]), visual reaction time (HR=1.57 [1.28-1.94]), balance (HR=0.97 [0.95-0.99]), comfortable (HR=0.65 [0.54-0.78]) and fast (HR=0.81 [0.72-0.91]) gait speed, grip strength (HR=0.97 [0.94-0.99]), and cardiorespiratory fitness (HR=0.997 [0.995-0.999]) were associated with a lower mortality risk. Auditive reaction time, muscular endurance and flexibility were not associated with mortality. Combining this with our previous results regarding daily functioning and mobility, we see that manual dexterity, balance, comfortable and fast gait speed, and cardiorespiratory fitness were associated with both a decline in daily functioning and mobility and mortality.
CONCLUSION: In this study, we showed for the first time that physical fitness was independently associated with mortality in older adults with ID. Along with our previous findings that a better physical fitness also resulted in less decline in daily functioning and mobility, these results stress the need for being physically fit at older age to postpone disability and mortality. It is therefore important to try to improve the low physical fitness levels often seen in older adults with ID.
References: 1. Oppewal A, Hilgenkamp TI, van Wijck R, Schoufour JD, Evenhuis HM. Physical fitness is predictive for a decline in daily functioning in older adults with intellectual disabilities: Results of the HA-ID study. Research in Developmental Disabilities. 2014;35(10):2299-315.
2. Oppewal A, Hilgenkamp TI, van Wijck R, Schoufour JD, Evenhuis HM. Physical fitness is predictive for a decline in the ability to perform instrumental activities of daily living in older adults with intellectual disabilities: Results of the HA-ID study. Research in Developmental Disabilities. 2015;41-42:76-85.

SECULAR TRENDS IN THE GRIP STRENGTH OF SPORT UNIVERSITY STUDENTS BETWEEN 1973 AND 2016: J-FIT+STUDY

KIDOKORO, T., KOHMURA, Y., FUKU, N., SOMEYA, Y., SUZUKI, K.

JUNTENDO UNIVERSITY

INTRODUCTION: Evidence has suggested that grip strength of young population was declined for the last few decades, which become a serious public health concern because grip strength is associated with an increased risk of all-cause, cardiovascular, and premature death 1,2). However, it is not clear whether the similar downward trend is confirmed in sport university students who usually have a strong sport background since early childhood. The present study aimed to examine the secular trends in grip strength of sport university students in comparison with the normal Japanese population between 1973 and 2016.
METHODS: Available data on the grip strength of sport university students and the normal Japanese population were examined. Existing data on the grip strength of 6,308 sport university students aged 18 years between 1973 and 2016 were examined. The data were obtained from the Juntendo Fitness Plus Study, a cohort study of the Department of Physical Education/Health and Sports Science of Juntendo University. For reference, data on the grip strength of people of the same age (18 years old) were obtained from a national database.
RESULTS: Compared with the normal Japanese population, the sport university students had greater body mass index and stronger grip strength at all times. The grip strength of sport university students significantly declined between the 1980s and 1990s, and it has plateaued since 2000, albeit at low levels. Compared with the peak performance of sport university students in 1984, the grip strength of the students in 2016 was significantly lower by 8.1 kg. Based on a previous longitudinal study 3), current sport university students may expect to have 25.9% and 27.5% increased risks for future all-cause mortality and cardiovascular death, respectively. The downward trends were also confirmed in the normal Japanese population during the same periods.
CONCLUSION: The sport university students had a greater grip strength than did the normal population at all times; however, the grip strength of these students has significantly declined over the last few decades. Immediate actions should be implemented to prevent further reductions in the grip strength of the young population.
References:
1. Ortega et al. Muscular strength in male adolescents and premature death: cohort study of one million participants. BMJ, 345:e7279, 2012.
2. Silventoinen et al. Association of body size and muscle strength with incidence of coronary heart disease and cerebrovascular diseases: a population-based cohort study of one million Swedish men. Int J Epidemiol, 8:110-8, 2009.
3. Leong et al. Prognostic value of grip strength: findings from the Prospective Urban Rural Epidemiology (PURE) study. Lancet, 386:266-73, 2015.

BIDIRECTIONAL RELATIONSHIPS BETWEEN CARDIORESPIRATORY FITNESS AND FATNESS IN CHILDREN AND ADOLESCENTS: THE UP&DOWN LONGITUDINAL STUDY.

PÉREZ-BEY, A.1, IZQUIERDO-GÓMEZ, R.1, VEIGA, O.L.3, ORTEGA, F.B.4, RUIZ, J.R.4, CASTRO-PIÑERO, J.1

1:UNIVERSITY OF CADIZ , 2:FACULTY OF EDUCATION, UNIVERSIDAD CENTRAL DE CHILE , 3:AUTONOMOUS UNIVERSITY OF MADRID , 4:UNIVERSITY OF GRANADA

INTRODUCTION: While the effect of changing cardiorespiratory fitness (CRF) levels over the years on fatness has been previously studied in youth, the effect of fatness levels on future CRF levels has not been fully determined. The objective of the present study was to determine the bidirectional longitudinal associations between cardiorespiratory fitness and fatness in children and adolescents.
METHODS: A total of 1082 children (512 girls) and 727 adolescents (342 girls) participated in this 2-year follow-up study with completed fitness and fatness measurements at baseline and follow-up. Height and weight were measured and body mass index (BMI) was calculated. Triceps and subescapular skinfold were assessed to estimate body fat percentage using the Slaughter's equation. Fat mass index was calculated as fat mass/height squared (kg/m2). CRF was determined by the 20-m shuttle run test. Bidirectionality was tested by including CRF and each marker of fatness (BMI, body fat percentage and fat mass index), separately, as independent/dependent variables, alternatively, in different linear and logistic regression models.
RESULTS: CRF at baseline was associated with body fat at 2-year follow-up ($p<0.001$). However, these associations disappeared after adjusting by BMI in children and by each marker of fatness in adolescents. Similar results were observed when baseline body fat markers were included as the independent variables and CRF as dependent variable (all $p<0.001$). Nevertheless, these associations persisted after adjusting by CRF at baseline except for adolescent boys. Those children and adolescents with unhealthy CRF levels at baseline presented higher risk of overweight/obesity at follow-up (OR ranging from 3.255 to 7.168; $p<0.001$), but these associations were lost after adjusting for baseline BMI levels in children and adolescents. Similarly, those who were overweight/obese at baseline had a greater risk of having unhealthy CRF levels than their normalweight counterparts at follow-up (OR ranging from 2.743 to 6.119; $p<0.001$), and these associations persisted after adjusting by CRF levels at baseline in children.
CONCLUSION: There is a bidirectional longitudinal association between physical fitness and fatness. Nonetheless, fatness at baseline seems to be a better predictor of physical fitness levels at follow-up, rather than vice versa, since these associations are generally independent of physical fitness levels at baseline.

PERIPHERAL BRAIN-DERIVED NEUROTROPHIC FACTOR IS WEAKLY ASSOCIATED WITH PHYSICAL FITNESS

KYRÖLÄINEN, H., SANTTILA, M., PIHLAINEN, K., KOSKI, H., VAARA, J.P.

UNIVERSITY OF JYVÄSKYLÄ

INTRODUCTION: Brain-derived neurotrophic factor (BDNF) is a member of neurotrophin family, and this protein is known to have a great impact on neuroplasticity, memory and learning (Chao 2003). Several longitudinal studies have shown that aerobic exercise acutely elevates the peripheral BDNF levels in humans (e.g. Knaepen et al 2010, Huang et al 2014). However, conflicting results have been reviewed in relation to basal concentration of peripheral BDNF and physical fitness in cross-sectional studies (Huang et al. 2014). Therefore, the present study aimed to investigate associations of peripheral BDNF with several physical fitness components.
METHODS: 792 adult (26±6 yrs.) men participated in the study. BDNF concentrations were analyzed from the venous blood samples by using a ELISA Assay (Human BDNF ELISA kit, ScienCell Research laboratories, San Diego, California) and Dynex DS 2 ELISA processing system (Dynex Technologies, Chantilly, Virginia). Cardiorespiratory fitness (VO2max) was determined using an indirect graded cycle ergometer test until exhaustion. Bilateral maximal isometric leg (MVCleg) and arm extension forces (MVCarm) were measured using

dynamometers for leg and bench press, respectively. Muscular endurance tests consisted of repeated push-ups and sit-ups (1-min), while standing long jump assessed muscular power.
RESULTS: The mean±SD BDNF concentration was 15.20±3.96 ng/ml (range 2.02-28.22 ng/ml). The respective values for VO2max were 41.1±8.8ml/kg/min, MVCleg 3394±933N, MVCarm 871±216N, push-ups 28±14reps/min, sit-ups 35±12reps/min, standing long jump 227±26cm. Regression analysis revealed that associations between BDNF and different physical fitness components were weak: VO2max (β=-0.077, p=0.006), MVCleg (β=-0.04, p=0.072), push-ups (β=0.038, p=0.016), and sit-ups (β=0.043, p=0.020).
CONCLUSION: The main findings indicate that the association between peripheral BDNF and different physical fitness components is weak or non-existing at rest in the present cross-sectional design. It has been shown that BDNF is a mediator of benefits of exercise for brain health (Cotman & Berchtold, 2002) and further, physical activity and exercise have positive effects on brain structure and cognitive functions (Chao, 2003). Nevertheless, physical fitness is strongly inherited capability and, therefore, the associations with BDNF may not be as clear as it seems to be for physical activity. Future studies are warranted in this regard.
REFERENCES: Erickson KI, Voss MW, Prakash RS, Basak C, et al. (2011) Proc Natl Acad Sci USA 108: 3017-3022.
Chao MV (2003) Nature Reviews Neuroscience, 4, 299 – 309.
Huang T, Larsen KT, Ried-Larsen M, Moller NC, Andersen LB (2014). Scand J Med Sci Sports, 24: 1–10.
Knaepen K, Goekint M, Heyman EM, Meeusen R (2010). Sports Med, 40, 9, 765 – 801.
CONTACT: heikki.kyrolainen@jyu.fi

ANTHROPOMETRIC AND PHYSICAL FITNESS MEASURES OF FIRST AND SECOND YEAR PHYSIOTHERAPY STUDENTS

ZINZEN, E., GUETTARD, E., VANROELEN, A., CHAPELLE, L.

VRIJE UNIVERSITEIT BRUSSEL

INTRODUCTION: The transition period from college to university is characterized by an increase in sedentary behavior, alcohol consumption and irregular, unhealthy eating. Correspondingly, previous studies have shown that during this transition period the prevalence of overweight and obesity increases whilst physical fitness measures decline. It is, nevertheless, unknown if Physiotherapy students, who have mandatory sports classes throughout their university education, display a similar decline in anthropometric and physical fitness measures.
Therefore, this study aimed to determine and report anthropometric and physical fitness measures of Physiotherapy students at the start of their first and second year of university.
METHODS: All Physiotherapy students enrolled in the Rehabilitation Sciences and Physiotherapy program of the Vrije Universiteit Brussel (Belgium) between 2012 and 2016 were examined at the start of their first and second year of university, creating a one-year follow up. A total of 356 (159 males and 197 females) students were examined in both their first and second year of university. Anthropometric (i.e. height, weight, BMI and fat percentage (determined using Bioelectrical Impedance Analysis)) and physical fitness (i.e. flamingo balance, plate tapping, sit and reach, standing broad jump, hand grip strength, sit ups, bent arm hang and shuttle run) measurements were examined according to the guidelines of the Eurofit test battery. The anthropometric and physical fitness measures were compared across both university years using paired samples t-tests in SPSS version 20.
RESULTS: Height, (171.9 ± 8.6 cm versus 172.5 ± 8.8 cm; $p < 0.001$), weight (64.5 ± 9.4 kg versus 66.1 ± 10.1 kg; $p < 0.001$), BMI (21.7 ± 2.3 versus 22.2 ± 2.5; $p < 0.001$) and fat percentage (22.2 ± 8.6 % versus 23.9 ± 8.5 %; $p < 0.001$) was significantly higher in the second year of university compared to the first year of university. In addition, the students performed significantly worse on the flamingo balance test (8.9 ± 4.6 attempts versus 8.2 ± 4.3 attempts; $p = 0.010$), plate tapping (9.9 ± 1.2 sec versus 10.1 ± 1.5 sec; $p = 0.039$), sit and reach (30.8 ± 8.6 cm versus 27.2 ± 9.5 cm; $p < 0.001$) and bent arm hang (27.2 ± 19.7 sec versus 25.5 ± 18.8 sec; $p = 0.002$) in the second year of university. No significant differences were found for the standing broad jump (191.4 ± 31.9 cm versus 191.0 ± 31.6 cm; $p = 0.499$), hand grip strength (40.6 ± 10.4 kg versus 40.9 ± 10.7 kg; $p = 0.370$), sit ups (22.6 ± 4.6 reps versus 22.8 ± 4.8 reps; $p = 0.529$) and shuttle run (20.6 ± 1.7 versus 20.5 ± 1.5; $p = 0.083$).
CONCLUSION: To conclude, despite mandatory sports classes, weight, fat percentage and BMI of Physiotherapy students significantly increased and physical fitness measures significantly declined after one year of university. These results could be explained by an increase in sedentary behavior, alcohol consumption and bad eating habits typically observed in the transition phase from college to university.

Oral presentations

OP-BN50 Pacing

THE PSYCHOPHYSIOLOGICAL REGULATION OF PACING BEHAVIOR AND PERFORMANCE DURING LONG-DISTANCE RUNNING WITH LOCOMOTOR MUSCLE FATIGUE AND EXERCISE-INDUCED MUSCLE DAMAGE IN HIGHLY-TRAINED RUNNERS

VENHORST, A.

UNIVERSITY OF CAPE TOWN

INTRODUCTION: Locomotor muscle fatigue (LMMF) and exercise induced muscle damage (EIMD) are common conditions in long-distance running characterized by pooled mechanical and metabolic strain on locomotor muscles. Research so far has focused on the physiological consequences of EIMD and thus largely on symptoms of delayed onset of muscular soreness. However, little is known about the immediate psychophysiological effects of combined LMMF and EIMD on endurance performance and pacing behavior as experienced during the decisive final stages of 'real-world' long-distance running events.
METHODS: Twenty-two highly-trained (performance level 4) runners (eleven female) completed two maximal self-paced 20-km treadmill time trials in a counterbalanced crossover design: (A) in a tapered condition and (B) with LMMF and EIMD produced by a standardized drop-jump protocol. Hematological indicators of tissue damage, muscle metabolic strain, and endocrinological stress were assessed to investigate the 'direct' physiological effects; and a three-dimensional framework of perceived fatigability was applied to investigate the 'indirect' perceptual effects of LMMF and EIMD on performance fatigability (locomotor muscle strength, running economy, and endurance performance) and observed pacing behavior.

RESULTS: LMMF and EIMD caused large restrictions in work capacity (isokinetic knee extensor power output and time trial time), moderate decreases in running economy (oxygen consumption, energy cost, heart rate, and carbohydrate usage), and moderate increases in blood leukocyte and neutrophil count as well as blood interleukin-6 and cortisol concentrations. Thus, collectively forming a physiological milieu that per se is not conducive to high-performance. LMMF and EIMD further caused large increases in perceived physical strain, large decreases in valence as well as large shifts from an implemental to a deliberative mindset indicated by mirror-like responses in action crisis and flow state. Thus, under the constraint of amplified physiological duress, the dynamic interdependencies of sensory, affective, and cognitive processes are suggestive of linked heuristic and rational antecedents in the initiation of the goal-disengagement process.
CONCLUSION: Dynamic changes and complex interactions in 'direct' physiological and 'indirect' perceptual effects of LMMF and EIMD are hypothesized to underpin the observed alterations in pacing behavior and endurance performance during the decisive final stages in long-distance running events. The applied three-dimensional framework of perceived fatigability provides a more comprehensive understanding of strain-perception-thinking-action coupling in centrally regulated and goal-directed exercise behavior. By emphasizing a holistic and dynamical systems perspective, the proposed framework offers a sophisticated alternative to the traditional Gestalt concept of perceived exertion in the investigation of complex exercise-related phenomena.
Contact: andreas.venhorst@gmail.com

PACING BEHAVIOUR OF ELITE YOUTH SHORT TRACK SPEED SKATERS IN 1500M HEAD-TO-HEAD COMPETITION.

MENTING, S.G.P., KONINGS, M.J., ELFERINK-GEMSER, M.T., HETTINGA, F.J.
UNIVERSITY OF GRONINGEN

INTRODUCTION: The decision-making process of the velocity distribution over a race (i.e. pacing) has proven to be a decisive factor in athlete performance. In this respect, experience has been shown to play a large role in this decision-making process involved in pacing (Foster et al., 2009), yet not much is known on how pacing behaviour develops throughout adolescence (Elferink-Gemser & Hettinga, 2017). The purpose of this study was to gain more insight into the pacing behaviour of youth athletes in a head-to-head type sport: short track speed skating.
METHODS: Lap times and intermediate positions of elite short track speed skaters performing 1500m races (13.5 laps), during the seasons 2011/2012-2015/2016, were analysed (n=9715). The effect of age group, categorized as under 17 (U17), under 19 (U19), under 21 (U21) and adult, was analysed using a MANOVA ($p<0.05$). Relative section times (RST), the percentages of total time spend in a single lap time, were used as dependent variables. Kendall's Tau-b correlations were used to analyse the relation between intermediate positioning, and final ranking in the different age groups ($r<0.5$ low, 0.50.70 high).
RESULTS: A significant effect for age group ($F=10.43$, $df=42$, $p<0.001$) was found. The RST score of younger skaters was significantly higher during the laps 1-4 and significantly lower during laps 12, 13 and 14 compared to older skaters. For example, the RST of respectively U17, U19, U21 and adults during lap 4: 7.70±0.55, 7.77±0.53, 7.79±0.51, 7.79±0.47 and during lap 13: 6.90±0.52, 6.81±0.49, 6.75±0.47, 6.69±0.41. Younger skaters presented a higher correlation between intermediate position and final ranking earlier in the race, compared to their older counterparts. For example, the correlations in lap 11: $r=0.73$, 0.67, 0.64, 0.57, for U17, U19, U21 and adults respectively.
CONCLUSION: The RST and positioning data show that pacing behaviour of youth elite short track speed skaters differs from adults. Younger skaters start relatively fast and finish relatively slow compared to adults. The pacing behaviour of the older adolescent age groups shares more resemblance to the conservative pacing behaviour of adults, suggesting a development of pacing behaviour with age throughout adolescence. These finding stress the importance of experience in the development of pacing skills in youth athletes. Talent development programs of head-to-head sports may benefit by increasing their focus on pacing behaviour development during adolescence.

INVESTIGATING THE ROLE OF CONSCIOUS MONITORING AND CONTROL OF MOVEMENT DURING RUNNING

UIGA, L., MALHOTRA, N., CAPIO, C.M., VAN DUIJN, T., MASTERS, R.S.W.
UNIVERSITY OF WAIKATO

INTRODUCTION: Research suggests that a high propensity for conscious monitoring and control of movements (i.e., movement specific reinvestment) is associated with disrupted performance under pressure; however, most of the research has examined performance of skills that require fine motor coordination (e.g., golf, darts, laparoscopic peg transfer). To the best of our knowledge, movement specific reinvestment has not been investigated in the context of endurance sports, such as long distance running, which do not require technical precision, yet provide ample time for conscious monitoring and control. Two studies were conducted to explore the relationship between movement specific reinvestment and running performance.
METHODS: In Study 1, the performance of runners who completed a 12 km running race was monitored. Prior to the start of the race, participants completed the Movement Specific Reinvestment Scale (MSRS; Masters, Eves, & Maxwell, 2005), which comprises a conscious motor processing dimension and a movement self-consciousness dimension. Participants self-evaluated their anxiety, preparation satisfaction and self-confidence associated with the competition. Performance time was recorded. Study 2 investigated the association between movement specific reinvestment and self-awareness of physiological and movement-related markers associated with running. Specifically, participants were asked to run on a treadmill and estimate their heart rate, distance covered and average step length.
RESULTS: The results of Study 1 revealed that MSRS was the only significant predictor of running time, with higher scores related to slower performance times. Higher scores on the movement self-consciousness dimension, but not the conscious motor processing dimension, of the Scale were related to slower running times. The results of Study 2 revealed that movement specific reinvestment was associated with subjective estimations of physiological and movement-related markers of running.
CONCLUSION: Endurance skills, which occur over extended periods of time, may allow opportunity for self-focused attention and reflection, which potentially disrupts physical performance. Our results suggest that a person's disposition for conscious monitoring and control of their movements (MSRS) particularly for movement self-consciousness, plays an influential role in competitive long distance running.
References: Masters, R. S. W., Eves, F. F., & Maxwell, J. P. (2005). Development of a movement specific Reinvestment Scale. Paper presented at the International Society of Sport Psychology (ISSP) World Congress, Sydney, Australia.

TACTICAL PACING DECISIONS IN THE MIDDLE-DISTANCE RUNNING EVENTS AT THE 2017 IAAF WORLD CHAMPIONSHIPS.

CASADO, A., RENFREE, A.

UNIVERSIDAD ISABEL I DE CASTILLA AND UNIVERSITY OF WORCESTER

INTRODUCTION: Successful participation in competitive endurance events requires regulation of exercise intensity in an attempt to achieve a performance goal, meaning pacing behaviours are reflections of continual decision-making processes . Although some research has investigated pacing strategies in middle-distance running events through analysis of distribution of speeds over race segments , other work has examined the influence of tactical positioning at intermediate points on finishing position . Preliminary qualifying rounds at major championships represent an interesting tactical decision-making environment, as qualification to the next stage of competition can be based on either finishing position or on finishing time . This study therefore assesses tactical and performance factors associated with progression from qualification rounds in the 800m and 1500m running events at the 2017 IAAF World Championships.
METHODS: Official results were used to access final and intermediate positions and 400m split times, as well as performance characteristics of all competitors. Shared variance between intermediate positions and rank order lap times with finishing positions were calculated, along with probability of automatic qualification, for athletes in each available race position at every intermediate point. Differences in race positions and lap times relative to seasons best performances were also assessed between automatic qualifiers , fastest losers , and non-qualifiers .
RESULTS: Race positions remained much more stable through 800m races than 1500m races. Probability of automatic qualification decreased along with both race position and ROSPT on each lap, although ROSPT accounted for a higher degree of shared variance than did intermediate position. In the 1500m event FL ran at a higher percentage of SB speed, and adopted positions closer to the race lead in the early stages than other competitors. This was not the case in the 800m.
CONCLUSION: Intermediate positioning and the ability to produce a fast final race segment are strongly related to successful advancement from qualification rounds in middle distance running events at a major championship. The adoption of a more 'risky' strategy characterized by higher speeds relative to SB may be associated with increased likelihood of qualification as FL in the 1500m event.
References: Renfree A, Martin L, Micklewright D & St Clair Gibson A. <2014>. Sports Med, 44<9>, 1319–1320.
Noakes TD, Lambert MI & Hauman R. <2009> Br J Sports Med, 43<10>, 760–764.
Renfree A, Mytton GJ, Skorski S & Clair Gibson AS. <2014>. Int J Sports Physiol Perform, 9<2>, 362–364.
Contact: arturocasado1500@gmail.com

SEX DIFFERENCES IN PERFORMANCE AND PACING STRATEGIES DURING A SPRINT TIME-TRIAL IN CROSS-COUNTRY SKIING

ANDERSSON, E.1, GOVUS, A.1,2, SHANNON, O.3, MCGAWLEY, K.1

<1> MID SWEDEN UNIVERSITY, SWEDEN; <2> LA TROBE UNIVERSITY, AUSTRALIA; <3> NEWCASTLE UNIVERSITY, UNITED KINGDOM

INTRODUCTION: The aim of this study was to compare the pacing strategies, choice of sub-technique (or gear) and overall performance between elite male and female cross-country (XC) skiers during a ski-skating sprint time-trial (TT) on snow.
METHODS: Thirty-four elite XC skiers (20 males and 14 females: age, 23 ± 4 and 21 ± 3 yr; body mass, 76 ± 8 and 64 ± 5 kg; height, 183 ± 7 and 171 ± 5 cm; sprint FIS points, 86 ± 42 and 90 ± 54) performed a 1.6 km TT, which was 56% flat (or undulating), 21% uphill and 22% downhill. The sprint course was measured with a differential global navigation satellite system and divided into four flat, three uphill and two downhill sections. Race time was measured with the EMIT timing system (Emit AS, Oslo, Norway) and one 25-m uphill (4°) section was filmed continuously with a fixed camcorder (50 Hz). All skiers used a similar stone-grind and all skis were glide-waxed similarly. The air temperature was +1°C (fresh snow at ±0°C), relative humidity was 90% and the friction coefficient between ski and snow was estimated to 0.045 (i.e., very slow).
RESULTS: Average speed during the TT was 25 ± 1 and 22 ± 1 km/h (TT time: 227 ± 11 and 254 ± 10 s) for males and females, respectively ($P < 0.001$, Cohen's d effect size [ES] = 2.6). Average relative power output (PO) was estimated to 3.9 ± 0.3 and 3.3 ± 0.2 W/kg for males and females, respectively ($P < 0.001$, ES = 2.5). Average heart rate was 95 ± 2% and 96 ± 1% of maximum for males and females ($P = 0.51$), with a 2-min post-race blood lactate concentration of 10 ± 2 mmol/L for both sexes ($P = 0.64$). Within-athlete coefficient of variation in speed between sections was 20 ± 2% for males and 24 ± 1% for females ($P < 0.001$, ES = 2.6). Speeds on the flat, uphill and downhill sections were 26 ± 1, 19 ± 1 and 32 ± 1 km/h for males and 23 ± 1, 16 ± 1 and 30 ± 1 km/h for females (main effects for terrain, sex and interaction, all $P < 0.01$) corresponding to 9%, 16% and 8% slower speeds on flat, uphill and downhill terrain for females. Speeds relative to the average TT speed were 103 ± 1%, 77 ± 2% and 129 ± 4% for males and 105 ± 1%, 72 ± 2% and 133 ± 2% for females (main effects for terrain, sex and interaction, all $P < 0.001$). Relative PO on the flat, uphill and downhill sections were estimated to 4.0 ± 0.3, 4.9 ± 0.4 and 1.9 ± 0.2 W/kg for males and 3.5 ± 0.2, 4.0 ± 0.3 and 1.5 ± 0.2 W/kg for females (main effects for terrain, sex and interaction, all $P < 0.001$). The males were 20% faster than the females on the uphill video section (16 ± 1 versus 13 ± 1 km/h, $P < 0.001$, ES = 2.6), with 95% of the male skiers and 21% of the female skiers using gear 3 exclusively, and the remaining skiers using gear 2 exclusively or a combination of gears 2 and 3.
CONCLUSION: The present results indicate an overall sex difference in sprint skiing performance of ~12% and reveal differences in terrain-specific pacing as well as gear choice between sexes with females showing a higher overall variation in speed and considerably slower uphill skiing.

DOES THE LABOUR/LEISURE MODEL TRANSLATE INTO THE REGULATION OF A STRENUOUS PHYSICAL TASK?

GIBOIN, L.S., GRUBER, M., SCHÜLER, J., WOLFF, W.

UNIVERSITÄT KONSTANZ

INTRODUCTION: Maintenance of physical effort, despite the development of fatigue, is key in many sport disciplines. Recently, it has been suggested that "giving up" in an endurance task may lie more at the cognitive than neuromuscular level. In the present study, we tested the hypothesis that the regulation of demanding physical effort follows the same model that can be used to describe the regulation of demanding cognitive effort1.
METHODS: In a within (time 1 vs. time 2) between (control group vs. intervention group) experimental design, 34 male participants had to perform an isometric knee extension above a target (15% maximal voluntary contraction (MVC)). The participants received monetary reward per unit of time until self-disengagement. At time 2, the experimental group received an upfront payment and a decreased

income per unit of time. It has been shown that this procedure can induce a reduction in cognitive control compared to the procedure at time 11. Thus, we predicted to find a decreased time before self-disengagement in the intervention group at time 2. To control neuromuscular fatigue, we measured MVC, voluntary activation (VA) and the potentiated twitch at rest (Ptw) before and just after the termination of the fatigue task. We measured dorso-lateral pre frontal cortex activity (dlPFC) with NIRS as this area as this area has been frequently associated with cognitive control.
RESULTS: We observed neither a group ($p = 0.5$) nor an interaction ($p = 0.08$) effect. However, a time effect was seen ($p < 0.001$), which could be explained in a post-hoc analysis by a longer time before self-disengagement in the intervention group at time 2 ($p = 0.002$). Perception of effort over time and neuromuscular fatigue were identical between groups. However, the task was performed more efficiently by the intervention group at time 2 (reduced mean force during the task, interaction effect, $p = 0.03$). We also observed a different dlPFC activity during the task (interaction effect, $p = 0.008$).
CONCLUSION: The model used to describe the regulation of a demanding cognitive effort1 may not correctly describe the regulation of a voluntary muscle contraction until self-disengagement. The increased task performance at time 2 could be explained by a higher task efficiency and not by an increase in resource depletion due to an altered cognitive control. These results have important implications in designing strategies to cope with fatigue during long lasting physical exertion tasks, e.g. in endurance sports.
1 Kool, W. & Botvinick, M. A labor/leisure tradeoff in cognitive control. J Exp Psychol Gen 143, 131-141, doi:10.1037/a0031048 (2014).

Oral presentations

OP-PM55 Thermoregulation

EFFECTS OF ELECTROLYZED HYDROGEN WATER DURING ENDURANCE EXERCISE IN HEAT ENVIRONMENT ON BODY FLUID BALANCE AND EXERCISE PERFORMANCE

ITO, H.1, KASAI, N.1, HWANG, H.1, KABAYAMA, S.2, GOTO, K.1
[1]RITSUMEIKAN UNIVERSITY, SHIGA, JAPAN [2]NIHON TRIM CO. LTD, OSAKA, JAPAN

INTRODUCTION: Electrolyzed hydrogen water (EHW), which is generated in cathode containing rich hydrogen molecules, indicates high alkalinity (pH: 9.5-9.9). It is commonly believed that the absorption in gastrointestinal tract is superior to general water. However, the effect of EHW ingestion on physiological responses during exercise remains unclear. Therefore, the purpose of the present study was to determine the effects of EHW ingestion during exercise in heat environment on body fluid balance and exercise performance.
METHODS: Twelve triathletes (20 ± 1.3 yrs., 171 ± 6.0 cm, 60.6 ± 3.9 kg VO_2max: 67.1 ± 3.8ml/kg/min) performed 60 min of pedaling at 65% of VO2max followed by incremental pedaling test either with consuming (2.0ml/kg, every 10 min) purified water (CON trial) or EHW (EHW trial). Blood variables, skin and muscle temperature and respiratory variables and score of subjective feelings were determined during 60 min of exercise. Time to exhaustion (TTE) during incremental test was also evaluated as an indication of endurance capacity.
RESULTS: Body weight reduced 1.1 ± 0.4 kg (1.7 ± 0.7%) after exercise, with no significant difference between the two trials. Plasma volume and serum osmolality, blood sodium(Na^+) and potassium(K^+) concentrations were significantly altered with progress of exercise but, no significant difference was observed between the two trials. Blood lactate, pH, bicarbonate ion concentrations were not significantly different between the two trials. Changes in skin temperature and muscle temperature were not significantly different between the two trials. However, exercise-induced elevation of muscle temperature tended to be smaller in EHW trial. Energy expenditure (calculated by $VO_2$and VCO_2) showed significantly lower value in EHW trial (13.2 ± 1.6 kcal/min) than in CON trial (13.7 ± 1.5 kcal/min, p=0.04). Serum glycerol concentration during exercise did not differ between the EHW and CON trials. In addition, the area under the curve did not differ significantly between the two trials. The TTE did not differ significantly between EHW trial (313 ± 90 s) and CON trial (350 ± 83 s).
CONCLUSION: The EHW ingestion during endurance exercise in heat environment decreased energy expenditure during exercise, suggesting improvement of pedaling (cycling) economy. However, EHW did not affect significantly the body fluid balance or exercise performance.

INTERMITTENT SPRINT PERFORMANCE IN THE HEAT IS NOT ALTERED BY AUGMENTING THERMAL PERCEPTION VIA L-MENTHOL OR CAPSAICIN MOUTHRINSES.

GIBSON, O.R., WRIGHTSON, J.G., HAYES, M.
BRUNEL UNIVERSITY LONDON

INTRODUCTION: Cooling sensations elicited by mouth rinsing with menthol have been reported as ergogenic during continuous intensity performance in the heat e.g. time trials/time to exhaustion tests, with improved thermal perception (cooling sensation/enhanced comfort) reported as a key mechanism. Presently, responses to menthol mouth rinsing during intermittent sprint performance (ISP) in the heat are not known. The impact of increasing negative thermal perception via the warming properties of capsaicin on ISP has also not been quantified. This experiment aimed to identify whether eliciting a cooling/warming sensation via menthol/capsaicin would alter ISP in the heat.
METHODS: Participants [n=14, body mass = 72±9 kg, VO2peak = 3.30±0.90], undertook four experimental trials, involving 40 min of ISP (20x 5s maximal sprints, 105s active recovery, 10s passive recovery) in hot conditions (40.2±0.6°C, 42±2%R.H.) with mouth rinsing (25 mL for 6 sec) at the onset of the protocol, and every 10 min thereafter. Cooling (0.01% L-Menthol; MEN), warming (0.2% Capsaicin; CAP), placebo (0.3% CHO fruit drink; PLA) and control (distilled water; CON) mouth rinses were utilised. Performance was quantified as peak power (PP) and work done (WD) during sprints. Heart rate (HR), core (Trec) and skin (Tskin) temperature, perceived exertion (RPE), thermal sensation (TS) and comfort (TC) were measured at 10 min intervals. Sweat rate (SR) was calculated from Δ nude body mass. ANOVA was used to determine differences between conditions, and over time.
RESULTS: PP reduced over time ($P<0.05$), however no change in performance was observed ($P>0.05$) between trials (MEN 9.7±2.0 W, CAP 9.3±2.0 W, PLA 9.7±2.2 W, CON 9.6±2.4 W). Total WD did not differ between trials (MEN 67±14 kJ, CAP 65±16 kJ, PLA 67±15 kJ, CON 67±18 kJ).
TC was lower ($P<0.05$) in MEN (3.0±0.7) with no difference between CAP (3.5±0.6), PLA (3.6±0.7) and CON (3.4±0.9). RPE (MEN 16±2, CAPS 16±1, PLA 16±1, CON16±1) and TS (MEN 6.5±0.6, CAPS 6.7±0.3, PLA 6.6±0.4, CON 6.6±0.6) were not different between trials ($P>0.05$). RPE, TS and TC increased over time ($P<0.05$).

Despite increases from baseline (P<0.05), no between trial difference (P>0.05) existed in HR (MEN 156±14 b.min-1, CAP 154±13 b.min-1, PLA 156±15 b.min-1, CON 153±12 b.min-1) , Trec (MEN 37.9±0.3°C, CAP 37.9±0.3°C, PLA 38.0±0.2°C, CON 37.9±0.4°C) or Tskin (MEN 36.7±0.5°C, CAPS 36.7±0.7°C, PLA 36.8±0.7°C, CON 36.6±0.7°C). SR was equal in all trials (P>0.05; MEN 1.4±0.7 L.hr-1, CAP 1.4±0.7 L.hr-1, PLA 1.4±0.8 L.hr-1, CON 1.5±0.7 L.hr-1).
CONCLUSION: Despite improved thermal comfort via menthol, ISP did not improve. Capsaicin did not alter thermal perception or ISP. Alterations to the intervention e.g. mouth rinse frequency/duration subsequently leading to a greater change in thermal perception may alter ISP, however based on these data, the reduction in ISP over time in hot conditions is not influenced by altering thermal perception. This is likely due to the demands of this type of activity.

PRE-COOLING WITH OR WITHOUT COOLING APPLIED DURING EXERCISE IN THE HEAT ON CYCLING PERFORMANCE

MOSS, J.

UNIVERSITY OF ROEHAMPTON

INTRODUCTION: Pre- and per-cooling can improve exercise performance in the heat; however, the mechanism of benefit is likely to differ. Pre-cooling reduces the physiological strain during exercise in hot environmental temperatures whereas per-cooling seems to improve exercise by improving perceived, rather than actual strain. The aim of the present study was to investigate the effects of cooling strategies applied before exercise and during exercise on pre-loaded 15 min time trial performance (TT) in the heat (40 °C, 50% RH).
METHODS: Nine male, trained, non-acclimated cyclists (32.1 ±10.3 y, 183.5 ± 6.48 cm, 75.8 ± 8.93 kg, and 65 ± 6.5 ml.min.-1kg-1) participated. Participants completed five experimental trials, a temperate control (CON) and 4 in the heat - no cooling (HOT), pre-cooling (HOTPRE), pre-cooling and neck per-cooling (HOTPRE+PER), and neck per-cooling (HOTPER). Pre-cooling trials began with 30 min of cool water (22°C) immersion. Participants completed a 45 min preload exercise (50% VO2max), followed by a 15 min TT. Mean temperatures (core, skin, and head) and heart rate (HR) were measured every 5 min during preload and 3 min during TT, ratings of perceived exertion (RPE), thermal comfort (TC) and thermal sensation (TS) were measured every 5 min during the preload.
RESULTS: Distanced covered during the TT was greatest in CON (17.1 ± 1.6km; P<0.05). There were no differences between HOT (15.7 ± 1.6km), HOTPER (15.7 ± 1.5km), HOTPRE (15.9 ± 1.5km), and HOTPRE+PER (15.8 ± 1.5km) (P > 0.05). Precooling lowered mean core and skin temperature during the 45 min; however, there was a greater rate of rise in precooling trials during the pre-load (0.05°C.min-1 versus 0.03°C.min-1). Water immersion lowered rectal temp by 1 ± 0.2 °C and mean skin temp by 5 ± 0.6 °C and did not reach pre immersion measurements until 22± 2 min during preload, these results ran parallel with RPE, TC and TC which, were lower for the first 20-25 min during the pre-cooling trials. Neck per-cooling lowered mean neck skin temperature (P<0.05) but had no effect on other physiological measurements. Participants reported to have a lower TC and TS during HOTPER compared to HOT for the first 30 min of preload.
CONCLUSION: Pre-cooling was able to reduced physiological strain but neither pre-cooling nor per-cooling improved TT performance in the heat.

THE EFFECTS OF ACUTE FLUID INGESTION ON RECOVERY AND SUBSEQUENT BOUTS OF SHORT-TERM HIGH-INTENSITY EXERCISE PERFORMANCE WHEN FLUID LOSS IS MINIMAL.

BARGH, M., KING, R., GRAY, M., JONES, B.

LEEDS BECKETT UNIERSITY

INTRODUCTION: Hydration guidelines suggest fluid ingestion is required to offset fluid losses <<2% body water loss> and minimise fluid gains . Fluid loss is usually minimal within short-duration, high-intensity exercise in cool environmental conditions and thus acute rehydration is not recommended, although it may attenuate negative physiological and perceptual variables. This study investigated the efficacy of acute fluid ingestion in excess of fluid replacement requirements on the recovery and subsequent response of physiological and perceptual measures and performance of short-term, high-intensity exercise.
METHODS: Sixteen male team-sport athletes completed a familiarisation, and two experimental trials. Experimental trials were conducted in a crossover counterbalanced design, separated by 5-7 days. Participants performed two , 2 minute self-paced high-intensity exercise bouts on a Wattbike cycle ergometer, interspersed with a 7-minute recovery period with either fluid or no fluid available. Measures of performance , perceptual , cardiovascular and haematological responses were collected.
RESULTS: There were likely trivial differences in mean change scores between B1 and B2 in PO <0.8%; ±5.7%> and TD <-0.0%; ±2.0%> with F compared to NF. F possibly reduced BLa during recovery <-9.73%; ±9.19> and B2 <-9.32 ±10.23>; likely lowered POsm <-0.83%; ±0.58%> and PV% <-2.41%; ± 1.91%> during recovery. After recovery with F, participants reported most likely lower TS <-1.32; ±0.41,> and very likely lower MD <-1.51; ±0.82> compared to NF. After B2 individuals were likely to report lower TS <-1.49 AU; ±0.37>, MD <-1.22 mm; ±0.82> and likely higher TC <0.47 AU; ±0.58> in F. RPE was possibly reduced in F <0.19 AU; ±0.38>.
CONCLUSION: Despite no changes in performance when participants consumed fluid, they had improved ratings of perception and maintenance of physiology when consuming fluid, which may be beneficial, challenging current recommendations .
McDermott, B.P., Anderson, S.A., Armstrong, L.E., Casa, D.J., Cheuvront, S.N., Cooper, L., Kenney, W.L., OConnor, F.G. and Roberts, W.O., 2017. National Athletic Trainers Association Position Statement: Fluid Replacement for the Physically Active. Journal of athletic training, 52<9>, pp.877-895.

CAN TRIATHLETES USE ADDITIONAL CLOTHING TO HEAT ACCLIMATE WHILE TRAINING IN A TEMPERATE ENVIRONMENT?

STEVENS, C., HEATHCOTE, S., PLEWS, D., LAURSEN, P., TAYLOR, L.

SOUTHERN CROSS UNIVERSITY

INTRODUCTION: Heat acclimation is beneficial for endurance performance in the heat, however, training in the heat is not always practical. Therefore, the acute and chronic physiological and perceptual responses to wearing warm clothing during outdoor endurance training in temperate environments was assessed; to determine if this strategy could increase the heat load and induce heat acclimation for athletes training in temperate environments.
METHODS: Trained male triathletes completed (a) randomised cross-over cycling sessions (n=7) wearing shorts and a short sleeve top (NORM) or additional clothing of full length pants, jacket, gloves (AC), separately; then (b) a randomised control trial (n=15) where two performance-matched groups completed a 2-week endurance cycling/running program wearing NORM or AC, in 18±4°C and 67±12% RH. In (b), participants completed three separate 60 min pre-loaded cycling time-trials (familiarisation, pre- and post-program) in 33°C

and 55% RH. Core and skin temperatures, heart rate, sweat rate, perceived exertion, thermal sensation, thermal comfort and training load were measured.
RESULTS: A magnitude-based inference approach was used for data analysis and effect sizes (ES) are reported with 90% confidence intervals. In (a), moderate increases were observed in AC vs. NORM for the change in mean core temperature (0.4±0.3°C, ES=1.16±0.55), change in maximum core temperature (0.5±0.3°C, ES=1.07±0.48) and sweat rate (0.24±0.16 L.h-1, ES=1.04±0.59). A small increase in mean heart rate (3±3 bpm, ES=0.32±0.28) was observed as well as a 'very likely' (% difference=22.4±7.1) and 'most likely' (% difference=42.9±11.9) increase in thermal sensation and thermal comfort, in AC vs. NORM. In (b), all training was completed in the required attire, and training loads were similar, however, there were no signs of heat acclimation, and changes in mean power output were unclear (NORM=180±15 W and AC=186±26 W, ES=0.31±0.87).
CONCLUSION: Endurance training in AC while outdoors in a temperate environment increased physiological strain and sensations of warmth and warm discomfort, suggesting that this strategy can increase the heat load of a training session. However, implementing AC across a two-week training program in a temperate environment was not a performance enhancing strategy for triathletes. Future research should investigate different clothing materials for the purposes of increasing the heat load, and combine other practical heat acclimation techniques (e.g. hot-water immersion and sauna), with the use of additional clothing to induce heat adaptation.

Oral presentations

OP-BN46 Ageing

EFFECT OF TRAINING INTENSITY AND AGE ON TRICEPS SURAE MUSCLE DIMENSIONS – AN MRI STUDY

LÉTOCART, A.1, SHI, Y.1, MABESOONE, F.2, COUPPÉ, C.3,4, CHARLEUX, F.5, CANON, F.1, MARIN, F.1, MAGNUSSON, S.P.3,4, GROSSET, J.F.1,6

1UNIVERSITÉ DE TECHNOLOGIE DE COMPIÈGNE FRANCE, 2 CH COMPIÈGNE-NOYON FRANCE,3 ISMCDENMARK,4 CENTER FOR HEALTHY AGING DENMARK, 5 ACRIM-POLYCLINIQUE SAINT CÔME FRANCE,6 PARIS 13 UFR SMBH FRANCE

INTRODUCTION: Muscle ageing is known to be associated with a marked decrease in muscle mass and muscular performances with an increase in the risk of fall. It has been clearly shown that resistance training (RT) improves Triceps Sural (TS) muscles force and volume which has been related to an improvement in motion capability and stability1. Nevertheless, the optimal training intensity leading to maximal muscle changes in old subjects remains unknown. Thus, the aim of this study is to compare muscle volume changes between high versus moderate RT programs applied to TS muscles in young and old men.
METHODS: Healthy young (YM55, n=7, age 25.6 ± 3.6yrs) and old men (n=14) were recruited and assigned to a 12 weeks RT program (3 times/week) on TS muscle. YM as well as an old men group (OM55, n=7, age 69.9 ± 3.6yrs) took part in a moderate training program corresponding to 55% 1RM, while a second group was imposed a high training intensity of 80% 1RM (OM80, n=7, age 71.4 ± 5.7yrs). Each groups received the exact same training volume on TS (Reps x Sets x Intensity) using seated calf machine. TS muscles were scanned using a 1.5T MRI scanner from the calcaneus to patella before and after RT period. Anatomical Cross Sectional Area (ACSA) of each of three individual TS muscles were determined every 6 slides (15.6mm) all along the muscle excursions. The ACSA-muscle length curves of each muscle were then plotted and the best minimal fitting polynomial regression for each of these curves (third or fourth order) was defined and used to calculate muscle volume.
RESULTS: After training, mean ACSAs in Lateral Gastrocnemius (LG) were only significantly increased in YM55 and OM55 respectively between 40 to 70% and between 45 to 65 % of the relative muscle length. Mean ACSAs in Medial Gastrocnemius (MG) were significantly increased in the three training groups: only at 25% for YM55, between 50 to 70% for OM55, and between 40 to 70% of the relative muscle length in OM80. For Soleus muscle, an increase in ACSA was found in YM55 and OM55 only, respectively between 55 to 60% and between 50 to 65 % of the relative muscle length. TS muscle volume were significantly increased after a 12-w RT by respectively +2.3% for YM55, +5.5% for OM55, and +3.2% for OM80. Muscle volume was significantly increased in LG and MG muscles.
CONCLUSION: The present study shows for the first time that strength training in young/old subjects and applying moderate or high intensities do not lead to an increase in ACSA homogeneously throughout the muscle length. Moreover, training at moderate intensity seems to lead to a significant increase in muscle ACSA and volume in the same extent as reported in the high intensity group (OM80). Thus, we highlighted that there is no additional gain on muscle dimensions between training intensities of 55% and 80% 1RM in old subjects to counteract the loss of muscle mass due to aging.
Acknowledgments : We would like to thank the Picardie Region
Correspondence : Email: adrien.letocart@utc.fr

EFFECT OF TRAINING INTENSITY AND AGE ON ACHILLES AND PATELLAR TENDON

LÉTOCART, A.J.1, MABESOONE, F.2, COUPPÉ, C.3,4, CHARLEUX, F.5, CANON, F.1, MARIN, F.1, MAGNUSSON, S.P.3,4, GROSSET, J.F.1,6

1 UNIVERSITÉ DE TECHNOLOGIE DE COMPIÈGNE FRANCE, 2 CH COMPIÈGNE-NOYON FRANCE,3 ISMC DENMARK,4 CENTER FOR HEALTHY AGING DENMARK, 5 ACRIM-POLYCLINIQUE FRANCE,6 PARIS 13 UFR SMBH FRANCE

INTRODUCTION: Age is known to be associated to changes in muscle-tendon architecture and properties leading to alteration in mobility and balance. However, it has been shown that resistance training (RT) improves muscle-tendon properties which were associated with increased balance ability. Nevertheless, the optimal training intensity leading to tendon adaptations in old subjects remains unknown. Thus, the aim of this study is to investigate the effect of resistance training at moderate or high intensity (respectively MRT and HRT) on architectural and mechanical properties of the Patellar (PT) and Achilles tendon (AT) in young and old men.
METHODS: Healthy young (YM55, n=7, age 25.6 ± 3.6yrs) and old men (n=14) were recruited and assigned to a 12 weeks RT program (3 times/week) on Triceps Surae (TS) and Quadriceps muscles. YM as well as an old men group (OM55, n=7, age 69.9 ± 3.6yrs) took part in a moderate training program corresponding to 55% 1RM, while a second group of old men was imposed a high training intensity of 80% 1RM (OM80, n=7, age 71.4 ± 5.7yrs). Each groups received the exact same training volume on QF and TS using: leg press, leg extension and seated calf machine. Tendon architecture was investigated using a 1.5T MRI scanner before and after RT period. Cross Sectional Area (CSA) of AT and PT was determined every 10% of tendon length and were summed. Mechanical properties of free and total AT, PT and deep aponeurosis of Vastus Lateralis muscle (VL) were investigated using ultrasound technique at maximal force.

RESULTS: Regarding to tendon architecture, training leads to an increase in AT and PT CSA in OM55 and OM80 ($p<0.05$) while no changes were reported in YM55 (OM55: respectively +2.0% and 2.2%; OM80: +2.5% and +1.4%). Regarding to tendon mechanical properties, a 12-w RT period leads to an increase in free AT force and stiffness ($p<0.05$) in OM80 (+25.6% and +54.7% respectively), OM55 (+20.2% and +31.3% respectively), and YM55 (+16.8% and +13.3% respectively). Total AT stiffness has also increased in the three groups (OM80: +25.9%; OM55: +19.3%; YM55: +8.6%). For PT, an increase in force and stiffness were found in OM80 (+29.4%; +41.2%), OM55 (+30.6%; +29.4%), and YM55 (+24.4%; +26.1%) after training. Finally, VL aponeurosis stiffness was also increased after the intervention period by +19.6% for OM80, +16.8% for OM55, and +14.3% for YM55.
CONCLUSION: The present study shows for the first time the effects of different resistance training intensities on tendon adaptations with age. Interestingly, we highlighted that moderate RT leads to the same extend of tendon changes (architectural and mechanical properties) as compared with high RT in old men. Moreover, the two investigated tendons shows similar changes after training whatever the considered group. Thus, we evidenced that training with high intensity in old men do not lead to higher gains in tendon architectural and mechanical properties.
Correspondence
Email: adrien.letocart@utc.fr

INFLUENCE OF POSITIVE AND NEGATIVE DUAL TASK PERFORMANCE IN OLDER ADULTS WHILE WALKING

WANSTRATH, M., SCHULZ, S., WOLLESEN, B.

UNIVERSITY HAMBURG

INTRODUCTION: Dual-task related changes in performance are usually interpreted as interference due to competing demands for attention resources needed for both tasks and depend on one's ability to properly allocate attention between two tasks. Dual-task interference is quantified by calculating Dual task costs (DTC) for each task. Negative DTC values indicate that performance deteriorated in the dual-task relative to the single-task, whereas positive DTC values indicate a relative improvement in DT performance (Plummer, 2015). Different models to explain the contradictory results for the DTC exist (Wollesen et al., 2016). The aim of this explorative study was to compare the differences of demographics, comorbidities and physical functioning of older adults who improved or decreased their walking performance while walking with a visual-verbal Stroop task.
METHODS: Forty participants (72.58±6.52 years) performed a Single task and a Dual task condition (visual-verbal Stroop task) while walking on a treadmill. Gait parameters (step length, step width, and gait line) were measured at 100 Hz for both conditions. Demographics, comorbidities and physical functioning were assessed (SF-12, FES-1, hand grip force, MMST, SPPB). Two subgroups with 21 persons with positive (DTC-Pos) und 19 persons with negative DTC (DTC-Neg) were built depending on the changes in gait kinematics. ANOVA tested subgroup differences in baseline characteristics (SF-12, FES-1, hand grip force, MMST, SPPB) by using SPSS 24.
RESULTS: The baseline characteristics between the subgroups showed significant differences in gait speed ($F(39)=6.68$, $p=.014$; $\eta p2=.150$) and hand grip force($F(39)=5.39$,$p=.026$; $\eta p2 =.127$). The mean (±SD) gait speed in the DTC-Pos group was 5.12±1.08km/h and 4.31±0.89km/h in the DTC-Neg group. In the DTC-Pos group the mean hand grip force (25.84±10.8kg) was bigger than in the DTC-Neg (16.25±7.46kg) group. No significant differences were found for SPPB, MMST, SF-12, and FES-I. Indeed the subgroup with negative DTC showed overall lower values for the SPPB, MMST, SF-12, and FES-I.
CONCLUSION: The results of this study showed a clear trend from differences in baseline characteristics (SF-12, FES-1, hand grip force, MMST, SPPB) between negative and positive DTC performer. There are several influences on the magnitude and pattern of dual-task interference that need to be considered when implementing and interpreting dual-task assessments. To date there are only a few studies which deal with the influence of differences in baseline characteristics between positive and negative DTC performer. Further analyses are needed to confirm these results.

EXPANSION OF MOTOR UNIT SIZE IN LIFELONG ATHLETES MAY ATTENUATE NEUROMUSCULAR IMPAIRMENTS IN OLDER AGE

PIASECKI, M., IRELAND, A., PIASECKI, J., DEGENS, H., STASHUK, D.W., SWIECICKA, A., RUTTER, M.K., JONES, D.A., MCPHEE, J.S.

UNIVERSITY OF NOTTINGHAM. MANCHESTER METROPOLITAN UNIVERSITY.

INTRODUCTION: The age-related loss of muscle mass is due to both muscle fibre atrophy and loss of fibres associated with declining motor unit (MU) numbers (Piasecki et al., 2015). Fibres denervated as motor units are lost will be degraded, or they can be 'rescued' by reinnervation from a nearby surviving axon which increases the size of the surviving motor units. A failure of reinnervation accelerates muscle loss and distinguishes sarcopenic from non-sarcopenic older men (Piasecki et al, 2018). Thus, any intervention that enhances reinnervation will preserve muscle mass for longer into older age. The purpose of the present study was to compare estimates of motor unit size (indicative of the amount of reinnervation) between young and older power, endurance and non-athletes. Based on the hypothesis that regular intense exercise enhances reinnervation, it was expected that athletic old would have larger MU than non-athletic old.
METHODS: Eighty-six male participants were divided into six groups based on age and discipline. Groups consisted of young controls (n=15), young endurance athletes (n=9), young power athletes (n=11), old controls (n=22), old endurance athletes (n=18) and old power athletes (n=11). All athletes were competing in their respective sports at the time of testing and all were classed as advanced or elite based on their age-graded performance. Cross-sectional area (CSA) was obtained by MRI and MU size was obtained by intramuscular electromyography (iEMG) in the vastus lateralis (VL). Statistical analysis was performed with a two-way ANOVA with age and discipline as fixed factors, followed by interaction contrasts and simple main effects analysis. Significance was accepted at $p<0.05$.
RESULTS: All young groups had larger muscles and smaller MUs than old ($p<0.001$). Power athletes had the largest muscles ($p<0.001$), but interaction contrasts revealed a greater age-related difference between young and old power athletes ($p=0.001$) when compared to endurance athletes and controls. Interaction contrasts performed following a significant age*discipline interaction ($p<0.001$) revealed that the age-related increase in MU size was greater in endurance ($p=0.038$) and power athletes ($p=0.013$) compared to controls, with no difference between the two athletic disciplines ($p=0.292$). Furthermore, the old endurance and power athletes had larger MUs than old controls ($p<0.001$).
CONCLUSION: The cross-sectional evidence presented here suggests that although power athletes may lose the greatest amount of muscle with age, they retain more than age-matched controls. The expansion of MU size is greater in older athletes of both disciplines, which suggests the older athletes are more successful at reinnervation and retaining muscle fibre number.

AGING AND STRENGTH TRAINING INFLUENCE ON COMMON INPUTS TO ALPHA-MOTONEURONS DURING LOW- AND HIGH-FORCE ISOMETRIC KNEE EXTENSIONS

WALKER, S., AVELA, J., WIKGREN, J., MEEUSEN, R., PIITULAINEN, H., BAKER, S.N., PARVIAINEN, T.
UNIVERSITY OF JYVÄSKYLÄ

INTRODUCTION: Aging is associated with reduced maximum force production and force steadiness during low-force tasks, but these can be improved by training. Coherence measures coupling between two neurophysiological signals in the frequency domain. However, functional meaning of coherence magnitude, particularly regarding neuromuscular adaptation in aging and training, remain unclear. This study investigated effects of strength training on cortico- and intermuscular coherence in untrained young and older individuals.
METHODS: Significant coherence between vertex EEG channels (i.e. F3-F4, C3-C4, P3-P4) and EMG signals was observed in 11/15 YOUNG (aged 18-30 years) and 11/13 OLD (aged 66-73 years) subjects, who were included in subsequent analyses. Maximum isometric knee extension force (MVC), as well as 70%MVC (16×6s) and 20%MVC (4×30s) tasks were performed before and after 14 weeks of strength training. MVC and force steadiness were used as performance parameters. 24-channels of EEG and EMG of vastus medialis and lateralis muscles were recorded during the submaximal contractions. Peak coherence values were extracted for 15-30Hz and 40-60Hz bands both for EEG-EMG (i.e. corticomuscular) and EMG-EMG (i.e. intermuscular) coherence.
RESULTS: Both YOUNG and OLD improved MVC (24±17% versus 11±13%, P=0.051 between groups), whereas only OLD improved force steadiness during 20%MVC (14±23% versus 17±13%, P=0.68 between-groups). Before training, YOUNG demonstrated stronger 15-30Hz intermuscular coherence during 20%MVC (0.074±0.041 versus 0.022±0.013, P=0.001 between groups) and 70%MVC (0.163±0.083 versus 0.066±0.036, P=0.003 between groups) tasks. However, OLD increased 15-30Hz intermuscular coherence compared to YOUNG during 20%MVC after training (-9±36% versus 84±81%, P=0.004 between-groups). Conversely, only YOUNG increased 40-60Hz intermuscular coherence during 70%MVC (from 0.073±0.054 to 0.104±0.046, P=0.007 within-group). This change in 40-60Hz coherence was positively related to improved MVC (r=0.416, P=0.054, n=22). No between-group differences or training-induced changes were observed in corticomuscular coherence.
CONCLUSION: Age-associated differences and training-induced changes in intermuscular coherence were observed in the present study. Training-induced changes in 15-30Hz intermuscular coherence coincided with improved force steadiness in OLD, while changes in 40-60Hz intermuscular coherence accompanied large increases in MVC in YOUNG. This data suggests that coherence represents functional relevance for low- and high-force performance tasks, respectively. Given that no differences were observed in corticomuscular coherence, the observed changes may have been due to non-cortical sources.

EFFECT OF KNEE JOINT ANGLE AND ANTAGONIST CO-ACTIVATION ON TORQUE STEADINESS IN YOUNG AND OLDER MEN

WU, R.1, DELAHUNT, E.1, DITROILO, M.1, LOWERY, M.2, DE VITO, G.1
UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: During submaximal isometric contractions, the ability to precisely control movement execution, i.e. force steadiness, is impaired in older adults. However, the findings of published studies investigating the effect of age on force steadiness during sustained muscle contractions are still inconsistent, probably due to the different testing methodologies. The aim of this study was to investigate the effect of joint angle (muscle length) on steadiness of knee extensors (KE) and the associated neural activation of agonist and antagonist muscles in young and older men at varying intensities of isometric contraction.
METHODS: 10 young (24.6 ± 2.8 years) and 11 older (70.3 ± 1.9 years) healthy men participated. Maximal voluntary isometric contraction (MVIC) of the KE and knee flexors was examined at 90° and 60° of knee flexion (0° = full extension). At each angle, participants performed, in a random order, 12-s isometric contractions at 20%, 50% and 80% of KE MVIC. The coefficient of variation (CV) of the torque and the root mean square (RMS) of surface EMG were estimated over the middle 8-s of each contraction intensity. To quantify the neural activation, at each intensity, EMG RMS values for each muscle were normalized to the RMS amplitude for that muscle when acting as an agonist during MVIC at the same angle.
RESULTS: Age-related impairment in steadiness was observed only at 20% MVIC ($p < 0.05$). CV (all $p < 0.05$) and the associated agonist activation (all $p < 0.001$) and antagonist co-activation (all $p < 0.05$) were higher at 90° than at 60° of knee flexion over all contraction intensities. When the responses in terms of steadiness ($p < 0.05$) and neural activations (all $p < 0.01$) between the two angular positions were compared, young men exhibited a larger difference than older men. In addition, KE torque steadiness (CV) was correlated with agonist activation (90 : $R2 = 0.33$, $p < 0.001$; 60 : $R2 = 0.22$, $p < 0.01$) and antagonist co-activation (90 : $R2 = 0.17$, $p < 0.05$; 60 : $R2 = 0.14$, $p < 0.05$) at both angles but only in older men.
CONCLUSION: These findings suggest that, at least for voluntary knee extension contractions, torque steadiness depends on the joint angle and concerning age, it is impaired only at the lowest considered contraction intensity (20% MVIC). Moreover, our results support previous studies, which suggested that older adults may tend to rely on the antagonist co-activation to stabilise/protect knee joint stability and maintain a constant torque output.
rui.wu.1@ucdconnect.ie

Oral presentations

OP-SH14 Physical activity, major skills / competencies in youth

ASSOCIATIONS BETWEEN IMPLICIT ASSOCIATIONS TOWARDS SPORT, BASIC MOTOR COMPETENCIES AND THE AMOUNT OF EVERYDAY PHYSICAL ACTIVITY IN 11-14 YEARS OLD CHILDREN

MUECKE, M., LUDYGA, S., ANDRAE, C., HERRMANN, C., GERBER, M.
UNIVERSITY OF BASEL

Background
Interventions with the target to increase physical activity usually focus on conscious regulatory processes and explicit attitudes. Recent research aggregated evidence, that not only explicit attitudes, but also implicit associations and attitudes influence behavior (Rebar et al., 2016). Implicit associations are spontaneous, involuntary attitudes or evaluative reactions on a non-conscious level. In the present study,

we investigated if implicit attitudes towards sports are related to basic motor competencies and everyday moderate-to-vigorous physical activity (MVPA).
Method
Participants were recruited from 3 different schools in Basel, Switzerland, and Leipzig, Germany (N=91, age 11-14 years, 57 % male). Implicit associations towards sport were measured using a computerized, reaction time-based single target implicit association test (ST-IAT). Basic motor competencies were assessed with the test battery MOBAK-5 (Herrmann & Seelig, 2017). Accelerometry over the course of 7 days was used to measure MVPA in everyday life. For ST-IAT, a D-score (Greenwald, Nosek, & Banaji, 2003) was calculated, ranging from -2 to 2 with scores closer to 0 interpreted as less extreme standing on the construct of interest. Partial correlations, controlling for ST-IAT sequence, were calculated. P-values were considered statistically significant at a level of $p \leq 0.05$.
Results: Data from 2 participants were excluded due to missing values. Descriptive statistics revealed a mean (SD) D-Score of 0.08 (0.3), mean MVPA of 127 (43) minutes per day and a mean MOBAK score of 6.6 (2.9), respectively. Analysis of partial correlations showed a significant positive correlation of the ST-IAT D-score with the MOBAK sum score ($r(89)=.31$, $p=.003$). No significant correlations were found with MVPA ($r(84)=.05$, $p=.676$).
Discussion: The results suggest that in children aged 10-14 years, basic motor competencies, but not the amount of everyday MVPA, are related to non-conscious attitudes towards sports. One interpretation – beyond potential reciprocal interferences - is, that the quality of exercise might contribute more to a positive implicit image of sport than the mere quantity of activity. This might be relevant for future interventions with the target to increase physical activity.
References: Greenwald, A. G., Nosek, B. A., & Banaji, M. R. (2003). Understanding and using the Implicit Association Test: I. An improved scoring algorithm. Journal of Personality and Social Psychology, 85(2), 197–216. https://doi.org/10.1037/0022-3514.85.2.197
Herrmann, C., & Seelig, H. (2017). Basic motor competencies of fifth graders. German Journal of Exercise and Sport Research, 47(2), 110–121. https://doi.org/10.1007/s12662-016-0430-3
Rebar, A. L., Dimmock, J. A., Jackson, B., Rhodes, R. E., Kates, A., Starling, J., & Vandelanotte, C. (2016). A systematic review of the effects of non-conscious regulatory processes in physical activity. Health psychology review, 10(4), 395–407.

DIFFERENCES IN THE PERCEIVED PHYSICAL ABILITY AMONG DIFFERENT MOTOR PERFORMANCE BETWEEN GERMAN AND CHINESE CHILDREN

YIN, X.1, HOHMANN, A.2, YA, P.2, YANG, S.1, ZHANG, B.1, YANG, T.3
1: SHRISS, 2:UBT, 3: DP LAB

Introduction: According to Bandura(Bandura 1977), self-efficacy is the cognitive mechanism which mediates information on personal capacities to successfully execute necessary courses of action in a specific domain. Thus, perceived ability regarding to motor activity represents a frame of reference to explain links between cognitive processes and physical performance. Given the importance of self-efficacy in the motor main, the purpose of the study was to compare psychological trait self-efficacy among children in the age group of 6 to 8 yrs from the German and Chinese primary schools.
Methods: Participants were 125 German (Nmale=58; age M = 93.18 mon, SD = 5.98) and 512 Chinese children (Nmale=275; age M = 86.35 mon, SD = 5.94) who completed Perceived Physical Ability Scale for Children(PPASC) developed by Colella (Colella, et al. 2008) assessing their self-efficacy, and the German Motor Test 6-18 (GMT 6-18; Boes & Schlenker, 2016) plus a ball throw. The participants were divided into three groups according to the overall performance of GMT 6-18: the talent group comprised of the best 20 percent of the participants. The lowest 20 percent were classified as the promotion group. The medium fraction of the children (60 percent) entered the general group.
Firstly, Two-way ANOVA was executed to determine whether there were a significant interaction and/ or significant differences among three motor performance groups and two countries, in regard to children's PPASC scores.
Secondly, two one-way ANOVAs were respectively performed to test whether there were significant differences among three motor performance groups in regard to Chinese children's PPASC scores, and in regard to German children's.
Result
The test result showed that there was not a significant interaction effect of different countries and motor performance levels ($F=2.04$, $P>0.05$). Neither was there a significant difference among three motor performance groups ($F=2.54$, $P>0.05$). However, a statistically significant difference was found between nationalities in self-efficacy ($F=13.25$, $P=0.00$).
A statistically significant difference was found among three motor performance groups (talent group, general group, and promotion group) in regard to Chinese children's PPASC scores ($F = 9.356$, $p = 0.00$). Post hoc Analysis indicated that there was a significant difference between Chinese talent group and Chinese promotion group ($p < 0.05$, $d = 0.45$), in regard to their PPASC scores. Also, there was a significant difference between Chinese general group and Chinese promotion group ($p = 0.00$, $d = 0.54$), in regard to their PPASC scores. However, the result with respect to German children's PPASC scores ($F = 1.52$, $p > 0.05$) among the three motor performance group was not significant.
Discussion: The results demonstrate the magnitude and direction of the relation between self-efficacy and motor performance varies considerably, which is consistent with previous studies (McAuley, E., & Blissmer, B. 2002). Growth environment and cultural background can affect the strength of the relationship. Chinese motor talent group and the general group were both significantly better on perceived physical ability than promotion group.
Reference
Bandura, Albert1977Self-efficacy: toward a unifying theory of behavioral change. Psychological Review 84(2):191.
Colella, Dario, et al. 2008 A physical self-efficacy scale for children. Social Behavior and Personality: an international journal 36(6):841-848.
McAuley, E., & Blissmer, B. (2002). Self-efficacy and attributional processes in physical activity. In T. S. Horn (Ed.), Advances in sport psychology (pp. 185-200). Champaign, IL: Human Kinetics.

SHOULD INTEGRATIVE NEUROMUSCULAR TRAINING BE IMPLEMENTED EARLIER THAN MIDDLE CHILDHOOD?

WALKER, L.J., DUNCAN, M., EYRE, E.
COVENTRY UNIVERSITY

Fundamental motor skills (FMS) competency encompasses combining cognitive processing, correct FMS patterns and force production effectively. Effective development of FMS may be better achieved through integrative neuromuscular training (INT) which improves early childhood (EC) strength, power, fitness and FMS (Faigenbaum et al. 2011). Despite the potential of INT as an intervention method, research

showing its efficacy in older children is scarce. Therefore, the study aims to determine the effects of a 6-week INT programme on FMS proficiency and health-related fitness (HRF) in middle childhood (MC; 9-10year olds); replacing 1 of 2 PE lessons (UK) per week. Following institutional ethics approval 59 children, (28 INT group; 9.62±.48years and 31 control group (CNT); 9.96±.29years) took part. Standing and seated height (cm) was measured using a Stadiometer (Seca213, Germany). Body mass (kg) and fat (%) were assessed using Bioelectrical Impedance (TanitaBF305, Tanita Inc, Japan). Maturation (PHV) was calculated guided by Mirwald et al. (2002). FMS was assessed using The Test of Gross Motor Development-2 (Ulrich, 2000). HRF included upper body power, assessed with a 2kg seated medicine ball throw (MBT); light gates (Fusion Sport, Coopers Plains, Australia) measured 10m sprint speed (SS) and standing Long jump (SLJ) distance assessed with a tape measure. Assessments were conducted pre, immediately post and at post-6-weeks (P6). Repeated measures ANCOVA results, controlling for PHV, revealed total FMS only improved in the INT group from pre to post (MPost-Pre= 2.99; p>.05), then decreased post to P6 though not significant. Locomotor FMS showed a main effect; performance improved pre to post for the INT group but not the CNT (MPost-Pre= 1.43 vs .67; p>.05). SS showed a group (INT vs. control) by time (pre vs post vs P6) interaction (p>.001); bonferroni post hoc pairwise comparison identified INT and CNT ran faster pre to post (MPost-Pre= -.23 vs -.14). The INT group upheld a faster speed P6 but the CNT ran slower (MP6-Post= -.03 vs .19). The samples SLJ increased while MBT decreased (MPost-Pre= 13.62 and -31.51). Results suggest combining INT and PE improves total and locomotor FMS short-term, and SS long-term compared to standalone PE in MC; though INT may not be as effective as reported in EC. FMS mastery is expected by MC so identifying improvements once 'mastery' has been classified may be challenging. Thus, the effective development of FMS during EC may be pivotal as FMS are expected to be mastered and sport-specifically applied in MC.

Faigenbaum, A. D., et al. (2011). Effects of integrative neuromuscular training on fitness performance in children. Pediatric exercise science, 23(4), 573-584.
Mirwald, R. L., et al. (2002) An Assessment of Maturity from Anthropometric Measurements. Medicine and Science in Sports and Exercise 34 (4), 689-694.
Ulrich, D. A. (2000). Test of gross motor development, 2nd ed. Examiner's manual. Austin, Texas: Pro-ED

VALIDATION OF A NEW PHYSICAL EDUCATION CRITERIA-BASED TEST BATTERY FOR THE ASSESSMENT OF FUNDAMENTAL MOTOR SKILLS OF ELEMENTARY AND MIDDLE SCHOOL STUDENTS

IANCU, H.D., PICARD, Y., BELANGER, M., RICHARD, J., SAVOIE, R., RICHARD, J.F.
ÉCOLE DE KINÉSIOLOGIE ET DE LOISIR - UNIVERSITÉ DE MONCTON

VALIDATION OF A NEW PHYSICAL EDUCATION CRITERIA-BASED TEST BATTERY FOR THE ASSESSMENT OF FUNDAMENTAL MOTOR SKILLS OF ELEMENTARY AND MIDDLE SCHOOL STUDENTS
Iancu, H.D.1, Picard, Y.1, Bélanger, M.2, Richard, J.1, Savoie, R.1, Richard, J.F.1
1: Université de Moncton (Canada), 2: Université de Sherbrooke (Canada)
INTRODUCTION: A key role of quality school physical education (PE) is to enable children to learn and master motor skills. The assessment of fundamental motor skills (FMS) therefore becomes essential. Limitations of existing measurement tools include being designed for clinical contexts, having age restrictions (3 - 10 years old) and not emphasizing pedagogical purposes of PE learnings (Russell et al., 2002; Sun et al., 2010; Tremblay & Lloyd, 2010). Accordingly, we developed a battery of 24 tests for their evaluation. Pilot testing took place in 7 schools (N = 1356 students) to assess feasibility, validity and reliability of these tests.
METHODS: In accordance with established standards for the development of psychomotor tests (Morrow et al., 2010), we identified the skills to be assessed, developed evaluation parameters by focusing on the performance process (quality) rather than the product, and determined the tests procedures. Other experts evaluated the face and content validity of this battery. Finally, each test was administered to targeted age groups students (2nd, 5th and 8th grade) to assess the test's feasibility and to refine evaluation parameters. This process was repeated following modifications of testing procedures aimed at improving psychometric properties. Inter-rater reliability and construct validity were assessed with Pearson correlations, Kappa statistics, Pearsons chi-squared statistics and Cramers V symmetric measurements.
RESULTS: Subsequent to the first test administration and the first feedback from PE teachers on test parameters, we modified instructions to improve clarity and adjusted the estimated time of administration for some grade levels and the training of raters. Following the 2nd and 3rd school's visits and modifications of testing procedures, acceptable to good indices of inter-rater reliability (Pearson = 0,61-0,87; Kappa = 0,55-0,83) and construct validity (Pearsons chi-squared $\chi 2$ = 98,942-124,732; Cramers V symmetric = 0,696-0,827) were found for final versions of the tests.
DISCUSSION: Our study shows that the development of this criteria-based test battery following a rigorous methodological process is complex and time intensive (over 4 years). Nevertheless, the statistical analyses led to an appropriate validity and intra-rater reliability. We are continuing to investigate the ability of this criteria-based test battery to identify known group differences. Also, a process of establishing standardized measuring procedures is already in place. This test battery could become a standard measuring tool for assessing the PE objectives within French school curricula in New Brunswick, Canada.

EFFECTS OF AEROBIC EXERCISE AND COGNITIVELY ENGAGING EXERCISE ON CARDIOVASCULAR FITNESS, MOTOR SKILLS, AND BODY-MASS INDEX IN SCHOOL-AGED CHILDREN

VAN DER FELS, I.M.J., HARTMAN, J., BOSKER, R.J., SMITH, J., VISSCHER, C.
UNIVERSITY OF GRONINGEN, THE NETHERLANDS.

INTRODUCTION: The effects of different types of exercise on physical fitness remain poorly understood in physical education settings. Two physical exercise interventions, aerobic exercise and cognitively engaging exercise, were developed for use in a primary school setting. The aim of this study was to investigate the effects of these interventions on cardiovascular fitness, motor skills, and body-mass index.
METHODS: Children (n = 407) aged 7-11 years (50.5% boys) from 22 classes, across 11 primary schools in the Northern Netherlands participated in this study. Using cluster randomization at class level, children were assigned to the aerobic exercise (APE) group, the cognitively engaging exercise (CEPE) group, or the control group (CG). The intervention groups received their intervention four times a week during physical education (PE) for a period of 14 weeks. Children in the CG followed their own PE program twice a week for a period of 14 weeks. Cardiovascular fitness, motor skills and BMI were measured before and after the intervention period. Cardiovascular fitness was assessed with the 20-m Shuttle Run Test, motor skills were assessed using items of the Körperkoordinationstest für Kinder and the Bruininks-Oseretsky Test of Motor Proficiency (2nd Edition). A factor score was calculated out of the four motor skill items. Time spent in moderate-to-vigorous physical activity (MVPA) of two PE lessons was measured with wGT3X ActiGraph accelerometers.

RESULTS: Multilevel analysis revealed no significant effects of APE and CEPE on cardiovascular fitness, motor skills, and BMI. However, a significant interaction effect between pretest and condition for BMI was found: children with a higher BMI decreased their BMI more in the APE group compared to the CG (B = -.18, p < .01) and the CEPE group (B = -.21, p < .01). There was also a significant relation between MVPA and cardiovascular fitness, independent of condition: children who exercised more in MPVA scored higher on cardiovascular fitness at the post-test (B = .06, p = 0.01).
CONCLUSION: Results reveal that APE and CEPE do not enhance cardiovascular fitness, motor skills, and BMI at group level. However, a dose-response relation between MVPA and cardiovascular fitness was found, indicating that the extent of the improvement in cardiovascular fitness is related to the time spent in MVPA. Finally, aerobic exercise is recommended for children with a higher BMI, since BMI decreases more with APE compared to CEPE or CG.
REFERENCES:
Londsdale et al., (2013). Preventive Medicine, 56, 152-161.
CONTACT:
i.m.j.van.der.fels@umcg.nl

Oral presentations

OP-SH05 Sport Management and law 1

SPORTS MANAGEMENT CAREER: A STORY TO BE TOLD IN FOOTBALL.

ANGELO, L.
SEDES SAPIENTIAE INSTITUCION

There are few studies about sports management career addressing the processes of transition, their cycles and post athletic career in sports science. It is also unusual using research methods that use open interviews with athletes and post athletes which approach in a widely way the athlete's life where this topic is inserted. In the specific case of football, journalism in general, tends to explore this topic, principally intending to report situations that contradict the glamour and visibility that the athlete lives during his productive phase of the career. The modality was chosen by the influence power in national public policies, and for presenting an impressive group of athletes who experienced both amateur and professional phases. The objective of this research was to identify and analyze how it is the process of managing career among Olympic athletes in football who also lived one long-lived career in professional football from the perspective of identity transformation in the different cycles that make up the athlete's career. It is worth to discuss the formation processes of athletic identity, as well as the ways of management of professional sports career pointing its meanings and feelings during its development, in its finalization and in the construction of a new career. However, it was intentionally selected 12 athletes, 10 of them already removed from the professional activity, and 2 others yet in activity, all of them over 33 years old from several parts of Brazil. For both, the method used was the biographical narratives of Brazilian athletes who took part of at least one Brazilian team that participated of an edition of the Olympic Games between the decades of 1960 and 2000. The thesis argues that the management of sports career is made based on the relation the individual has with his subjective career and the career socially built enabling the career concept as a life project following the ideas proposed by the paradigm, Life Design

RESEARCH ON CHINA'S STRATEGIES FOR DEVELOPING WINTER SPORTS SINCE THE SUCCESSFUL BID FOR THE 2022 WINTER OLYMPICS

HOU, H.
CHINA SPORT INFORMATION CENTER

Introduction: In 2015, Beijing won the right to host the 2022 Winter Olympics. How to grasp the opportunity to develop winter sports in China is now a hot topic among the Chinese sports community.
Methods: By way of literature review, statistical analysis, expert consultation and analytical comparison, this paper discusses China's strategies for developing winter sports in recent years and does some thinking about how to further the development of ice and snow sports in the country.
Results: Winter sports in China have always been "strong in ice and weak in snow". Since Beijing was awarded the 2022 Winter Olympics, China has taken proactive measures to boost the level of its competitive winter events, including searching for talent all over the country, drawing summer athletes to winter sports and strengthening international cooperation and exchanges. In recent years, China has built national teams in all of the 102 disciplines to be contested in PyeongChang. Chinese athletes qualified for an unprecedented 55 medal events at the 2018 Winter Olympics. The country also aims to popularize winter sports to a scale large enough to benefit people of all stripes. The General Administration of Sport of China issued in 2016 "the Development Plan for Winter Sports (2016-2025)" and "the National Plan for the Construction of Winter Sports Venues and Facilities (2016-2022)",under which the government will use revenue from the sports lottery and other funds to build more venues, set up sports associations, and organize competitions and festivals for winter sports. Winter sports venue developers will be offered reasonable and flexible policies in tax reduction and land acquisition. Meanwhile, modern technologies are used by the Chinese winter sports industry to enhance the winter sports experience.
Discussion: The 2022 Winter Olympics has put winter sports development in China on a fast track, generating more public interest and government support.
However, compared with winter sports powers, China's ice and snow sports got off to a late start and has a poor foundation. The newly issued development plans have yet to be further implemented. The training of reserve talent in competitive winter sports needs to be more systematic, the training of coaches, professional teachers, instructors of social sports and professionals in areas such as science and technology, management and industry needs to be further strengthened, and there should be more types of ski resorts. Official industry-approved quality standards and support facilities need to be perfected, and the quality of service in winter sports needs to be further improved.
China should grasp the opportunities the 2022 Winter Olympics will offer, use the experience of other countries for reference and explore a road for the development of winter sports with Chinese characteristics.
References: General Administration of Sport of China (2016). "the Development Plan for Winter Sports (2016-2025)".
Wu Bin, Wei Qinghua, "2017 China Ski Industry White Book", 25 January 2018.

Contact: Email address: houhaibo66@163.com.

THE CURRENT SITUATION, PROBLEMS AND PROSPECTS OF NON-PROFIT SPORTS ORGANIZATIONS IN CHINESE COMMUNITY

LUO, Y.

CHINA INSTITUTE OF SPORT SCIENCE

Research background:
At present, with the high-speed development of China's economy, sport plays a important role in constructing and perfecting the public sport services and it emerges with the development of tourism, leisure, entertainment, etc . The sport industry development and the advancement of sport economy are not only the instruments for the employment and the service industry but also the requirements for the adjustment of economy structure.
Research METHODS: By using the methods of documentation, expert interview, questionnaire and mathematical statistics, taking the level of economic and social development as the standard, the presentation investigated each two provinces and cities of s developed areas, moderately developed areas and underdeveloped areas in China and 6 municipal units in each province. This paper investigates and analyzes the current situation of municipal sports administrative institutions, municipal sports associations and community non-profit sports organizations, and summarizes its organizational form, form of activity, funding channels and participating groups, so as to provide basis for policies-making.
Results :
1, there are essential differences between the non-profit sports organizations in communities and the organizational forms and forms of activities of individual sports organizations and business sports clubs. The characteristics of localization are obvious, and the consumption ability is low.
2, the channels of activity funding mainly come from local financial allocation, sports lottery fund, corporate sponsorship and personal sponsorship, which are closely related to the level of local economic and social development.
3 the main purpose of sports participants is fitness, health and entertainment, and the proportion of competitive components is very small.
4 The content of 4 activities is diversified, and the trend of sports, culture and entertainment is obvious. The specific sports project is based on square dance, with table tennis, badminton and other competitive sports, as well as traditional Chinese sports such as Taijiquan, fitness Qigong and so on.
CONCLUSION: Community non-profit sport organizations show the aging and entertainment trend and have no motivation. The governments and sports administrative departments should be policy-oriented.
First, there should be policy and funding support. Second, it should be cooperated with civil affairs and caring organizations. Third, competitive and performance elements should be added so as to attract the youngsters and the middle age group.

MOTIVATIONAL ASPECTS FOR VOLUNTEER ENGAGEMENT OF THE EXECUTIVE BOARD – AN EMPIRICAL ANALYSIS OF SPORTS CLUBS IN HAMBURG, GERMANY

MINTERT, S.M., REHMER, M.

FRESENIUS UNIVERSITY OF APPLIED SCIENCES

Many sports clubs increasingly face the problem of not being able to attract enough staff members for their voluntary leadership tasks. Therefore, the willingness to devote itself to the complex and responsible tasks in a club Board is more and more diminishing. It is important to find out why many people are still investing a large part of their time in the execution of this voluntary activity and what motivates them to do so. Are selfish or altruistic aspects predominant?
This study gives an overview of motives for voluntary commitment of persons in the executive Boards of sports clubs in Hamburg. Differences and influences are examined by means of sociodemographic characteristics and structural conditions. In addition, the question arises whether this commitment may also be used as a means of social integration. Based on a quantitative data collection using a specially created questionnaire for 160 Board members from 36 sports clubs in Hamburg, the results show that the commitment is most pronounced in a life stage where people are already very heavily burdened by family and work. Women are not as underrepresented as often suspected. The motives vary, but mainly focus on social and humanistic aspects.
The original form of organization of a sports club must reflect its social position due to increasing consumption and non-union. Club specific structures are no longer necessarily the reason for commitment. Given the results of motivational aspects, a series of recommendations for sports clubs is provided in order to successfully attract and retain voluntary members of the Management Board.

EXPLORING NEW DEVELOPMENT FRONTIERS: THE ROLE OF YOUTH, SPORT AND CULTURAL INTERVENTIONS

SADLIER, A., GIULIANOTTI, R., ESSON, J., SAAVEDRA, M., SHARMA, S.R.

LOUGHBOROUGH UNIVERSITY

Sport conjures up conflicting images in the cultural imaginary. On the world stage, it is often associated with a competitive spirit, which from a more critical perspective is viewed as being organised around the structures of patriarchy, neoliberalism and Western colonialism. Sport in this vision is not entirely inclusive and seems to be removed from cultural life. Yet, sport can also be used to connect people and to enable social change. An example of this is the Sport for Development and Peace sector, which has expanded rapidly over the past decade, and which aims to use sport to address human development goals, such as tackling poverty and gender inequality. The extent to which sport can be a panacea for social inclusion and transformation in an unequal world has been the focus of substantial research in diverse locations.
The international ESRC-funded 'New Development Frontiers? The Role of Youth, Sport and Cultural Interventions' project at Loughborough University seeks to contribute significantly to this literature, through a multi-site comparative investigation of the role of sport, cultural and educational programmes in promoting sustainable development in three low- to middle-income countries – Cape Verde, Nepal and Timor-Leste.
This paper will draw on emergent findings from fieldwork undertaken with NGOs in two of our three research locations: Delta Cultura and Empowering Women of Nepal . The data discussed will be taken from qualitative interviews with various stakeholders in the SDP sector, notably representatives of NGOs, governmental organisations and sports federations, and Participatory Action Research with pro-

gramme users. The paper will explore the role of local traditions; the danger of idealising sport; the difficulties facing the SDP sector, such as lack of resources; and the underexplored relationships between sport and other cultural interventions on social programmes.
Keywords: Sport for Development and Peace ; Youth; Sustainable Development; Cultural Interventions; Cross-cultural qualitative research; Participatory Action Research .

14:00 - 15:30

Oral presentations

OP-PM05 AGEING and FRAILTY

THE PHYSIOLOGICAL AND MECHANISTIC EFFECTS OF TESTOSTERONE ADMINISTRATION DURING RESISTANCE EXERCISE TRAINING IN OLDER MEN: A DOUBLE-BLIND PLACEBO-CONTROLLED CLINICAL TRIAL

GHARAHDAGHI, N., RUDRAPPA, S., PHILLIPS, B.E., HAMROCK, C., IDRIS, I., BROOK, M.S., WILKINSON, D.J., SZEWCZYK, N.J., SMITH, K., ATHERTON, P.J.

UNIVERSITY OF NOTTINGHAM

INTRODUCTION: The andropause is associated with declines in serum testosterone (T), an associated loss of skeletal muscle mass and function (i.e. sarcopenia) and insulin resistance. Two of the major interventions purported to offset sarcopenia are T therapy and Resistance Exercise Training (RET). Nonetheless, the efficacy and global physiological impacts and mechanisms of T therapy adjuvant to RET remain poorly defined in older individuals.
METHODS: To address this, 18 non-hypogonadic healthy older men, 65-75y, BMI≤30kg.m-2 (serum T>8.3nmol.l-1) were assigned in a random double-blinded fashion to receive bi-weekly: placebo (P, saline, n=9) or T (Sustanon 250-mg, n=9) injections over 6-weeks of whole-body RET (leg-extension, leg-press, leg-curl, lat-pull-down, shoulder-press and bench-press (3-sets, 8-10 reps at 80% 1-RM)). Subjects underwent Dual-energy X-ray Absorptiometry (DXA), ultrasound of m.vastus lateralis (VL) architecture, isometric dynamometer knee-extensor Maximal Voluntary Contraction (MVC) and Oral Glucose Tolerance Testing (OGTT); finally, m.vastus biopsies were taken to quantify myogenic gene expression and activation of insulin/anabolic pathways.
RESULTS: T adjuvant to RET, augmented whole-body (53002±5240g to 56068±5262g vs. 54132±6331g to 54860±5870g, P<0.0001, ES=0.58) and appendicular lean mass gains (23887±3190g to 25571±3336g vs. 24591±3752g to 24811±3390g, P<0.0001, ES=0.52) while decreasing body fat (1194g vs. 209g, P=0.01, ES=0.29). T also augmented VL thickness gains (2.36±0.21cm to 2.61±0.13cm vs. 2.31±0.3cm to 2.45±0.28cm, P<0.0001, ES=0.73) and fascicle-length (7.18±0.8cm to 7.9±0.75cm vs. 7.7±0.19cm to 8.11±0.1cm, P=0.0008, ES=0.92) in addition to strength gains e.g. 1-RM leg-extension (69.89±15.11kg to 125.6±15.82kg vs. 61.22±29.58kg to 103.1±46.88kg, P=0.0003, ES=0.64) and MVC (166.6±32.7Nm to 210±38.33Nm vs. 164.8±51.25Nm to 194.6±44.23Nm, P=0.0119). Additionally, T augmented insulin sensitivity (e.g. Cederholm index: 54.08±12.77 to 65.41±18.1 mg·L2·mmol·L−1·mU−1·min−1 vs. 46.95±10.99 to 52.05±12.29 mg·L2·mmol·L−1·mU−1·min−1, P=0.028, ES=0.86) and gene expression related to T metabolism (Androgen Receptor: 1.4-fold; Srd5a1: 1.8-fold; AKR1C3: 2.6-fold; HSD17B3: 2.1-fold), and anabolism/myogenesis (IGF-1EA (3.6-fold), IGF-1EC (3.3-fold), Myogenin (2.7-fold), Myf6 (3.9-fold), c-Met (1.7-fold) and c-Myc (7.3-fold)). Finally, acute RE-induced phosphorylation of AKTser473 (0.088±0.07 to 0.2±0.1 vs. 0.034±0.02 to 0.089±0.06, P=0.008, ES=1.1) and mTORC1ser2448 (0.027±0.01 to 0.12±0.06 vs. 0.05±0.03 to 0.085±0.05, P=0.041, ES=0.59) was enhanced with T.
CONCLUSION: Administration of T (vs. placebo) adjuvant to RET enhanced insulin/anabolic signalling pathway activity in response to RE, while upregulating muscle T processing genes and myogenic gene regulation, perhaps explaining augmented muscle growth and insulin sensitivity. Thus, T coupled to RET is an effective short-term intervention to improve muscle mass, function and glycaemic control in older aged men.

COMBINED EFFECTS OF PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR ON BONE HEALTH AND FRAILTY IN ELDERLY PEOPLE: COMPOSITIONAL DATA ANALYSIS

RODRÍGUEZ-GÓMEZ, I.1, MAÑAS, A.1, LOSA-REYNA, J.1,2, RODRÍGUEZ-MAÑAS, L.3, GARCÍA-GARCÍA, F.J.2, CHASTIN, S.F.M.4, ALEGRE, L.M.1, ARA, I.1

1: GENUD, UCLM , 2: HVV , 3: HUG , 4: GCU

INTRODUCTION: Ageing is associated with a progressive decrease in bone mass and frailty, which can favor the development of osteoporosis and bone fractures and derives in loss of physical function and dependence (1). Physical activity (PA) is one of the main strategies to combat this loss of bone mass (2) and one of the keystones in the development of frailty (3). Nonetheless, due to daily time is limited, the time spent on each PA behaviour is codependent (4). The aim of this study is to analyse the relationship between bone mass and PA behaviours on bone health in elderly people using a compositional data analysis depending on the frailty status.
METHODS: We analysed 740 older people (77±4.9 y) from the Toledo Study of Healthy Aging (TSHA). The time spent in sedentary behaviour (SB), light PA (LPA) and moderate-vigorous PA (MVPA) were estimated by accelerometry. Whole-body bone mass was determined by bone densitometry (DXA) and frailty status (robust, pre-frailty and frailty) was evaluated according to the criteria proposed by Fried et al. (5). The statistical system R was used to carry out this analysis and, all models were adjusted for age, education, marital status, income, body mass index, fat mass, lean mass, alcohol intake, smoking, nutritional status, thyroid disease, arthritis and calcium, by backward elimination.
RESULTS: The combined effect of PA and SB was significantly associated with legs bone mineral content (BMC) and density (BMD) in the robust subgroup (p≤0.01) and, with whole-body and legs BMC and BMD in pre-frails older people (p≤0.05). In relation to the other behaviors, older people legs BMC and BMD were positively associated with SB (p<0.01), and legs BMC and BMD were negatively associated with LPA (p<0.01) in robust elderly. Finally, in pre-frail older people, whole-body and legs BMC and BMD were positively associated with MVPA (p<0.05). No associations were found in the frail subgroup.
CONCLUSION: This analysis provides new insights into the relationship between bone mass and the lifestyle of older people. Therefore, we identified that increasing MVPA, and maintaining or decreasing time spent in LPA and SB, respectively, contributes toward a more

favorable bone mass in the case of pre-frail elderly. Despite no clear patterns were found in frail older people, MVPA could be a good strategy to improve bone health before reaching frailty status. More studies would be necessary to understand these associations in robust and frail older population.

References: 1 Chou, C. H., Hwang, C. L., & Wu, Y. T. (2012). Arch Phys Med Rehabil, 93(2), 237-244
2 Sallis, R. (2015). Phys Sportsmed, 43:1, pages 22-26
3 Bergman H, Ferrucci L, Guralnik J, Hogan DB, Hummel S, Karunananthan S, et al. (2007). J Gerontol A Biol Sci Med Sci, 62(7):731-7.
4 Chastin, S. F., Palarea-Albaladejo, J., Dontje, M. L., & Skelton, D. A. (2015). PLoS One, 10(10), e0139984
5 Fried LP, Tangen CM, Walston J et al. (2001). J Gerontol A Biol Sci Med Sci, 56(3):M146-56
Contact: Irene.rodriguez@uclm.es

HEMODYNAMIC RESPONSES TO BLOOD FLOW RESTRICTION TRAINING FOR OLDER ADULTS

SCOTT, B.R.1, PEIFFER, J.J.1, MARSTON, K.J.1, THOMAS, H.J.2, HILL, K.D.3

1: MURDOCH UNIVERSITY, 2: UNIVERSITY OF WESTERN AUSTRALIA, 3: CURTIN UNIVERSITY

INTRODUCTION: While current guidelines for muscular development promote heavy weights training, many older people cannot safely tolerate high loads. Blood flow restriction (BFR) during low-load resistance exercise (LLBFR) increases muscle size similarly to heavy training, albeit with lighter weights. However, few studies have addressed the cardiovascular safety of LLBFR. This study aimed to quantify the acute hemodynamic responses to LLBFR, and to compare these responses to higher-load exercise (HL).
METHODS: Ten healthy older females (63-75 yr) were assessed for maximal strength (1RM) in the leg press and leg extension. In a randomised and counterbalanced order, subjects completed three protocols: 1) low-load exercise (LL), comprising 3 sets of 20, 15, 15 repetitions at 20% 1RM; 2) LLBFR, identical to LL but with BFR cuffs applied to the thighs, and; 3) HL, including 3 sets of 10 repetitions at 70% 1RM. The BFR cuffs were inflated to 60% of individualised pre-determined arterial occlusion pressure, but were deflated between exercises. Systolic, diastolic and mean arterial pressures (SBP, DBP, MAP) were manually assessed at baseline and after each set. Impedance cardiography measured heart rate (HR) and cardiac output (CO), and was used to calculate rate pressure product (RPP). Two-way ANOVA was used to assess differences between time points and conditions. Data are mean ± SEM.
RESULTS: Baseline hemodynamic values were consistent between trials. DBP increased across all sets for LLBFR (from 68.8±1.5 to 82.0±2.6 mmHg; p≤0.003), and during leg press for HL (from 64.8±2.2 to 69.1±1.9 mmHg; p≤0.045), but did not change during LL. SBP increased from baseline during all trials (p≤0.041), and was higher during LLBFR (168.2±7.0 mmHg) than in LL or HL (151.9±6.2 and 155.6±6.6 mmHg; p≤0.048). Similar observations were made for MAP, which was highest during LLBFR (110.7±3.4 mmHg) compared to LL or HL (94.7±3.2 and 97.9±2.6 mmHg; p≤0.013). Peak HR was highest during HL (122±12 bpm) compared with LLBFR and LL (114±10 and 109±9 bpm; p≤0.036), though CO was not different between conditions. Peak RPP was lower during LL (159.9±30.0 AU) compared with LLBFR and HL (188.3±34.7 and 184.2±34.1 AU; p≤0.001).
CONCLUSION: This study indicates that LLBFR provides similar myocardial workload to HL, as estimated by RPP, but via different mechanisms; LLBFR increased SBP while HL increased HR. Therefore, the physiological impacts of BFR may be more severe for the peripheral vasculature rather than the heart itself, and caution is advised when prescribing BFR exercise for older people with increased risk for vascular dysfunction.

CAN SMALL-SIDED GAMES IMPROVE CARDIOVASCULAR HEALTH IN MIDDLE-AGED INDIGENOUS AUSTRALIAN MEN?

SAMPSON, J.A., WINCH, S., VENABLES, S.

UNIVERSITY OF WOLLONGONG

INTRODUCTION: Small-sided games played for 60-90 mins 2-3 ×/week can improve cardiovascular health (Bangsbo et al, 2014). Indigenous Australian men prefer such forms of exercise, yet time constraints can present a barrier (Hunt et al, 2008). It is however known that substantially lower duration bouts of high intensity exercise can also improve cardiovascular health (Gibala et al, 2012) and that high intensity activity is greater during small-sided games when short exercise bouts are dispersed with rest (Sampson et al, 2015). This investigation thus aims to determine if this format of small-sided games can improve cardiovascular health in middle-aged indigenous men.
METHODS: 14 indigenous men, N=6 assigned to a control (33.7 yrs SD, cm SD, 92.8 kg SD) and N=8 (35.9 yrs SD, 180.1cm SD, 93.6 kg SD) to an experimental group actively participating in small-sided touch football (4 × 5 min bouts dispersed with 2 minutes of rest) 2 ×/week for 12 weeks volunteered for this investigation. Baseline and post-experimental assessments of total mass, fat (%), muscle mass, Visceral fat (Tanita SC330S); body mass index, waist-to-hip circumference, blood pressure, average sleeping heart rate (actigraph/polar H7), and capillary blood samples to assess total (Tc) and high density lipid (HDL) cholesterol (cardiochek) were performed. Framingham risk was calculated. The mean, 90% confidence interval and Cohens effect size (ES) differences between groups are presented where likely, very likely or almost clear effects were observed.
RESULTS: Baseline HDL and Tc was likely higher (9.8 mg/dl CI -5.2 to 24.7 ES 0.64 and 33.1 mg/dl CI 5.3 to 60.9, ES 1.02) in the experimental group. After 12 weeks, fat (%) was very likely lower (-5.0% CI -8.6 to -1.4, ES 0.8); muscle mass likely greater (5.9% CI 1.3 to 10.6, ES 0.64), Waist-to-hip ratio likely lower (-.05 CI -0.1 to 0, ES 0.78); average sleeping heart rate likely lower (-6.2 bpm CI -15.7 to 3.4, ES 0.59), HDL likely lower (-14.8 mg/dl CI -36.4 to 6.9, ES 0.97) and Tc very likely lower (-48.7 CI-93.9 to -3.4, ES 1.51) in the experimental group. However, no change or meaningful difference in Framingham risk was observed between groups at any stage.
CONCLUSION: Regular small-sided games played for 20 mins 2 x per week can improve parameters of cardiovascular health and should be considered a valuable exercise alternative for middle-aged indigenous men. However, dietary interventions must also be considered to substantially reduce cardiovascular risk.
REFERENCES: Bangsbo et al. (2014) Scand J Med Sci Sports. 24: 147-150
Hunt, J., et al. (2008) Health Promot J Aust. 19: 102-08
Gibala, M.J. et al.(2012) J Physiol, 590: 1077-84.
Sampson, J.A. et al. (2015) J Sp Sci 33: 85-98

CAN HEAVY-LOAD STRENGTH TRAINING PERFORMED TWICE WEEKLY IMPROVE MUSCLE MASS, MUSCLE STRENGTH AND FUNCTION IN FRAIL ELDERLY INDIVIDUALS?

NYVIK AAS, S., ROGNLIEN, S.H., GODAGER, S., RAASTAD, T.

NORWEGIAN SCHOOL OG SPORT SCIENCES

INTRODUCTION: Muscle strength is inversely and independently associated with mortality [1], emphasizing the importance of strategies aiming to maintain or improve muscle strength in later life. Low muscle strength is particularly evident in frail elderly individuals [2] and our objective was therefore to investigate the effects of heavy-load strength training on muscle mass, strength and function in this population.
METHODS: Short Physical Performance Battery (SPPB) was performed to screen subjects for eligibility in the study. Nineteen men and sixteen women (age: 85.8±7 yr) were randomized to the intervention group performing strength training twice a week for 10 weeks (ST) or the control group (CON). Both groups received daily supplementation of 17 grams of milk protein. Each training session lasted for approximately 30 minutes, and exercises included step-up, leg press and knee extension (KE) (one to four sets of 6-12 RM). Prior to randomization, leg lean mass was measured by dual-energy X-ray absorptiometry (DXA), and muscle strength by 1RM test in KE. Sit-to-stand x 5, habitual and maximal gait velocity was tested to assess functional status.
RESULTS: Average SPPB score at baseline was 5.7±3. Following the intervention, the change in leg lean mass in ST (0.3±0.6 kg) was not significantly different from the change in CON (-0.1±0.7 kg, $p = 0.07$). KE 1RM increased significantly more in ST (18±15 %) than in CON (6±10 %, $p < 0.05$). Chair stand time improved significantly in ST (-15±20 %, $p < 0.05$), and the change tended to be significantly different from the change in CON (1±19 %, $p = 0.051$). Habitual and maximal gait velocity did not change following the intervention.
CONCLUSION: An SPPB score of 4-6 typically corresponds to moderate limitations in activities of daily living [3], confirming the low functional capacity of the subjects included in this study. The results from the intervention showed that high-load strength training performed twice weekly for ten weeks was sufficient to elicit improvements in muscle strength and chair stand performance, without effects on gait velocity. A higher training frequency might be needed to elicit greater improvements in functional performance.
1. Ruiz, J.R., et al., Association between muscular strength and mortality in men: prospective cohort study. BMJ, 2008. 337: p. a439.
2. Keevil, V.L. and R. Romero-Ortuno, Ageing well: a review of sarcopenia and frailty. Proc Nutr Soc, 2015. 74(4): p. 337-47.
3. Guralnik, J.M., et al., Lower-extremity function in persons over the age of 70 years as a predictor of subsequent disability. N Engl J Med, 1995. 332(9): p. 556-61.

Oral presentations

OP-PM06 ENERGY BALANCE

ENERGY BALANCE IN YOUNGER AND OLDER WELL-TRAINED MEN DURING 15 DAYS CYCLING AT NEAR-MAXIMAL ENERGY EXPENDITURE RATES

SAHL, R.E., FRANDSEN, J., HANSEN, M., RØMER, T., NIELSEN, A.B., LIE-OLSEN, M., ROSENKILDE, M., LARSEN, S., WESTERTERP, K., DELA, F., HELGE, J.W.

UNIVERSITY OF COPENHAGEN

INTRODUCTION: Energy intake during repeated excessive exercise is inadequate to cover energy expenditure, especially in older subjects, based on prior data from our lab showing an energy deficit of 5 MJ/day when near-maximal energy expenditure rates was sustained for two weeks. The aim of this study was to investigate the influence on maximal oxygen uptake and the ability to match energy intake with energy expenditure during excessive prolonged exercise in younger and older well-trained men. We hypothesized that the older group would have a larger negative energy balance than the younger group.
METHODS: Young (age 30±2 y, mean±SD, n=7) and old (age 65±2 y, n=7) male cyclist covered 3008±80 km (22350±522 meters of altitude) from Copenhagen (Denmark) to Palermo (Italy) in 15 days. Maximal oxygen uptake (VO2max) was measured with online equipment (Cosmed, Italy), 7-14 days before departure, and 2-3 days after arrival. Energy balance was calculated as the difference between expenditure (EE), as measured over the 15-day race with doubly labeled water, and energy intake (EI) as recorded under supervision for 2 consecutive days on 3 occasions (day 2+3, 5+6 and 12+13). Body composition was determined with bio impedance and with isotope dilution, before and after the intervention.
RESULTS: EE was higher in the younger group (33.4±2.0 MJ/day) compared to the older group (27.0±3.7 MJ/day, P=0.001). EI was not different between groups (27.2±1.9 vs. 25.7±3.4 MJ/day, P=0.24), resulting in a higher negative energy balance in the younger group (-6.4±2.6 MJ/day) compared with the older group (-1.7±1.7 MJ/day, P=0.002). VO2max at baseline was 61.5±0.9 and 46.8±1.7 ml/min/kg in the younger and older group, respectively. Two days after arrival in Palermo VO2max was unchanged in the younger group (63.8±0.8 ml/min/kg, P=0.113) but decreased in the older group (43.5±3.2 ml/min/kg, P=0.047). There were no changes in body weight, but fat mass in the older group decreased from 12.6±3.2 to 9.5±2.6 kg (P=0.012) and lean mass increased from 59.9±9.4 to 62.8±9.1 kg (P=0.024). Fat mass in the younger group showed a tendency to decrease from 9.4±3.3 to 7.4±3.6 kg (P=0.074) with no change in lean mass 68.5±3.7 to 69.3±4.2 kg (P=0.489).
CONCLUSION: In contrast to our hypothesis, the older group had a lower negative energy balance than the younger group. EE in the younger group was equivalent to some of the highest reported values and EI values were close to observed maximal daily consumption, explaining the higher energy deficit in the younger compared to older subject. Despite the lower energy deficit and the positive change in lean mass in older compared to younger subjects, VO2max was decreased only in the older group. We conclude that energy balance could not be maintained during repeated excessive exercise in younger and older cyclist, but this only concurred with an attenuated VO2max in the latter group.
For further information, contact: ronnisahl@sund.ku.dk

METABOLIC POWER AND ENERGY EXPENDITURE IN THE GERMAN BUNDESLIGA

VENZKE, J.1, WEBER, H.2, SALMEN, J.3, SCHLIPSING, M.3, PLATEN, P.1

RUHR-UNIVERSITY BOCHUM1, SPORTTEC SOLUTIONS GMBH (A DFL COMPANY) FRANKFURT2, ATHLENS GMBH BOCHUM3

INTRODUCTION: Soccer can be characterized as a physically demanding, high-intense intermittent team sport. Player tracking technology is used to determine displacement variables and the distribution of movement across speed and acceleration zones. Additionally, a mathematical approach allows calculating energetic load and metabolic power1. Recent research shows that there are differences in positional groups in field hockey and American football and claims that the approach to classify intensity out of speed zones is not suitable anymore. Therefore, the aims of this study were: (1) to describe the metabolic power demands for different position groups; and (2) to compare the traditional speed-zone with the metabolic power approach.
METHODS: 1344 video match analysis (25Hz) datasets from 416 players (182.3±6.7cm, 77.1±7.0kg, 25.8±3.9y) out of 96 matches of the German Bundesliga were gathered by an automatic player detection and tracking system. Displacement (speed, acceleration, distance) and energetic (Metabolic Power, energy expenditure) variables were determined and intensity was classified utilizing conventional thresholds[2]. Metabolic and running profile were analyzed and compared between positional groups. Time spent, Distance covered and energy expended at high speed (>15.5km/h) was compared to those at high metabolic power (>20W/kg) by using one-way analysis of variances.
RESULTS: Midfielders (MID) expended more energy (46.8±3.2 kJ/kg) than strikers (STR) (43.3±4.2kJ/kg) and defenders (DEF) (41.7±3.1kJ/kg) ($p<0.001$) and covered more distance (11193±772m) than the other positions groups (STR: 10319±1018m; DEF: 9988±670m) ($p<0.001$). Also MID spent more time (355±69s; DEF: 252±68s; STR: 313±69s), covered more distance (1908±380m; DEF: 1372±384m; STR: 1728±380m) and expended more energy (8.2±1.7kJ/kg; DEF: 6.1±1.7kJ/kg; STR: 7.8±1.7kJ/kg) at high speed (>15.5km/h) and high metabolic power (>20W/kg) (MID: 427±63s; 1811±290m; 12.9±1.9kJ/kg; DEF: 332±63s; 1384±304m; 10.3±2.1kJ/kg; STR: 377±69s; 1641±315m; 12.1±2.2kJ/kg) ($p<0.001$, respectively). Less time was spent and less energy was expended at high speed when compared to high metabolic power ($p < 0.001$).
CONCLUSION: Data shows that soccer can be defined as intense and highly intermittent sport and that positional differences for metabolic power and running parameters exist. Generally, midfielders had greater activity profiles compared to the other position groups. Although displacement variables can provide an activity profile for each positional group and can help to understand the different movement patterns, these parameters underestimate the amount of high-intensity activities. Therefore, metabolic power rather than displacement variables should be used for the determination of the metabolic demands of soccer.
References:
1. di Prampero, PE et al. (2005). J Exp Biol, 208, 2809.
2. Polglaze, T et al. (2017). J Sports Sci, 36 (2), 140.
Contact: jan.venzke@rub.de

ASSESSMENT OF ENERGY INTAKE AND ENERGY EXPENDITURE OF ELITE GAELIC FOOTBALLERS DURING A COMPETITIVE WEEK.

O BRIEN, L., COLLINS, K., AMIRABDOLLAHIAN, F.

LIVERPOOL HOPE UNIVERSITY, IT TALLAGHT

INTRODUCTION: Gaelic football is an invasion based field sport that includes repeated bouts of high-intensity activity interspersed with periods of low-intensity activity. Despite the recognised importance of nutrition in optimising performance and health, limited data exists on the dietary intake of elite Gaelic footballers. To develop appropriate nutritional strategies for Gaelic footballer's energy intake (EI) should be reported alongside energy expenditure (EE), during different phases of training and competition. Therefore, the aim of the current study was to investigate energy and macronutrient intake and EE of elite Gaelic football players during a competitive week.
METHODS: Over a 6-day period, leading up a competitive match, dietary intake (self-reported estimated food diary) and EE (Sensewear Pro armband) were recorded in 7 male players from an elite Gaelic football squad.
RESULTS: Mean daily EI (3084 ± 332 kcal) was significantly lower than mean daily EE (3549 ± 411 kcal) ($p = 0.03$). This resulted in a mean daily energy deficit of -465 ± 563 kcal. Mean carbohydrate (CHO) intake was 3.8 ± 0.5 g.kg−1 body mass, protein intake was 2.1 ± 0.4 g.kg−1 body mass, and the fat intake was 1.5 ± 0.1 g.kg−1 body mass. EI and EE over the six assessment days, were reported as days away from match (Game day (GD) -5, -4, -3, -2, -1 and GD +1), EE was significantly greater on GD -5 (training day) than GD -4, -1 ,+1. EI and CHO intake remained constant throughout the week.
CONCLUSION: The mean daily energy intake of elite Gaelic football players was lower than the energy expended during a competitive week. CHO intakes were below that which is currently recommended for players preparing for competition (Thomas et al, 2016). No variation in EI and CHO intake between days was observed. The dietary regimes of the sampled players were inadequate to support optimal performance throughout training and match play. We suggest players should undertake a heavier training load at the beginning of the week with EE exceeding EI to maintain optimal body composition, followed by a decrease in training load and increase in energy and CHO intake leading up to competition in order to optimise glycogen stores.

PERCEPTION OF BREAKFAST RATHER THAN CARBOHYDRATE/ENERGY INTAKE IMPROVES MORNING RESISTANCE EXERCISE PERFORMANCE

NAHARUDIN, M.N., RICHARDSON, H., THOMPSON, T., ADAMS, J., OXINOU, C.1, MARSHALL, C., YUSOF, A., MEARS, S.A., JAMES, L.J.

LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Research examining how pre-exercise nutrition influences performance in resistance-type exercise is sparse, but recently we observed that a typical high carbohydrate breakfast increased repetitions performed during resistance exercise 2 h later, compared to no breakfast (Naharudin et al. Unpublished). Muscle glycogen is an important fuel source during resistance exercise, but is unlikely to limit performance. Thus, given the common preconception that breakfast (i.e. pre-exercise nutrition) is an important determinant of performance the present study investigated whether breakfast might enhance resistance exercise performance via a placebo or metabolic effect.
METHODS: Twenty two resistance trained men (age 22 ± 3 y) who routinely consume breakfast completed 10 repetition maximum (10RM) testing, a familiarisation trial and three experimental trials, during which they consumed one of three breakfasts in a randomised order

105 min before completing a resistance exercise session (warm up, followed by 4 sets of back squat and 4 sets of bench press to failure at 90% 10RM, each separated by 3 min rest). Breakfasts were provided in a volume of 5 mL/kg and were a water-only control (WAT), or carbohydrate (CHO) and placebo (PLA) breakfasts. CHO and PLA breakfasts were eaten with a spoon from a bowl and contained 0.75 mL/kg no-added sugar orange flavouring (~20 kJ), and 0.1 g/kg xanthan gum (~65 kJ) as a thickener, with the addition of maltodextrin (1.5 g/kg) in the CHO trial. Blood samples were taken to measure plasma glucose, insulin, GLP1 and PYY concentrations pre-breakfast (0 min), as well as 45 and 105 min post-breakfast. Subjective appetite (hunger and fullness) was measured at the same time points.
RESULTS: Total repetitions of back squat were greater in CHO (44 ± 10 reps) and PLA (43 ± 10 reps) than WAT (38 ± 10 reps; P<0.001). Total repetitions for bench press were greater in CHO (39 ± 7 reps) than WAT (37 ± 7 reps; P<0.01), with PLA not different from other trials (38 ± 7 reps; P>0.160). There were no performance differences between CHO and PLA. Breakfast suppressed hunger and increased fullness similarly in PLA and CHO relative to WAT (P<0.001). Plasma glucose was elevated at 45 min in CHO (6.04 ± 0.51 mmol/L; P<0.05), returning to baseline at 105 min, but did not change during WAT and PLA.
CONCLUSION: These results demonstrate that breakfast, rather than carbohydrate/energy per se, enhances resistance exercise performance, suggesting that pre-resistance exercise carbohydrate ingestion does not confer any ergogenic effect above that of a placebo. In conclusion, it appears that the perception of consuming breakfast or a pre-exercise meal may act as a placebo to enhance resistance exercise performance, although a potential mediating role of hunger cannot be discounted.

HABITUAL ENERGY AND MACRONUTRIENT INTAKE OF SEMI-PROFESSIONAL FEMALE SOCCER PLAYERS DURING A TYPICAL IN-SEASON WEEK

NAUGHTON, R.J.1, FLEMING, J.A.1, BROWNLEE, T.E.2, CLIFFORD, T.3, HARPER, L.D.1

1: UNIVERSITY OF HUDDERSFIELD ; 2: LIVERPOOL JOHN MOORES UNIVERSITY ; 3: NEWCASTLE UNIVERSITY

INTRODUCTION: Within the last decade competitive female soccer has undergone substantial growth in participation and interest. This has led to more structured training regimes and an increase in competitive match-play during a season. However, little is known about the current energy and macronutrient intakes of these athletes, with guidelines generally derived from literature which has analysed their male counterparts. Of significant concern is ensuring adequate energy intake to help support performance, and more importantly, maintain good health. The aim of the present study is to assess the energy and macronutrient intake from a 6-day period within the in-season.
METHODS: Nine part-time players (22 ± 4 years, 169.3 ± 5.0 cm, 68.1 ± 5.8 kg) from a Scottish Womens Premier League club recorded their dietary intake using a self-recorded written food diary over a period of 6-days during the 2017 in-season. The week was categorised in three separate types of day; training-days (n=3), match-day (n=1), and off-days (n=2). Energy and macronutrient intake for each day was analysed and subsequently compared between day type.
RESULTS: There were no differences between individual days (P>0.05), with a mean energy and macronutrient total intake of; energy 1824 ± 279 kcal; carbohydrate (CHO) 3.0 ± 0.3 g/kg-1/body mass (BM)-1; protein 1.5 ± 0.3 g/kg-1/BM-1; fat 0.9 ± 0.2 g/kg-1/BM-1. Additionally, there was also no effect of day type on nutritional intake (P>0.05), although on match-days a slightly higher CHO intake (3.6 ± 0.5 g/kg-1/BM-1) was observed in comparison to training-days (3.1 ± 0.7 g/kg-1/BM-1) and off-days (2.7 ± 0.7 g/kg-1/BM-1).
CONCLUSION: The data suggests that female soccer players nutritional habits are sub-optimal, with relatively low energy and CHO intake observed throughout the week. Although protein intake is in line with current intake recommendations for athletes (Phillips and Van Loon, 2011). The reported energy intakes on training-days (1912 ± 419 kcal) and match-day (1918 ± 259 kcal) is of particular concern as when combined with prolonged high-intensity soccer exercise (~90 minutes) these reported intakes are likely to result in an energy deficiency. Sustained periods of time within an energy deficiency can result in compromised bone health and irregularities with the menstrual cycle (Loucks, Kiens, and Wright, 2011), and are likely to also negatively affect physical performance. This low energy intake seems mainly due to a relatively low CHO intake. This data may be of interest to coaches and applied sports nutritionists/dietitians working within female soccer.
References: Loucks AB, Kiens B, Wright HH. (2011). J Sports Sci 29(Sup1), S7-S15.
Phillips SM, Van Loon LJ. (2011). J Sports Sci 29(Sup1), S29-S38.

NUTRITION STATUS AND CARBOHYDRATE INTAKE IN RELATION TO TRAINING VOLUME OF 421 YOUNG ELITE GERMAN ATHLETES

VON ANDRIAN-WERBURG, J.1,2, BRAUN, H.1,2, BAUHAUS, H.1,2, THEVIS, M.1,2,3

GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: Young athletes often face the challenge to meet the recommended nutrient and energy intake for sports performance and development. Training demands vary throughout the season wherefore nutrient intake, especially the carbohydrate (CHO) intake, has to be adjusted in respect to training volume and intensity (Burke 2011). The purpose of this study was to investigate the nutritional status in regard to the training demands of young elite German athletes from 28 different sports using a 7-day food record in parallel with a 7-day activity record.
METHODS: A total of 728 young elite athletes (15.4±1.9 yrs) completed the validated food and activity protocol (Koehler et al. 2010). Misreporting was assessed by the ratio of energy intake to energy expenditure and misreported protocols (n=307) were excluded from analysis (Black 2000). The food records of 421 remaining young athletes (15.4±1.9 yrs; 213 females, 207 males) were analyzed concerning energy and macronutrient intake using the German food database (BLS 3.01). Energy expenditure was calculated using predictive equations.
RESULTS: Mean energy intake was 2746±540 kcal/d (females: 2326±385; males: 2972±664) and estimated energy expenditure averaged 2643±630 kcal/d (females: 2442±281; males: 3061±564). Overall macronutrient intake averaged 5.4±1.4 g/kg body weight (BW) CHO, 1.6±0.4 g/kg BW protein and 1.7±0.5 g/kg BW fat. Regarding gender differences and daily training volumes of <1, 1-3h, >3h, CHO intake for the male athletes was 5.2±1.2, 5.7±1.4, 6.1±1.7 g/kg BW and for the female athletes was 5.1±1.1, 5.2±1.3, 6.6±1.7 g/kg BW, respectively. Energy balance for the different training volumes was +6, -104, -228 kcal/d (male athletes) and +7, -147, -127 kcal/d (female athletes).
CONCLUSION: Energy balance and CHO intake recommendations (5-7g/kg BW/d) (Burke 2011) were met, when the average daily training volume was <1h, indicating a reduced training phase. With an increased training volume of 1-3 hours/d, energy and CHO requirements (6 10g/kg BW) (Burke 2011) increase and these were not met by the young male and female athletes. When the average daily training volume increased to >3 hours, energy balance as well as increased CHO requirements were not met by both genders. As a consequence, strategies for young athletes have to be developed to meet nutrient requirements when performing a high training volume.

Sustained periods within negative energy balance can result in severe physiological concerns regarding growth, development, the menstrual cycle and bone health. Young elite athletes need to learn general nutritional and timing strategies according to the individual schedules starting already from a young age in order to be well prepared when training volumes and demands increase with age.
References: Burke LM, Hawley JA, Wong, Stephen HS, Jeukendrup AE. (2011). J Sports Sci, 29 (1), 17-27.
Koehler K, Braun H, De Marees M, Fusch G, Fusch C, Mester J, Schaenzer W. (2010). J Sports Sci, 28 (13), 1435-49.

Oral presentations

AW-PRES01 Award Presentations - GSSI Nutrition Award

DOES MONTMORENCY TART CHERRY JUICE REDUCE MARKERS OF INFLAMMATION DURING PROFESSIONAL RUGBY LEAGUE MATCH-PLAY? A RANDOMISED CROSS-OVER DESIGN

MOREHEN, J., BRADLEY, W., TWIST, C., STEWART, C., MORTON, J., CLOSE, G.
LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Given the unique demands of Rugby League (RL) match-play, muscle damage, inflammation and immediate and prolonged symptoms of fatigue are all inevitable outcomes. Alterations in the structural integrity of tissue following trauma results in a cascaded release of cytokines, including interleukin-6, followed by interleukin-8 and -10, which initiate the programme of skeletal muscle recovery. In an attempt to alleviate markers of inflammation, common nutritional interventions such as ingestion of Montmorency tart cherry juice, are employed pre- and post-match in team sport athletes.
METHODS: In this study, twelve professional RL players from the same team, played in 3 consecutive matches, against 3 different opposition teams from the same league. During match 2 and 3, a randomised cross-over design was implemented with Cherry ActiveTM (CA) and Placebo (PLA). Measures of match-play demands including total minutes played (min), relative match intensity (m.min-1), total contacts (n) and relative contacts (con.min-1) were recorded during all fixtures.
RESULTS: The average full-time IL-6, -8 and -10 concentrations were significantly elevated ($P < 0.05$) versus -48h pre-match, half-time and +48 post-match values (IL-6 = 2.9 ± 2.4 Vs 0.7 ± 0.7, 1.4 ± 0.9 and 0.7 ± 0.5 pg.ml-1, IL-8 = 3.5 ± 1.6 Vs 2.0 ± 1.2, 2.5 ± 1.2 and 2.1 ± 1.0 pg.ml-1, IL-10 = 2.7 ± 2.4 Vs 0.6 ± 0.6, 1.0 ± 0.8 and 0.5 ± 0.5 pg.ml-1. On average 68 ± 19 minutes was played of which 77 ± 5 m.min-1 relative metres were covered by all players across the 3 matches. Additionally, players were involved in 27 ± 12 total contacts and 0.5 ± 0.2 con.min-1.
CONCLUSION: We report no significant beneficial impact with ingestion of CA versus PLA on concentrations of ILs following match-2 and -3. Players who consumed PLA in match-2 displayed lower concentration of ILs versus those who consumed CA, with the opposite seen in match-3. Our data is the first to demonstrate concentrations of ILs across three professional consecutive within season matches in RL. No benefits of consuming CA were evident in this study, and its recommendations as a recovery aid should be reviewed against the benefits of real food.

BLINDED AND UNBLINDED HYPOHYDRATION SIMILARLY IMPAIR CYCLING PERFORMANCE IN THE HEAT

FUNNELL, M.P., JAMES, L.J., MEARS, S.A.
LOUGHBOROUGH UNIVERSITY

INTRODUCTION: A substantial body of evidence suggests that hypohydration ≥2% body mass impairs endurance performance, but a lack of study blinding might confound much of this work, making strong conclusions difficult to draw. Therefore, this study aimed to compare the effects of blinded and unblinded hypohydration on cycling performance in trained cyclists/triathletes.
METHODS: Fourteen men (age 25 ± 5 y; VO2max = 63.3 ± 4.7 mL/kg/min; cycling experience 6 ± 3 y) were pair-matched and assigned to a blinded (B) or unblinded (UB) study group. After familiarisation, subjects completed euhydrated (B-EUH; UB-EUH) and hypohydrated (B-HYP; UB-HYP) trials in the heat (31°C), consisting of a 120 min cycling preload (50% Wmax) and a time trial (TT; ~15 min). During the preload of all trials, a small volume of water (0.2 mL/kg) was ingested every 10 min, with additional water provided during EUH trials to match sweat loss. To blind subjects in the B group, a nasogastric tube was placed in the stomach for both trials and used to provide water in B-EUH, with subjects told the study was investigating different drinks. Blood samples to determine haemoglobin concentration, haematocrit and serum osmolality were drawn pre-exercise, at 60 and 120 min of preload and post-TT. Thirst, GI comfort, RPE, heart rate, core and skin temperatures were also determined.
RESULTS: The preload induced similar (trial*group interaction P=0.895) changes in body mass between groups (B-EUH -0.6 ± 0.5%; B-HYP -3.0 ± 0.5%; UB-EUH -0.5 ± 0.3%; UB-HYP -3.0 ± 0.3%). Furthermore, all variables responded similarly between B and UB groups (trial*time*group interaction P≥0.558), except thirst (P=0.004). Changes typical of hypohydration were apparent in HYP compared to EUH trials by 120 min, including increased heart rate, RPE, serum osmolality and thirst, and decreased plasma volume (trial*time interaction P<0.001), with a trend for an increased core temperature (P=0.071). TT performance was similar between groups (trial*group interaction P=0.710), and was slower with HYP for B (B-EUH 903 ± 89 s; B-HYP 1008 ± 121 s; -11.4%; P=0.001) and UB (UB-EUH 874 ± 108 s; UB-HYP 967 ± 170 s; -10.1%; P=0.013) groups.
CONCLUSION: These results demonstrate that hypohydration of ~3% body mass impairs endurance performance in the heat in trained men, with this decrement in performance similar when subjects are blinded or unblinded to the manipulation of hydration status. Additionally, using intragastric feeding of water during exercise replicates typical physiological and perceptual responses to euhydration/hypoydration. Therefore, this study suggests previous work in this area is not confounded by a lack of study blinding, and at least at ~3% hypohydration, performance impairments are mediated by the associated physiological and perceptual consequences of hypohydration.

INCREASED CONSUMPTION OF NITRATE-RICH VEGETABLES ELEVATES PLASMA NITRATE AND NITRITE CONCENTRATIONS AND REDUCES BLOOD PRESSURE IN HEALTHY YOUNG ADULTS

VAN DER AVOORT, C., VAN LOON, L., HOPMAN, M., VERDIJK, L.

HAN UNIVERSITY OF APPLIED SCIENCES, MAASTRICHT UNIVERSITY MEDICAL CENTER+, RADBOUDUMC NIJMEGEN

INTRODUCTION: Dietary nitrate elicits cardio protective and ergogenic effects. Whereas 'supplementation' with dietary nitrate has mainly been accomplished through the use of beetroot juice, we hypothesized that increased consumption of nitrate-rich vegetables in the habitual diet will elevate plasma nitrate and nitrite concentrations and lower blood pressure.
METHODS: After 1-wk of recording habitual dietary intake, 30 healthy men and women (both n=15; age: 24±6 y; BMI: 22.6±2.4 kg/m2) participated in a randomized cross-over study in which they ingested ~400 mg nitrate at lunch time, provided through nitrate-rich vegetables (NRV) or beetroot juice (BRJ). Both interventions lasted 7 days, with 1-wk washout. Plasma nitrate and nitrite concentrations and resting systolic (SBP) and diastolic blood pressure (DBP) were measured in a fasted state on day 1 and day 8, as well as ~2.5 h after lunch on day 0 (before), and day 1, 4, and 7 of both interventions. Dietary intake was registered throughout both interventions. Data were analyzed using repeated measures ANOVA with time and treatment as within-subject factors. Data are means±SD or median [IQR].
RESULTS: One week of increased NRV consumption resulted in higher vegetable intake (382 [329-450] vs 177 [115-278] g/d; P<0.001), but slightly lower nitrate intake (549 [494-635] vs 683 [632-750] mg/d; P=0.001) when compared with BRJ supplementation. Fasting plasma nitrate concentrations averaged 57±28 µmol/L before intervention and increased with both treatments, with a greater increase in BRJ vs NRV (126±42 vs 84±36 µmol/L; P<0.001). In accordance, plasma nitrate concentrations after lunch were 66±52 µmol/L before intervention and increased with both treatments, but were higher in following BRJ vs NRV consumption (day 1, BRJ: 373±90 vs NRV: 277±134 µmol/L, P<0.001). Fasting plasma nitrite concentrations increased, with no differences between BRJ and NRV consumption (P=0.095). Plasma nitrite concentrations after lunch were 227±86 nmol/L before intervention and increased with both treatments (P<0.001), but were higher in BRJ vs NRV (day 1, BRJ: 560±331 vs NRV: 468±263 nmol/L, P=0.020). Fasting SBP/DBP did not change with both treatments. In contrast, SBP assessed ~2.5 h after lunch was significantly reduced throughout both intervention periods (P=0.001), with no differences between BRJ and NRV (day 1: -5.1±9.5 and -5.3±8.9 mmHg, respectively; P=0.12). Likewise, DBP was reduced (P=0.013) with no differences between BRJ and NRV (day 1: -3.5±6.7 and -2.6±6.9 mmHg, respectively; P=0.23).
CONCLUSION: Daily consumption of ~400 mg dietary nitrate, in the form of nitrate-rich vegetable consumption or beetroot juice supplementation effectively increases plasma nitrate and nitrite concentrations and reduces blood pressure in healthy young adults. We propose that the benefits of dietary nitrate may be achieved through the consumption of a diet rich in vegetables.

THE EFFECTS OF CHRONIC BEETROOT SUPPLEMENTATION ON NITRATE REDUCING BACTERIA IN THE ORAL CAVITY

BURLEIGH, M.C.1, LIDDLE, L.1, MONAGHAN, C.1, MUGGERIDGE, D.J.2, SCULTHORPE, N.1, BUTCHER, J.3, HENRIQUEZ, F.1, EASTON, C.1

1 UNIVERSITY OF THE WEST OF SCOTLAND, HAMILTON, UK . 2 UNIVERSITY OF STRATHCLYDE, GLASGOW, UK. 3 GLASGOW CALEDONIAN UNIVERSITY, GLASGOW, UK

INTRODUCTION: Dietary nitrate (NO3-) supplementation can increase nitrite (NO2-) bioavailability following the reduction of NO3- to NO2- by NO3- reducing symbiotic bacteria in the oral cavity and, in some contexts, improve exercise performance. Whilst the factors that influence the abundance of these bacteria are unclear, data from animal models suggests these are enhanced through additional NO3- in the diet. The purpose of this study was to determine the effects of chronic NO3- supplementation on the oral microbiome of healthy humans.
METHODS: Eleven healthy males (age 30 ± 7 year and body mass 86.9 ± 14.1 kg) consumed 2 x 70 ml shots of NO3- rich beetroot juice (one mid-morning and one mid-evening, ~ 12.4 mmol/day-1) or NO3- depleted placebo for 7 days in a crossover design separated by a minimum of 4 weeks. Blood and saliva samples were collected at the beginning and end of each condition following 30 min of lying supine. Samples were analysed for [NO2-] and [NO3-] using gas-phase chemiluminescence. The posterior dorsal surface of the tongue was sampled for bacteria for 16s rRNA gene sequencing of the v3-v4 region. Quality filtered sequences were clustered de novo and binned into operational taxonomic units based on 97% identity using Qiime software. Taxonomy was assigned using the RDP classifier trained to the GreenGenes database (October 2013 release).
RESULTS: NO3- supplementation significantly altered NO3- reducing bacteria; Neisseria subflava were increased (from 1.9% ± 2.2% to 8.0% ± 4.9%, P < 0.001), but Prevotella melaninogenica were decreased (from 24.9% ± 11.9% to 11.6% ± 7.5%, P = 0.001). Neisseria subflava were also significantly increased in the placebo condition but to lesser extent (from 1% ± 1.1% to 3.2% ± 2.9%, P = 0.008). There were no significant changes in any other NO3- reducing bacteria all (P > 0.05). Saliva and plasma [NO2-] and [NO3-] were significantly elevated after 7 days NO3- supplementation (all (P < 0.05) but not altered following placebo intervention (all P > 0.05).
CONCLUSION: We demonstrate that the oral microbiome can be altered through consumption of NO3- rich beetroot juice with increases in Neisseria subflava and decreases in Prevotella melaninogenica. These results are interesting given that an altered microbiome will alter NO3- reduction capacity and may consequently have effects on performance. In addition, given that Neisseria subflava are non-pathogenic and Prevotella melaninogenica are commonly associated with periodontitis and dental caries, these data further support the notion that NO3- supplementation may have benefits to health.

POST-EXERCISE COOLING IMPAIRS THE POSTPRANDIAL MUSCLE PROTEIN SYNTHETIC RESPONSE TO PROTEIN INGESTION

FUCHS, C.J., KOUW, I.W.K., CHURCHWARD-VENNE, T.A., SMEETS, J.S.J., SENDEN, J.M., VAN MARKEN LICHTENBELT, W.D., VERDIJK, L.B., VAN LOON, L.J.C.

MAASTRICHT UNIVERSITY

INTRODUCTION: Protein ingestion and cooling are strategies employed by athletes to improve post-exercise recovery and, as such, to facilitate muscle reconditioning following exercise. However, whether post-exercise cooling affects postprandial protein handling and subsequent muscle protein synthesis rates during recovery from exercise has not been studied. Therefore, the aim of this study was to assess the impact of post-exercise cooling on postprandial muscle protein synthesis rates during recovery from resistance-type exercise.
METHODS: Twelve healthy, male adults (age: 21±1 y, BMI: 22.6±0.6 kg/m2) performed a single session of resistance-type exercise followed by water immersion of both legs for 20 min. One leg was immersed in cold water (8 °C: CWI) while the other leg was immersed in thermoneutral water (30 °C: CON). After water immersion, a beverage containing 20 g intrinsically L-[1-13C]-phenylalanine and L-[1-13C]-

leucine labelled milk protein with 45 g of carbohydrates was ingested. In addition, primed continuous L-[ring-2H5]-phenylalanine, L-[ring-2H2]-tyrosine and L-[1-13C]-leucine infusions were applied, with frequent collection of blood samples and muscle biopsies to assess myofibrillar protein synthesis rates in vivo over a 5 h recovery period. Skin and muscle temperature were measured throughout recovery. Paired samples t-tests were used to determine differences in myofibrillar protein synthesis rates and myofibrillar protein-bound L-[1-13C]-phenylalanine enrichments between treatments (CWI vs CON). A two-factor (treatment x time) repeated-measures ANOVA was performed for the analysis of skin and muscle temperature. Data represent means±SEM.
RESULTS: Muscle temperature was lower immediately after water immersion in CWI compared to CON (30.0±0.5 vs 34.9±0.2°C, respectively: P<0.001). Post-exercise myofibrillar protein synthesis rates based upon L-[1-13C]-leucine were lower in CWI compared to CON (0.058±0.003 vs 0.072±0.005%/h, respectively; P=0.024). Similar results were found for L-[ring-2H5]-phenylalanine. Incorporation of dietary protein-derived L-[1-13C]-phenylalanine into myofibrillar protein was significantly lower in CWI compared to CON (0.016±0.002 vs 0.021±0.002 MPE; P=0.016).
CONCLUSION: Cold water immersion during recovery from resistance-type exercise attenuates the postprandial rise in myofibrillar protein synthesis rates. Post-exercise cooling lowers the capacity of the muscle to use dietary protein-derived amino acids for de novo myofibrillar protein accretion during subsequent recovery in healthy young males.

Oral presentations

OP-PM07 LACTATE and ANAEROBIC WORK

METABOLIC AND PERFORMANCE-RELATED CONSEQUENCES OF EXERCISING AT AND SLIGHTLY ABOVE THE MAXIMAL LACTATE STEADY STATE

IANNETTA, D., INGLIS, E.C., PASSFIELD, L., MURIAS, J.M.
UNIVERSITY OF CALGARY

INTRODUCTION: The maximal lactate steady state (MLSS) represents the highest intensity of exercise at which overall metabolic stability can be preserved. However, the physiological and performance-related consequences of exercising only 10 W above this intensity are unknown.
METHODS: In this study, eleven trained men performed: i) a ramp-incremental (RI) test; ii) two to three 30-min constant-power output (PO) cycling exercise trials to determine the power output at MLSS (MLSSp), followed by a time-to-exhaustion ride 3 min after; iii) a 30-min constant-load cycling exercise at 10 W above MLSS (MLSSp+10) followed by a time-to-exhaustion similar to the above described; iii) a baseline time-to-exhaustion test with no prior exercise. The time-to-exhaustion trials were performed at 80% of the peak-PO recorded at the end of the RI test. Pulmonary O2 uptake (u̇O2) and blood lactate concentration ([La-]b) as well as local muscle O2 extraction ([HHb]) and muscle activity (EMG) of the vastus lateralis (VL) and rectus femoris (RF) muscles were measured during the testing sessions.
RESULTS: The PO at MLSSp was 231±49 W. The 9̇O2 at MLSSp and MLSSp+10 was 3.31±0.53 L·min-1 and 3.45±0.52 L·min-1. During MLSSp+10 there was a greater increase in ventilatory responses and EMG activity, along with a non-stable [La-]b response throughout the trial (P<0.05). The [HHb] signal of VL during MLSSp achieved similar (stable) values as during MLSSp+10, and did not show any further increase during the time-to-exhaustion trials (P>0.05). This ceiling in the [HHb] signal of VL occurred at a metabolic rate corresponding to that associated to the beginning of the plateau in the signal observed during the RI test (P>0.05). On the other hand, the [HHb] signal of RF was stable only during MLSSp, but progressively increased during MLSSp+10, and eventually achieved its apex during the subsequent time-to-exhaustion trials (P<0.05). The time-to-exhaustion performance was decreased after exercising at MLSSp by 37.3% (±16.4) compared to the baseline condition, and by an additional 41.2% (±16.4) after exercising at MLSSp+10 (P<0.05). Finally, the p̃O2peak value recorded at the end of the time-to-exhaustion performed after MLSSp+10 trial was 7.2% (±5.7) lower than those achieved during the RI and the other time-to-exhaustion tests (P<0.05).
CONCLUSION: In summary, this is the first study demonstrating that that the metabolic disturbances associated with exercising only 10 W above MLSS disproportionally reduce maximal exercise performance capacity. Additionally, the current study is the first showing that local mechanisms regulating the delivery and utilization of O2 in VL and RF muscles seems to be dependent upon a specific metabolic rate regardless of the exercise mode employed. The implications of these regional differences is that some muscle areas may contribute more than others to the elevation of [La-]b and other metabolites (e.g. H+, Pi) linked to the progressive loss of metabolic stability and increased fatigue accumulation.

VALIDATION OF LACTATE MINIMUM POWER TESTING IN ELITE CYCLISTS

DAUSIN, C.1, CAREY, C.C.2, GEUNS, W.1, HESPEL, P.1
1 EXERCISE PHYSIOLOGY RESEARCH GROUP AND BAKALA ACADEMY ATHLETIC PERFORMANCE CENTRE, K.U. LEUVEN AND 2 FACULTY OF SCIENCE AND HEALTH, DUBLIN CITY UNIVERSITY.

INTRODUCTION: Physiological profiling of elite endurance athletes should include determination of FATmax, maximal lactate steady state (MLSS) and VO2max. To improve determination of these three parameters in a single test session, we used the "lactate minimum power (LMP)" concept proposed by Tegtbur et al. in 1993(1). This procedure involves a maximal exercise bout to first substantially elevate blood lactate concentration, where after a submaximal incremental exercise bout, gradually shifts blood lactate balance from net lactate clearance to net accumulation. The nadir of the U-shaped blood lactate curve so obtained is believed to identify MLSS exercise intensity. In the current study we aimed 1) to evaluate the validity of LMP to determine MLSS, and 2) to develop a practical test protocol to precisely determine FATmax, MLSS and VO2max in a single laboratory exercise session in elite cyclists.
METHODS: Ten male well-trained cyclists (VO2max 61±6ml•kg-1•min-1) completed a series of tests on different days: a long maximal incremental exercise test (100W + 40W per 8 min); an LMP protocol; 2 or 3 constant-load MLSS tests. During the maximal incremental test FATmax was determined as the exercise intensity corresponding to a +0.5mmol•l-1 blood lactate increment above baseline, and MLSS was estimated by the lowest workload eliciting a >1mmol•l-1 rise from min 4 to 8. The LMP protocol started with a long incremental exercise phase until FATmax was determined. Immediately followed by a VO2max ramp (100W +25W per 30sec) to increase blood lactate concentration. Upon exhaustion workload was reduced to 85% of the predicted MLSS, where after workload was increased by 5% of predicted MLSS per 3 min till volitional exhaustion. Blood lactate was measured at the end of each step. MLSS in the constant-load tests

was taken as the highest workload, which could be maintained for 30min with a constant (Δ ≤ 1mmol•l-1) blood lactate level between min 10 and 30.
RESULTS: MLSS power output determined from the constant-load tests was 265±38W. MLSS prediction from the LMP test was 270±37W (p>0.05), and LMP was closely correlated with the true MLSS (r=0.93, p<0.05). VO2max was slightly higher in the short ramp protocol than in the long incremental exercise test (63.9±7.1 vs. 61.4±6.9 ml•min-1•kg-1, p<0.05).
CONCLUSION: To conclude, the LMP test including a VO2max ramp, yields valid measurements of both MLSS and VO2max.
REFERENCE:
1) Tegtbur U, Busse MW, Braumann KM. Med Sci Sports Exerc 1993;25(5):620–7.
Contact- christophe.dausin@kuleuven.be

TISSUE SATURATION INDEX AND LACTATE THRESHOLD

RALEIGH, C., DONNE, B., FLEMING, N.

TRINITY COLLEGE DUBLIN

INTRODUCTION: Tissue saturation index (TSI) measured via near infrared spectroscopy (NIRS) to assess training intensity and prescribe training has become popular amongst athletic populations. Delivery of O2 to working musculature increases with intensity but at upper limits reliance on anaerobic metabolism increases. TSI assessing a balance between O2 delivery and utilisation could, in theory, determine the relative contribution of anaerobic metabolism at a given intensity. We have previously shown that a breakpoint in TSI measured using a portable NIRS device (MOXY) cannot be used as a proxy estimate of lactate threshold (Raleigh et al. 2018). Currently, minimal evidence regarding association between MOXY and previously validated "gold standard" devices (Hamamatsu NIRO-200NX) exists. Although Hamamatsu is widely used in clinical scenarios, studies have determined O2 saturation in exercising tissue (Wittekin et al. 2012). We hypothesised that computed TSI thresholds using both NIRS devices should not differ significantly, as both theoretically measure the same variable.
METHODS: This pilot study assessed graded incremental cycling to volitional exhaustion in competitive male cyclists and triathletes (n=13). TSI data were continuously measured from left (Hamamatsu) and right (MOXY) vastus lateralis muscles, respectively. Cardio-respiratory variables were measured breath by breath, and blood lactate was assessed during each incremental stage. A segmented linear regression model, minimising squared sum of residuals, determined thresholds (TSIT) for both NIRS devices, and ventilatory breakpoint for VEVO2 (VT), lactate threshold was determined using Dmax (Cheng et al. 1992). Data were analysed using a repeated measures ANOVA, limits of agreement (95% LoA) computed and correlation assessed using Pearsons and interclass correlation coefficients (ICC).
RESULTS: ANOVA revealed that significant differences existed between computed thresholds (F=3.87, P=0.03). A significant difference existed between TSIT detected by Hamamatsu and Dmax (276±37 vs. 249±25 W, P<0.05, ES=0.85). All other comparisons were non-significant, however, correlation between thresholds were poor, especially comparing Hamamatsu and MOXY TSIT data (r = 0.52, ICC = 0.52, 95% LoA = 79 to -64 W).
CONCLUSION: Poor correlation between thresholds further consolidates previous work demonstrating that VT or TSIT are not suitable proxy measures for detecting an aerobic anaerobic transition. Current data further demonstrate that neither a novel portable NIRS device (MOXY) or gold standard NIRS device (Hamamatsu) are comparable, or suitable, for detecting an aerobic anaerobic transition in comparison to lactate data.

THE COMPARISON OF ANAEROBIC THRESHOLD AND MAXIMAL OXYGEN UPTAKE MEASURED BY TRADITIONAL MAXIMAL OXYGEN UPTAKE TEST AND MODIFIED INCREMENTAL STEP TEST .

LO, K.K., CHAN, Y.Y., IP, L.F.

HONG KONG SPORTS INSTITUTE

INTRODUCTION: The aim of traditional maximal oxygen uptake test (TVO2max) is determine the maximal aerobic capacity (VO2max) and the aim of incremental stepwise test with blood sampling is to determine the anaerobic threshold (AT) of an athlete. In order to obtain both the AT and VO2max accurately by a single test, a modified stepwise maximal oxygen uptake test (Step VO2max) were performed and compared.
METHODS: Subjects: Eighteen rowers from Chinese University of Hong Kong Women Rowing Team were recruited as subjects (age 19.9•0.1, height 166.3•0.1cm and weight 57.7•0.5kg). Subjects conducted TVO2max and Step VO2max tests in a randomized sequence. TVO2max test consisted of ergo on rowing machine with 100W for 3 mins, followed by a 15W increase every min until exhaustion. StepVO2max test consisted of stepwise and maximal parts, with four mins rest between two parts. Stepwise part consisted ergo on rowing machine with 3 mins/stage starting from 100W, with an increase of 15W/stage and 30 s rest between stage, until post-stage blood lactate exceeded 4 mmol and increased more than 1 mmol when compared with the previous stage. Maximal part started with power of the stage of stepwise part at or below anaerobic threshold. There was an increase of 15W/min afterwards until exhaustion.
RESULTS: Average power and VO2max values at maximum exercise intensity in StepVO2max and TVO2max are 198.7, 201.1 W and 46.01, 46.27 ml/kg/min, respectively. No significant difference were found in average power and VO2max values between two testing methodologies. Average power in stepVO2max and TVO2max at AT exercise intensity are 149.4 and 149.9W respectively. There are no significant difference in average power between two testing at anaerobic threshold. However, the TVO2max has significant lower oxygen consumption (VO2) value at AT than StepVO2max (p<0.05).
CONCLUSION: There were negligible differences in measuring VO2max and power in both testing methodologies. No difference in measuring power at anaerobic threshold exercise intensity. However, there are detectable difference in VO2 value at AT because of buffering system of lactate acid. The study has established a single test for both maximum and anaerobic threshold exercise intensity. The modified test is less time consuming, with additional lactate reference parameters for coaches to develop individualize training programme in the future.
References: 1. Achten J. and Jeukendrup A.E., (2003). Sports Med, 33(7), 517-538.
2. Borg G.A. (1982). Med Sci Sports Exerc, 14(5), 377-381.
3. Steinacker, J. M. (1993). Evaluation, 47(57), 60-62.
4. Jurišić, D., Donadić, Z., & Lozovina, M. (2014). Acta Kinesiologica 8(2), 55-61.
5. Stevens, A. W., Olver, T. T., & Lemon, P. W. (2015). J of S & C Research, 29(1), 22-28.

Oral presentations

OP-BN02 TISSUE MECHANICS

SEASONAL CHANGES IN PLANTAR FASCIA THICKNESS IN DIVISION II BASKETBALL PLAYERS

KRUMPL, L., CANNAVAN, D.

SEATTLE PACIFIC UNIVERSITY

INTRODUCTION: The plantar fascia (PF) is a sheath of connective tissue on the bottom of the foot and its chronic inflammation may lead to plantar fasciitis. However, there is limited research on the underlying factors causing a PF injury, or indeed if these changes occur in sports that place excessive demand on the plantar fascia (for example plyometric activities). Thus, the purpose of this study was to evaluate the relationship between specific anatomical properties (foot arch height, hamstring flexibility, and ankle mobility), and PF thickness in Division II Basketball Players throughout the season.
METHODS: Twenty eight participants took part in this study, (13 males and 15 females; mean ± SD; age: 20.7 ± 0.03 y; body mass: 79.5 ± 12.8 kg; height: 184.5 ± 9.5 cm). Data were collected on three separate occasions over the course of a Division II basketball season; season start (first 2 weeks), season end (last 2 weeks), and two weeks post season. The measurements occurred in this order: 1) PF thickness measurement using B-mode ultrasonography, 2) foot arch height measurement using the Arch Height Index measurement system, 3) hamstring flexibility measurement via the active knee extension test, and 4) ankle joint passive range of motion measurement using a Biodex isokinetic dynamometer. All subsequent testing sessions occurred at the same time of day (i.e. am or pm).
RESULTS: A repeated measures ANOVA revealed significant changes in PF thickness throughout the season ($p < 0.001$, eta-squared = 0.62). Follow-up tests revealed a significant increase in PF thickness from start to end of the season ($p < 0.001$; mean difference: 0.4 mm), and a significant decrease from end to post-season ($p < 0.01$; mean difference: -0.57 mm). No significant difference was found between start and post-season values (mean difference: 0.16). Additionally, Pearson correlation revealed a significant ($p < 0.05$), and moderately strong, negative ($r = -0.61$) relationship between ankle mobility and PF thickness in males, but not females. There were no significant interactions for arch height index and hamstring flexibility.
CONCLUSION: To the author's knowledge, this is the first study that has demonstrated changes in PF thickness throughout a Basketball season. The significant increase in PF thickness was similar to cut-off values that clinicians use to diagnose plantar fasciitis. Although the players in this study remained asymptotic, it could be that if the season were longer plantar fascia injuries may occur. Of significant interest, the PF thickness returned to baseline levels two weeks post season. The correlation between PF thickness and ankle mobility suggests that limited ankle mobility may place undue tissue strain on the PF, especially under high intensity situations leading to plantar fascia type injuries.

MUSCLE AND NERVE STIFFNESS CHANGES FOLLOWING A 12-WEEKS OF SPECIFIC STRETCH TRAININGS

ANDRADE, R.J., FREITAS, S.R., HUG, F., LE SANT, G., LACOURPAILLE, L., GROSS, R., NORDEZ, A.

LABORATORY « MOVEMENT, INTERACTIONS, PERFORMANCE »

INTRODUCTION: Although it is widely accepted that chronic stretch training induces an increase in maximal joint range of motion (ROM), literature has demonstrated that these interventions do not alter muscle-tendon unit mechanical properties (Weppler & Magnusson, 2010). However, three important limitations of earlier studies may explain the lack of mechanical adaptations following chronic stretching interventions: (i) studies implemented relatively short stretch training periods; (ii) the mechanical properties are typically inferred from global passive torque-angle relationships, but stretching may load specific muscles' regions (Le Sant et al., 2017); and (iii) non-muscular structures such as peripheral nerves may play an important role on maximal ROM (Nordez et al., 2017). Thus, the aim of this study was to provide a deeper understanding of muscle and peripheral nerve mechanical adaptations following a long chronic stretching protocols targeting preferentially either muscular or nerve structures.
METHODS: Participants were randomly assigned to one of three interventions groups: sciatic nerve stretching (sciatic STR, n=21), triceps surae stretching (muscle STR, n=21), or control (CON, n=18). Sciatic STR and muscle STR groups were enrolled in a 12-weeks stretch training protocol (duration of 7.5 h over the 12-weeks training period). CON group was instructed to not enroll in any specific flexibility training. Pre- and post-training testing sessions were performed to assess: (i) the maximal dorsiflexion ROM; (ii) ankle passive torque; and (iii) the mechanical properties of triceps surae and sciatic nerve during slow passive ankle rotations. Specifically, passive maximal dorsiflexion ROM was assessed with the hip flexed (HIP-flexed, knee fully-extended) and neutral (HIP-neutral - 0°, knee fully-extended). Localized stiffness of triceps surae (gastrocnemius medialis, gastrocnemius lateralis and soleus) and sciatic nerve was estimated, at different regions of each structure, using ultrasound shear wave elastography.
RESULTS: Sciatic STR induced an increase in ankle ROM in both HIP-neutral and HIP-flexed conditions (+3.8±4.9°; +8.0±5.2°, respectively; both $P < 0.001$), and a decrease in sciatic nerve stiffness (-19.1±15.3%; $P < 0.0001$) in the absence of any change in triceps surae stiffness (all $P = 1$). Muscle STR induced an increase in ankle ROM in HIP-neutral position (+9.4°±3.8°; $P < 0.0001$) and a decrease in muscle stiffness (all $P < 0.03$), without changes sciatic nerve stiffness (all P=1). Ankle passive torque at a given angle decreased after muscle STR ($P = 0.03$) but remained unchanged following the sciatic STR ($P = 1$).
CONCLUSION: The present study shows that muscle-directed and nerve-directed chronic stretching interventions are both effective, compared to control, at increasing the maximal ROM. Also, this study demonstrates that the localized stiffness of both muscle and nerve structures can be selectively decreased with specific stretching that preferentially loaded each structure.

DO TRAINING-INDUCED CHANGES IN AT STIFFNESS AFFECT MUSCLE-TENDON BEHAVIOUR DURING LANDING?

WERKHAUSEN, A.1, ALBRACHT, K.2,3, CRONIN, N.J.4, PAULSEN, G.5, BOJSEN-MOELLER, J.1, SEYNNES, O.R.1

1: NSSS , 2: GSU , 3: UAS , 4: JYU , 5: OLT

INTRODUCTION: During rapid decelerations, tendons act as mechanical buffers against rapid stretches of the muscle fibres, allowing safer energy dissipation (2). A link between tendon stiffness, muscle contractile behaviour and mechanical efficiency has been shown in models of locomotion (1) and may apply to tasks requiring energy dissipation. Hence, this study aimed to examine the influence of training-induced stiffening of the Achilles tendon (AT) on triceps surae muscle-tendon (MTU) behaviour during a landing task. We hypothesized that increased stiffness would reduce the buffering effect of the AT.

METHODS: Twenty-one subjects were assigned to a 10-week resistance training programme consisting of single-leg isometric plantarflexions (n=11) or to a control group (n=10). Testing was performed at baseline and after training. Plantarflexion force, AT strain and stiffness were measured with a dynamometer and a combination of ultrasound and kinematics data. Synchronised ultrasound, kinematics and kinetics data were used to determine joint mechanics and the length of gastrocnemius (GM) and soleus (SOL) fascicles, AT and MTU during a step-landing task. Pre- to post-training differences between groups were tested for variables of interest with 2-way repeated-measures ANOVAs.
RESULTS: After training, an increase in Achilles tendon stiffness (18%) and plantarflexion strength (15%) in the training group did not alter tendon strain during landing. However, GM fascicles were offset to a longer length at touch down (8%), and fascicle lengthening and velocity were reduced in the training group by 27% and 21% respectively, while lengthening and negative work produced by the GM MTU did not change. These changes were not observed for SOL when accounting for the variation of the task execution between tests. No statistical changes were found in the control group.
CONCLUSION: Training-induced increases in AT stiffness and strength did not alter the tendon buffering action against large fascicle strain during rapid deceleration. On the contrary, GM muscle fascicle lengthening and lengthening velocity were reduced after training. Changes in fascicle mechanics could not be linked to different AT strain, perhaps because of adaptations only affecting AT strain or stiffness regionally (i.e. proximally to the free tendon), or because of changes affecting other elastic elements. Future studies are required to provide insight into the mechanisms underpinning these observations and their influence on energy dissipation.

PATELLAR TENDON STIFFNESS IS NOT REDUCED DURING PREGNANCY

BEY, M.E.1,2, ARAMPATZIS, A.1,2, LEGERLOTZ, K.1,2

HUMBOLDT-UNIVERSITAET ZU BERLIN

INTRODUCTION: The beneficial effects of exercise during pregnancy are well accepted. However, pregnant women are often told that hormonal changes in pregnancy would make their ligaments and tendons more compliant, increasing the risk to suffer from connective tissue injuries and falls when exercising. While the compliance of the ligaments of the pelvis increases to facilitate childbirth (Young, 1940), to our knowledge no study has ever investigated the mechanical properties of human tendons in different stages of pregnancy. Our longitudinal study therefore investigates the mechanical properties of the patellar tendon in different stages of pregnancy and in non-pregnant controls.
METHODS: 19 pregnant women (30±4 years) and 11 non-pregnant controls (28±3 years) performed 5 slow maximal isometric ramp contractions of the knee extensors with a resting knee joint angle of 90° to determine the patella tendon stiffness and maximum strain as well as the muscle strength of the knee extensors using dynamometry, ultrasound, kinematic and electromyographic measurements (Arampatzis et al., 2004; Mademli et al., 2004). The measurements were conducted in the 16±4th (EP) and in the 30±2th week of pregnancy (LP) and 28±4 weeks after delivery (PP).
RESULTS: Patellar tendon stiffness (EP: 1140.1 ± 224.5 N/mm; LP: 1170.5 ± 288.6 N/mm; PP: 1250.8 ± 209.1 N/mm; controls: 1147.5 ± 321.4 N/mm) and the achieved maximum strain during the knee extension contractions (EP: 6.8 ± 1.6 %; LP: 6.5 ± 1.7 %; PP: 6.8 ± 2.2 %; controls: 7.1 ± 1.5 %) did not change during pregnancy. Furthermore patellar tendon stiffness and maximum strain of the pregnant women did not significantly differ from non-pregnant controls. Similarly, the knee extensor moment normalized to body mass did not significantly change during pregnancy and did not significantly differ from non-pregnant controls (EP: 2.41 ± 0.7 Nm/kg; LP: 2.29 ± 0.7 Nm/kg; PP: 2.45 ± 0.6 Nm/kg; controls: 2.32 ± 0.6 Nm/kg).
CONCLUSION: Our data provide evidence that both patellar tendon stiffness and muscle strength are not affected by pregnancy. This is in agreement with previous findings in pregnant rats, detecting no change in strain or modulus of elasticity of the musculus digiti quinti tendon (Rundgren, 1974). While the compliance of some ligaments might change during pregnancy, the assumption that tendons are also subjected to the same change is not correct. As a consequence pregnant women should not be cautioned about tendon injuries when exercising.
REFERENCES
Arampatzis et al. (2004). Clin Biomech, 19(3):277-83
Mademli et al. (2004). J Electromyogr Kinesiol, 14(5):591-7
Rundgren (1974). Acta Physiol. Scand. Suppl. 417: 1–138.
Young (1940). J. Obstet. Gynecol. 47(5): 493-524
CONTACT: marie.elena.bey@hu-berlin.de

COLLAGEN PEPTIDES IMPROVE FUNCTIONAL ANKLE PROPERTIES IN SUBJECTS WITH CHRONIC ANKLE INSTABILITY

DRESSLER, P., GEHRING, D., ZDZIEBLIK, D., OESSER, S., GOLLHOFER, A., KÖNIG, D.

UNIVERSITY OF FREIBURG

INTRODUCTION: Following an initial ankle sprain it is not unlikely that chronic ankle instability (CAI) will develop. CAI is associated with impaired perceived functional and mechanical properties of the ligaments. Nutritional supplementation with collagen peptides has been shown to improve the functional and mechanical properties of the connective tissue. The purpose of this study was to investigate the effectiveness of specific collagen peptide supplementation (SCP) to improve ankle stability in athletes with CAI.
METHODS: 50 male and female athletes with CAI completed a randomized, double-blinded and placebo-controlled study with a daily oral administration of either 5 g SCP or 5 g placebo (Maltodextrin) over a period of six months. Both, the Cumberland Ankle Instability Tool (CAIT) and the German version of the Foot and Ankle Ability Measure (FAAM-G) were used to measure the subjective perceived function of the ankle. Additionally, the mechanical stability was determined by measuring the ankle stiffness by an ankle arthrometer. Finally, a three-month follow-up was performed.
RESULTS: ANOVA analysis indicated that the subjective ankle stability was improved in both the CAIT ($p < 0.001$) and the FAAM-G ($p < 0.001$) following SCP supplementation compared with placebo. No significant changes between the groups were detected in the results of the ankle arthrometer. After six month the subjective report of the ankle stability function significantly improved and the three month follow-up revealed a significant decline in the number of ankle joint injuries ($p < 0.05$).
CONCLUSION: These data support the concept that specific collagen peptide supplementation in athletes with chronic ankle instability results in significant improvements in subjective perceived ankle stability. The reduction in the re-injury rate of ankle sprains in the follow-up period suggests that these findings have clinical relevance.

ACHILLES TENDON LENGTH CHANGE DURING STAIR ASCENT IN YOUNG AND OLDER ADULTS

JOHANNSSON, J.1, JAKOBI, J.2, DUCHATEAU, J.1, BAUDRY, S.1

1: UNIVERSITÉ LIBRE DE BRUXELLES ; 2: UNIVERSITY OF BRITISH COLUMBIA OKANAGAN

INTRODUCTION: During walking, the Achilles tendon is responsible for most of the change in the muscle-tendon complex (MTC; Fukanaga et al. 2001). The greater ankle moments observed during stair ascent, (Reeves et al. 2009) may induce different results in the contribution of the Achilles tendon in MTC changes, especially in older adults that experienced a decrease in Achilles tendon stiffness (Stenroth et al. 2012). Therefore, the aim of this study was to assess the Achilles tendon length change during stair ascent in young and older adults.
METHODS: The muscle-tendon junction of the gastrocnemius lateralis was recorded with ultrasonography in 16 young (25.1±3.3yr) and 18 older (70.4±5.2yr) adults to assess Achilles tendon length during prone, upright standing and during stair ascent through expressions of tendon length changes as a proportion of the total MTC length estimated from an anatomical model (Grieve et al. 1978). The gait cycle of stair ascent was divided into a quiet standing and three independent foot placement phases that occurred over three stairs. Electromyogram (EMG) of soleus, gastrocnemius lateralis and tibialis anterior were also measured during standing and stair ascent. Achilles tendon stiffness was measured by using the force-length relation obtained with ultrasonography from a series of submaximal voluntary contractions in the prone position.
RESULTS: Achilles tendon stiffness was greater in young (157.5±57.2 N•mm-1) than older adults (95.6±38.5 N•mm-1, $p<0.001$). Achilles tendon length in prone position was 50.8±7.6% and 48.5±4.4% in older and young adults ($p=0.34$), respectively, and was significantly greater in older (58.7±4.0%) than young (50.9±5.5 %; $p=0.04$) during standing. During stair ascent, Achilles tendon length remained greater in older than young adults ($p<0.01$) but underwent greater elongation in young (1.3 ± 1.6 %) compared to older adults (0.3 ± 1.0 %; $p<0.01$). EMG of all three muscles were greater in older compared to young during standing and stair ascent ($p<0.05$).
CONCLUSION: Tendon stiffness in-part determines tendon length changes under loading. Results from this study suggest that in older adults, a less stiff tendon and greater EMG may contribute to change the gait strategy in older adults to safely ascend stairs (Reeves et al. 2009).
REFERENCES:
Fukunaga T et al. Proc Biol Sci. 268(1464):229-33; 2001
Grieve DW et al. Biomechanics-VI-A. 405-12; 1978
Lichtwark G and Wilson A. J Biomech. 40(8):1768-75; 2007
Stenroth L et al. J Appl Physiol (1985). 113(10) :1537-44; 2012
Reeves ND et al. J Electromyogr Kinesiol. 19(2):57-68; 2009
Ms Johanna Johannsson is supported by a grant of the National Research Fund of Luxembourg
CONTACT: jjohanns@ulb.ac.be

Oral presentations

OP-MI04 Women in sport

MUSCLE FUNCTION OVER THE MONOPHASIC ORAL CONTRACEPTIVE CYCLE TAKING INTO ACCOUNT DIFFERENT LEVELS OF ANDROGENICITY

JANSE DE JONGE, X., THOMPSON, B., BARBA, L., ALMAJAWI, A., SCULLEY, D.

UNIVERSITY OF NEWCASTLE, AUSTRALIA

INTRODUCTION: There has been a dramatic increase in the number of females participating in sport and exercise both recreationally and at an elite level. Oral contraceptives (OC) are a popular choice for birth control both in the general community and amongst female athletes. The monophasic OC is the most common type and generally follows a pattern of 7 days of non-active pills followed by 21 days of active hormone pills. The active hormones in the combined monophasic OC suppress the production of endogenous female sex hormones through a combination of ethinyl estradiol and progestin. There are different types of progestin, which may have low or high levels of androgenicity. Endogenous estrogen and progesterone are known to affect muscle strength, however, it is unclear if the synthetic hormones and the level of androgenicity of the progestins within OC affect muscle performance. Therefore, this study aimed to assess aspects of muscle function in low and high androgenicity OC users at three different time points over the OC cycle.
METHODS: Fourteen moderately active females aged 18-29 years, all taking a combined monophasic OC with high androgenicity (n=8) or low androgenicity (n=6), were tested during the non-active pill phase, the first week of the active OC and the last week of the active OC. Participants were tested for maximal isometric quadriceps strength with superimposed electrical stimulation, peak force response to an electrically evoked twitch of the quadriceps, handgrip strength and isokinetic quadriceps fatiguability. The isokinetic fatigue test involved 60 maximal knee extensions at a speed of 240 degrees/second.
RESULTS: Repeated measures ANOVA showed no significant differences between the time points of testing over the OC cycle for any of the muscle function variables measured. These findings were the same in both the low and high androgenicity groups.
CONCLUSION: The results suggest that exogenous hormone administration through high or low androgenicity monophasic combined OC use does not affect the muscle function parameters measured in this study. It is therefore proposed that muscle function testing in females can be performed at any time point throughout the OC cycle. Future research with larger participant numbers is recommended to further investigate potential acute effects of the different types of exogenous hormone administration through OC on muscle function characteristics. A comparison of muscle function between females taking different types of OC and those with a natural menstrual cycle is also recommended.

INFLUENCE OF MENSTRUAL CYCLE ON MUSCLE FUNCTION AND JUMP PERFORMANCE: IRONFEMME PROJECT

ROMERO-PARRA, N., PEINADO, A.B., ALFARO-MAGALLANES, V.M., RAEL, B., ROJO-TIRADO, M.A., BENITO, P.J., BENÍTEZ, J.A., GUTIÉRREZ-SUÁREZ, A., CUPEIRO, R.

FACULTY OF PHYSICAL ACTIVITY AND SPORT SCIENCE . UNIVERSIDAD POLITÉCNICA DE MADRID

INTRODUCTION: Female exhibit changes during menstrual cycle that may affect different sport performance variables. The decrease in performance of counter movement jump (CMJ) has been related with muscle damage and loss of muscle function after strength training.

Few studies have investigated these effects after an intense strength training in women (1). Therefore, the purpose of this study was to evaluate the influence of hormonal fluctuation along the menstrual cycle in lower-limb muscle function and damage in female athletes.
METHODS: Five eumenorrheic women (age 30±4 years, height 164±5.2 cm, body mass 60±6.3 kg) experienced in resistance training, performed a 1RM test to determine their maximal back squat load. After load estimation, they completed an eccentric-based resistance protocol consisting of 10 sets x 10 reps of back squat (2) in order to promote muscle damage. Both exercises were carry out in three different and randomized occasions: early follicular phase (EFP), late follicular phase (LFP) and luteal phase (LP) of menstrual cycle. Participants also performed CMJ before (pre-trial), and 0h, 24h and 48h after eccentric exercise (post-trial). Jump height was measured by using MyJump App (3). Mixed linear model was conducted to analyze repeated measures.
RESULTS: Mean jump height was 27.9±5.6 cm, 28.5±2.6 cm, and 29.2±7 cm for the previously mentioned phases. Mixed linear model showed no significant effect of phase in CMJ performance ($F_{2,8.007}=2.047$; $p=0.191$). Jump values were significantly affected by moment being post-trial ones significantly different from pre-trial measures ($F_{3,16.048}= 4.21$; $p<0.05$). Mean height values for pre-trial and 0h, 24h and 48h post-trial measures were 30.1±6 cm, 25.7±3.8 cm, 29.6±5.7 and 28.8±5.1 cm, respectively. No significant effect of interaction between phase and moment was observed ($F_{6,15.832}=0.319$; $p=0.971$).
CONCLUSION: An eccentric-based resistance exercise affects muscle function and muscle damage in women as CMJ values 0h post-trial were significantly lower than pre-trial ones. Nevertheless, muscle function may not be influenced by hormonal fluctuation as no differences among phases were observed. This finding could be due to sample size as our results are preliminary. Further studies are needed to evaluate sex hormone effects in women performance.
References:
1. Jakeman JR, Byrne C, Eston RG. Eur J Appl Physiol. 2010;109(6):1137-1144.
2. Macdonald GZ, Button DC, Drinkwater EJ, Behm DG. Med Sci Sports Exerc. 2014;46(1):131-142.
3. Gallardo-Fuentes F, Gallardo-Fuentes J, Ramírez-Campillo R, et al. J Strength Cond Res. 2016;30(7):2049-2056.

MAXIMUM FAT OXIDATION IS LOWER IN YOUNG COMPARED TO MIDDLE-AGED ADULT WOMEN FROM A LOW INCOME COMMUNITY IN SOUTH AFRICA.

ENGELBRECHT, L., DICKIE, K.E., TERBLANCHE, E.

STELLENBOSCH UNIVERSITY, SOUTH AFRICA

INTRODUCTION: According to the South Africa Demographic and Health Survey, 68% of South African women are obese, based on BMI scores. It is also known that there is a strong association between low socio-economic status and obesity risk (Pireyre et al., 2016). Furthermore, fat oxidation rate during rest and exercise is linked to increased metabolic risk factors. Therefore, this study set out to compare the maximal fat oxidation rates of young and middle-aged adult women from a low income community in South Africa.
METHODS: 28 women (group 1 (n=13): 18-29 years old; group 2 (n=15): 40-49 years old) from the same community performed a graded treadmill test till exhaustion after an overnight fast to determine maximum fat oxidation rate (MFO) and aerobic capacity (VO2max). Dual-energy X-ray absorptiometry scans were performed to determine fat mass (FM) and fat free mass (FFM). The Global Physical Activity Questionnaire (GPAQ) was used to determine a subjective measure of physical activity.
RESULTS: Both groups had a low MFO (group 1: 0.26 ± 0.07g/min; group 2: 0.34 ± 0.11g/min), however, the MFO of the older women was largely higher than group 1 (ES = 0.87; CI: 0.06 – 1.63). Relative VO2max were low in both groups (group 1: 27.9 ± 5.4 ml/kg/min; group 2: 22.1 ± 4.5min/kg/min). Group 2 had moderately higher body mass (ES = 0.75; CI: -0.14 – 1.49) and FM (ES = 0.70; CI: -0.09 – 1.46), with significantly higher FFM (ES = 1.02; CI: 0.19 – 1.79) compared to group 1. Group 2 was also more active than group 1 (ES = 0.69; CI: -0.11 – 1.44).
CONCLUSION: The surprising finding of this study was that the younger women had lower MFO than the older women. In fact, the older women's MFO was comparable with sedentary healthy women (Stisen et al., 2006). MFO is influenced by VO2max, FFM and physical activity (Venables et al., 2005). In this study, the difference in MFO between the groups may be explained by the lower FFM and activity levels observed in the younger women. A lower FFM is also associated with a higher risk of cardiovascular disease, while a reduced capacity to oxidise fat during exercise may increase the risk in developing metabolic syndrome. The finding of this study highlights the need to implement community intervention programs targeted at young adult women to lower their risk for chronic non-communicable diseases.

AGE-RELATED TRENDS IN ABDOMINAL OBESITY, CARDIORESPIRATORY FITNESS AND COGNITIVE FUNCTION IN LOW INCOME SOUTH AFRICAN WOMEN

NIEUWOUDT, S., TERBLANCHE, E.

STELLENBOSCH UNIVERSITY

INTRODUCTION: As people age, their cardiovascular health and cognitive function (CF) tends to decline, while the prevalence of non-communicable diseases (NCD's) rises. These changes are accelerated in low to middle income countries where the awareness and detection of NCD associated risk factors are low. Few studies describe the prevalence of these risk factors across age-groups, specifically in developing countries. This study therefore aims to describe the age-related trends in abdominal obesity, cardiorespiratory fitness and cognitive function in low income South African (SA) women.
METHODS: 61 women (age 39.8 ± 13.6 years (yrs), body fat% 46.4 ± 7.1%, education 10.3 ± 2.5 yrs) from a low income community volunteered for this cross-sectional study and were separated into four age categories (18-29 yrs; 30-39 yrs; 40-49 yrs and 50-64 yrs). Visceral adipose tissue (VAT) was measured using dual-energy x-ray absorptiometry, while waist circumference (WC) was measured according to the International Standards for Anthropometric Assessment (ISAK). Peak oxygen uptake was determined using a graded treadmill test to exhaustion. CF was assessed with the Brief Core computerised neurocognitive test, CNS Vital Signs. Data was analysed using one-way ANOVA for independent groups and $P<0.05$ was considered statistically significant. Institutional ethical approval was obtained from Stellenbosch University.
RESULTS: All outcome variables showed a negative trend across age groups. Abdominal obesity, as measured by VAT (g) and WC (cm), increased significantly between 18-29 yrs (389.6 ± 244.4g; 73.2 ± 17.6cm) and all respective groups, 30-39 yrs (757.5 ± 399.2g; 88.5 ± 18.8cm), 40-49 yrs (778.5 ± 282.2g; 91.5 ± 15cm), 50-64 yrs (845.9 ± 187.2g; 94 ± 10.3cm) ($P<0.05$). A significant decrease was seen in peak oxygen uptake between 18-29 yrs (27.9 ± 5.4ml.kg.min), 40-49 yrs (22.1 ± 4.5ml.kg.min) and 50-64 yrs (21 ± 3.9ml.kg.min) ($P<0.05$). CF declined significantly in eight cognitive domains between 18-29 yrs and 50-64 yrs and in five cognitive domains between 18-29 yrs and 40-49 yrs ($P<0.05$).

CONCLUSION: Adverse health is generally associated with older age, however, in low income SA women, risk factors for NCD's are occurring earlier than anticipated (Allen et al., 2017). With baseline measures of cardiovascular and cognitive health already poor in these women from early adulthood and further negative changes, specifically in abdominal obesity, with ageing, there is an urgent need for community interventions targeting young women to reduce the risk of future cardiovascular disease and dementia.
REFERENCES:
Allen, L., Cobiac, L. & Townsend, N. (2017). Quantifying the global distribution of premature mortality from non-communicable diseases. Journal of Public Health, 39(4): 698-703.
CONTACT:
15617572@sun.ac.za

THE PHYSIOLOGICAL AND METABOLIC DEMAND OF A STANDARDIZED 60-MINUTE POLE DANCING CLASS

NICHOLAS, J.C., MCDONALD, K.A., PEELING, P., JACKSON, B., DIMMOCK, J.A., ALDERSON, J.A., DONNELLY, C.J.

UNIVERSITY OF WESTERN AUSTRALIA

INTRODUCTION: Pole dancing has become a popular form of group exercise (Dale, 2012); however, no empirical quantitative scientific studies examining the acute physiological or metabolic demand of pole dancing classes exist. The aim of the study was to quantify the demands of a standardized recreational pole dancing class, classifying the outcomes according to American College of Sports Medicine (ACSM) exercise intensity guidelines (ACSM, 2011). Further, differences in physiological and metabolic measures between class discrete components were also explored.
METHODS: Fourteen advanced-level amateur female pole dancers completed a baseline test to determine peak oxygen consumption (VO2peak), heart rate (HR) and blood lactate (BLa); along with three 60-min standardized pole dancing classes, including warm up, skills-based (individual pole-based manoeuvres), routine-based (sequence of combinations including jazz-style dance moves and pole-based manoeuvres), and cool down components. In one class, participants were fitted with a portable metabolic analysis unit (CosMed K5, Roma, Italy).
RESULTS: Overall, classes were performed at a mean VO2 of 16.04 ml.kg-1.min-1 (49.6% VO2peak), total energy cost of 281.6 kcal (4.7 kcal.min-1), metabolic equivalent of 4.6 METs, HR of 132 b.min-1 (75.7% HRmax), and BLa of 3.1 mM (59.1% peak BLa). When comparing skills- and routine-based components of the class, % HRmax (73.4 vs. 78.6), %VO2peak (46.9 vs. 56.0), energy cost per min (4.4 vs. 5.3 kcal.min-1), and METs (4.3 vs. 5.2) were all greater in the routine-based component ($p < 0.01$).
CONCLUSION: In accordance with ASCM guidelines, a 60-min pole dancing class is classified as a moderate-intensity cardiorespiratory exercise, that when completed for ≥30 min, ≥5 days per week (total ≥150 min), satisfies the recommended level of cardiorespiratory exercise (ACSM, 2011). Additionally, given the greater %HRmax, %VO2peak, energy cost per min, and METs in the routine-based component, classes with a greater focus on routine-based training may benefit those seeking to exercise at a higher intensity, resulting in greater caloric expenditure.

OXYGEN SATURATION THROUGH PULSE OXIMETRY IN SPORTSWOMEN

MARTIN-ESCUDERO, P., MIGUEL-TOBAL, F., DOTOR-CASTILLA, M.L., LÓPEZ-SILVA, S.M., GIANNETTI, R., GALINDO-CANALES, M.

UNIVERSITY COMPLUTENSE OF MADRID

INTRODUCTION: Oximetry is a method used to assess peripheral blood oxygen saturation based on the determination of the level of red light absorption, directly influenced by the hemoglobin levels. Most studies on pulse oximetry, within the scope of sports medicine and clinic, have been performed in male populations, with few studies in female populations. The objective of our study was to determine transcutaneous oxygen saturation in sportswomen of different races and to analyze the correlation of this determination with the first (VT1) and second (VT2) ventilatory thresholds.
METHODS: Our study was performed in 27 voluntary female athletes of caucasian (25) and black (2) race, 22,96 SD 6,19 (years old); height 163,81 SD 6,89 (cm); and weight 57,23 SD 6,69 (Kg) from different sports, who practiced sport regularly prior to the study for at least 2 years. They trained regularly, on average 1 to 3 hours/session for 4-6 days a week as members of a sports club at local/regional level. Each of the athletes, (after signing an informed consent) underwent a maximal incremental ergospirometry test, from which a series of ergospirometric variables were determined. In conjunction with the stress test, peripheral oxygen saturation was measured by pulse oximetry, correlating these values with the data obtained by the gas analyzer.
RESULTS: Regarding VT1, we found statistical significance (p=0,030) between the time to reach the aerobic threshold after the first small decrease in oxygen saturation, and the appearance of that threshold (every minute the longer the first one is, the threshold will take 0,259 minutes more to appear), explaining a 43.3% of the variability in the time of appearance of VT1. As for VT2, we found a strong relationship between when oxygen desaturation starts to occur, after the aerobic threshold (what we called desaturation time), and the appearance of the VT2 (every minute longer the first one takes to appear, the threshold will take 0.865 minutes more to appear), with a Pearson correlation of close to 1 (0.892), and statistically significant ($p = 0.000$), explaining a 86.5% of the variability in the time of occurrence of the anaerobic threshold.
CONCLUSION: The pulse oximetry is a simple, reproducible method that is quite accurate and noninvasive to study physical condition of athletes performing physical effort. In all athletes a common behavior is present in the evolution of oxygen saturation during an incremental stress test. We found certain correlation between the time to reach VT1 after the first small decrease in oxygen saturation and the appearance of that threshold. The linear regression model of desaturation time with the time of occurrence of VT2 in female athletes is able to predict onset VT2.

Oral presentations

OP-BN34 Neuromechanics of ballistic movement +

RELATIONSHIP BETWEEN RATE OF FORCE DEVELOPMENT OF TOE FLEXOR STRENGTH AND VERTICAL JUMP PERFORMANCE

KOYAMA, K.1, KUDO, S.1, YAMAUCHI, J.2,3

1. TOIN UNIVERSITY OF YOKOHAMA, KANAGAWA, JAPAN 2. TOKYO METROPOLITAN UNIVERSITY, JAPAN 3. RESEARCH CENTER IN BACK, NECK, OTHER JOINT PAIN AND HUMAN PERFORMANCE , FACULTY OF ASSOCIATED MEDICAL

INTRODUCTION: Rate of force development (RFD) of maximum force has been a term to describe the ability to rapidly develop muscular force. RFD of the maximum leg extension strength was related to vertical jump performance (Yamauchi et al. 2007). This suggests that the ability of neuromuscular system to develop the greatest force in the shortest time is required for recruitment of the greatest number of motor units at the beginning of contractions and for the development of the high vertical force in jump performance.
In the push-off phase during jump, the toes are dorsiflexed and metatarsal phalangeal joint dorsiflexion moments rapidly increased (Goldmann et al. 2013). Thus, the muscle strength of the toe flexor muscles is a key to enhance the jump performance. Indeed, maximum toe flexor strength was significantly correlated with jump performance in children (Morita et al. 2015) and adolescents (Otsuka et al. 2015); however, there were no studies of how the rate of force development (RFD) of toe flexor strength is related to jump performance. The aim of this study was to examine whether the RFD of toe flexor strength correlates with jump performance.
METHODS: Thirty-one healthy men were measured toe flexor strength and jump performance with the toe grip dynamometer and the force plate. RFD of toe flexor strength was evaluated by the force-time curve and was calculated from time period between 20% and 80% of the total time of the maximum force. To record the force signals, the output from the dynamometer was introduced to the computer through an analog-to-digital converter. Jump performance was assessed using 3 styles of jump without arm swing: a countermovement jump (CMJ), a squat jump (SJ) and repeated rebound jumps. From the force-time data, jump height, maximum ground reaction force and RFD of ground reaction force in CMJ and SJ, and the rebound jump index (RJI) in repeated rebound jumps were calculated.
RESULTS: RFD of toe flexor strength was significantly correlated with jump height in CMJ, SJ and RJI; however, it was not significantly correlated with RFD of ground reaction force in CMJ and SJ.
CONCLUSION: The result of this study suggests that the rate of force development of toe flexor strength might be important factor of jump performance, although it was not major role for the rapid development of the high vertical force in jump performance.

POST-ACTIVATION POTENTIATION OF AN INERTIAL FLYWHEEL EXERCISE ON SQUAT JUMP PERFORMANCE

TIMÓN, R., ALLEMANO, S., CAMACHO-CARDEÑOSA, M., CAMACHO-CARDEÑOSA, A., MARTINEZ-GUARDADO, I., OLCINA, G.

FACULTY OF SPORT SCIENCES. UNIVERSITY OF EXTREMADURA. CÁCERES

INTRODUCTION: Post-activation potentiation (PAP) has been defined as an acute enhancement of muscular performance following a preload stimulus with maximal or submaximal muscle actions (Hughes et al, 2016). The eccentric supramaximal intensities (130% 1RM) seems be effective in eliciting PAP in strength trained (Golas, 2016). Given that the inertial flywheel exercise involves an eccentric overload that causes a maximal voluntary contraction, the aim of this study was to determine whether the inertial flywheel exercise can have a potentiation effect on squat jump performance.
METHODS: 15 active university students participated in the study (age: 22,1 ± 2,7 years; BMI: 23,9 ± 3,1). A randomized crossover design was used and all participants completed two different protocols on separate days after the same warm-up: Control Protocol (15 s. skipping + 8 free body weight squats) and Flywheel Protocol (3 x 8 reps. of inertial flywheel squat at peak power and 3 min. rest). The squat jump performance was measured by contact platform at baseline before the conditioning protocols, and four, eight and twelve minutes after the protocol. A repeated measures ANOVA was performed to analyse significant differences over time.
RESULTS: Vertical jump height (from 26.1 ± 5.2 to 28.7 ± 5.8 cm.), power (from 783.9 ± 178.0 to 816.10 ± 189.7 Watts) and velocity (from 2. 2 ± 0.2 to 2.3 ± 0.2 m/s) were increased significantly ($p = 0.05$) from baseline at four minutes after the inertial flywheel protocol, but no significant difference was observed at eight and twelve minutes.
CONCLUSION: The inertial flywheel exercise showed a potentiation effect on squat jump performance after four minutes of recovery, so this pre-conditioning strategy could be useful during the warm-up before competition. Anyway, given that the PAP phenomenon depends on many variables, it would always be important to individualize the conditioning protocol as much as possible.
Financial support for this study was received from Regional Government of Extremadura (Spain).
REFERENCES:
Golas A, Maszczyk A, Zajac A, Mikolajec K, Stastny P. Optimizing post activation potentiation for explosive activities in competitive sports. J Hum Kinet. 2016;52:95-106.
Hughes JD, Massiah RG, Clarke RD. The potentiating effect of an accentuated eccentric load on countermovement jump performance. Journal of Strength and Conditioning Research. 2016;30(12):3450-3455
Contact: rtimon@unex.es

EFFECT OF SQUAT MOVEMENT SPEED ON BEHAVIOR OF VASTUS LATERALIS MUSCLE-TENDON COMPLEX

NORO, H., TAKESHITA, T., YOSHIDA, T., TAGURI, A., KATO, R., HATA, K., YANAGIYA, T.

JUNTENDO UNIVERSITY

INTRODUCTION: Squat exercise is often conducted as the training of lower limb muscles at various movement speeds. Manabe et al (2004) reported that effective stretch-shortening cycle (SSC) exercise had occurred at the more quick condition in the EMG study. Moreover, Jacob et al (2016) investigated the effect of squat training manner (Squat Jump, Volitional speed, and slow fixed-tempo squat) on the muscle-tendon behavior using ultrasonography. However, we thought that it is necessary to compare at the same range of motion for investigating the effect of movement speed on the muscle-tendon behavior. Therefore, we aimed to compare muscle tendon behavior during squat exercise at different movement speed using ultrasonography in vivo.

METHODS: Active eight male students participated as subjects in this study (age: 22.8±0.9yrs; height: 1.75±0.06m; weight: 67.1±4.0kg). They had squat exercise with self-weighted load at 5 different movement speeds on the force platform, Right and left leg separately. Ground reaction forces were recorded at 1kHz. Behaviors of muscle-tendon complex in vastus laterals muscles were captured using real-time ultrasonography at 45fps, length changes in tendon and fascicle were calculated after that. Electromyogram in the right lower limb muscles was recorded at 1kHz.
RESULTS: Remarkable electromyogram activities in VL were observed in ascending phases during squat exercise in all movement speeds. Fascicle length tends to shorten in the ascending phase. On the other hand, tendon tends to lengthen in ascending phase. We could have observed changes in force-length relation during faster squat motions. The shorter fascicle length was observed as movement speed was faster until 3-s, after that it was maintained. Peak tendon length was almost constant at any movement speed.
CONCLUSION: Ultrasonography had given the effective information about the behavior of fascicle and tendon during squat exercise along with different movement speeds. However, no stretch effect was observed in tendon even if faster movement speed.
References: Manabe et al (2007) Journal of Sports Medicine and Physical Fitness: 47, 1; proQuest Central pg. 1
Jacob et al (2016) Frontiers in Physiology: 10.3389/fphys.2016.00366
Ishikawa et al (2003) Acta Physiol Scand :178,205-213
Contact: sh4117040@juntendo.co.jp

EFFECT OF SEQUENCE PATTERNS OF MOVEMENT DURING SINGLE SQUAT EXERCISE ON THE BEHAVIOR IN MUSCLE TENDON COMPLEX IN VASTUS LATERALIS MUSCLE.

TOSHIO, Y.
JUNTENDO UNIVERSITY

INTRODUCTION: Counter action, like squatting immediately before jumping, is known to help conducting movements efficiently during physical movements. This is called as a stretch shortening cycle (SSC) exercise. It is thought elastic energy is stored in the series elastic elements of muscles, like tendinous tissues in the stretching phases during counter actions. After that, elastic energy is thought to reuse for augmenting muscle forces immediately after stretching phases. However, it has not been known whether the augmentation in muscle tendon complex (MTC) could be acquire or not if sequence patterns are different.
Ultrasonography is used to get directly but non-invasively the movies of behaviors in MTC during various exercise. Therefore, the purpose of present study was to investigate effects of sequence patterns of movement during single squat exercise on the behavior in muscle tendon complex of Vastus Lateralis (VL) muscle.
METHODS: Seven male students who majoring sports science participated as subjects in this study (age: 22.8±0.9yrs; height: 1.75±0.06m; weight: 67.1±4.0kg). They conducted single squat exercise in two kinds of sequence patterns at same movement speeds. One sequence pattern was squat from standing position (descending-ascending; DA), the others were also squat but from sitting position (ascending-descending; AD). Their motion speeds and distances of rise and fall were almost the same among patterns. Motion of the body in sagittal plane was recorded by high speed video camera. Joint kinematics was analyzed by digitizing body land markers using computer software. Vertical ground reaction forces (VGRF) in both legs were measured separately. And real-time ultrasound images were recorded at 75 frames per second, from the center of VL muscle using linear array probe. Tendon length was calculated from lengths in fascicle and muscle tendon, according to previous studies.
RESULTS: Higher VGRF were observed in the ascending phase compared with descending phase in both sequence patterns. VGRF in the ascending phase was higher than that in the descending phase. Higher VGRF were developed through ascending phase in AD pattern compared with DA pattern. Lengthening of tendon was observed in descending phase in both sequence patterns, shortening of muscle fibre also observed at the same time.
CONCLUSION: It was thought that recoil of elastic energy stored in tendon was more efficiently used in DA pattern.

INFLUENCE OF ACCELERATION LEVELS ON REACTIVE JUMPS DURING ARTIFICIAL GRAVITY ELICITED BY CENTRIFUGATION

GRUBER, M., KRAMER, A., KÜMMEL, J.
UNIVERSITY OF KONSTANZ

INTRODUCTION: Humans are accustomed to Earth's constant gravitational acceleration of 1g. The absence of gravitational forces during space missions can cause severe deteriorations of the whole body. The results of a previous study suggest that artificial gravity elicited by centrifugation in combination with high-impact exercise with high peak forces has the potential to counteract many of these negative adaptations (Kramer et al., 2018). Therefore, the aim of the present study was to determine if reactive jumps are possible with different acceleration levels ranging from 0.5g to 1.5g in a non-constant force field elicited through centrifugation.
METHODS: Ground reaction forces and electromyographic (EMG) data of 14 healthy male subjects (27±5 years, 77±6kg, 181±7cm) were recorded during repetitive hopping in a short-arm human centrifuge for five different acceleration levels in counterbalanced order: two acceleration levels lower than normal gravity (0.5g, 0.75g), one with gravitational acceleration (1g) and two with higher acceleration (1.25g, 1.5g). These data were compared to normal hops with gravitational acceleration of 1g.
RESULTS: Increasing the acceleration from 0.5g to 1.5g resulted in increased peak forces (+83% when comparing the value at 1.5g to the one at 0.5g), rate of force development (+100%), with minor changes in ground contact time except for the 0.5g condition, and increased muscular preactivity (+17% to +120%, depending on the muscle). However, even for the 1.5g condition, these values did not attain the level observed for normal jumps on the ground: for example, the peak forces during centrifugation reached only 68% of the peak forces during vertical jumps.
CONCLUSION: The results show that in principle, the adaptation of a movement pattern to acceleration levels other than the normal constant gravitational acceleration of 1g is possible, even with a non-constant force field. However, the participants were not able to perform the movement with similarly high peak forces, short ground contact times and high muscle preactivity as compared to natural vertical jumps on earth.
REFERENCES:
Kramer, A., Gollhofer, A., Armbrecht, G., Felsenberg, D., Gruber, M. (2017). How to prevent the detrimentel effects oft wo month of bedrest on muscle, bone and cardio-vascular system: An RCT. Scientific Reports 7(1) doi:10.1038/s41598-017-13659-8

INFLUENCE OF DIFFERENT STRETCH VELOCITIES ON CONTRACTION PERFORMANCE OF THE HUMAN TRICEPS SURAE DURING AND AFTER STRETCH-SHORTENING CYCLES

GROEBER, M.1,2, BACA, A.1, SEIBERL, W.2

1: UNIVERSITY OF VIENNA, 2: TECHNICAL UNIVERSITY OF MUNICH

INTRODUCTION: The stretch-shortening cycle , a combination of an eccentric and immediately following concentric muscle activation, occurs in most everyday movements. The SSC is a component of essential movement patterns, such as walking, running and jumping. The goal of this work is to provide a better understanding of this muscle action. The focal point is to examine the influence of different stretch speeds on the contraction performance of the human triceps surae during maximal voluntary SSCs.
METHODS: The torque of n=13 subjects was measured during and after SSCs. The SSCs were performed with stretch speeds of 30°/s or 120°/s, and shortening speed fixed at 60°/s <30° range of motion>. ANOVA statistics and Pearson correlations served for analysis of differences and relationships of torque and work during and after SSCs, as well as pure stretch, pure shortening and isometric reference contractions.
RESULTS: After the SSCs, significant force depression was found <30°/s and 120°/s; 9.1±4.8% and 10.9±6.3%>, compared to pure shortening. The work during the shortening phase of SSCs was significant higher compared to pure shortening contractions <30°/s and 120°/s; 11.7±4.8% and 17.7±6.3%>. However, there was no difference between work and FD in SSCs. Furthermore, there was no correlation between FD after SSCs and peak torque values at the end of stretch 0.05>, or a correlation between the work performed during shortening and FD after SSCs 0.05>.
CONCLUSION: In conclusion, it was found that neither different peak torque values, nor the work performed during shortening are related to FD following the SSCs. Nevertheless, compared to pure shortening, stretch-induced mechanism counteracted FD, resulting in less FD. The storage and release of elastic energy, stretch reflexes and the activation dynamics can also contribute to increased torque and work during the shortening phase of SSCs .

EFFECTS OF SQUATS ON COUNTERMOVEMENT JUMP PERFORMANCE ACROSS MULTIPLE SETS OF A CONTRAST PROTOCOL IS NOT RELATED TO STRENGTH LEVEL

BAUER, P.1, SANSONE, P.2, MITTER, B.1, SEITZ, L.B.3, KRENN, B.P.1, TSCHAN, H.1

1: UNIVERSITY OF VIENNA, INSTITUTE OF SPORT SCIENCE ; 2: UNIVERSITY OF ROME "FORO ITALICO" ; 3: EDITH COWAN UNIVERSITY, CENTRE FOR EXERCISE AND SPORT SC

INTRODUCTION: Post-activation potentiation (PAP) response following the completion of a conditioning activity (CA) appears to be larger among stronger individuals (Seitz et al. 2016a). However, the influence of strength level on PAP across multiple sets of paired exercises (CAs and countermovement jumps (CMJ)) remains to be elucidated. Therefore, the present study was designed to evaluate the influence of strength level on the PAP effects of moderate (MI) and high intensity (HI) squat exercises on CMJ performance across multiple sets of a contrast training protocol.
METHODS: Sixty resistance-trained male (age, 23.3±3.3 y; body mass, 86.0±13.9 kg; relative squat 1RM, 1.8 ± 0.2 kg.kg) participated in a randomized, cross-over study. After baseline assessment they performed a contrast PAP protocol comprising three sets of either MI (6×60% of 1RM) or HI squats (4x90% of 1RM) or 20 seconds of recovery (CTRL) alternated with seven CMJs that were performed at 15 seconds, 1, 3, 5, 7, 9 and 11 minutes after the squats or recovery. Jump height (JH) and relative peak power (PP) recorded with a force plate during MI and HI was compared to that recorded during CTRL to calculate the PAP effect. After dividing the subjects into two groups ("strong" and "weak") based on the median of relative squat 1RM (i.e., 1.77 kg.kg) a 3-way mixed ANOVA was used to assess the effects of group, condition and time and their interaction on JH and PP. Additionally, Pearson product-moment correlations were calculated to assess the relationship between relative strength and PAP response.
RESULTS: Although PAP could be elicited across all three sets of MI and HI at around 3 – 7 minutes post-recovery (+1.3 -+4.4%, $p<.05$), no significant interaction between group x time, group x condition or group x condition x time was found (all $p>.05$). Likewise, all correlations between relative strength and PAP responses were small (all $r<.28$) and not significant ($p>.05$).
CONCLUSION: The present findings conflict with previous research which has suggested that strength level is a modulating factor in eliciting PAP. However, there is evidence suggesting that PAP response is influenced by other subject characteristics like jumping ability (Tsoukos et al., 2016) or type II myosin heavy-chain isoform percentage (Seitz et al, 2016b).
Seitz, LB, and Haff, GG. (2016a) Sports Med 46, 231-40.
Seitz, LB, et al. (2016b) Appl Physiol Nutr Metab 41(5), 491-7.
Tsoukos, A, et al. (2016) J Strength Cond Res. 30 (8), 2250-7.
CONTACT: pascal.bauer@univie.ac.at

Oral presentations

OP-BN35 Movement variability and motor competence

COMPETITIVE WEIGHTLIFTERS DISPLAY SIGNIFICANT INTER-AND INTRA-INDIVIDUAL VARIABILITY IN THE KINEMATICS OF THE BACK SQUAT

KRISTIANSEN, M., RASMUSSEN, G.H.F., SLOTH, M.E., VOIGT, M.

AALBORG UNIVERSITY

INTRODUCTION: Many coaches seem to act according to the idea of an ideal or average lifting pattern in e.g. back squat. However, due to individual differences in e.g. anthropometry, muscle morphology and neurophysiology it seems plausible that significant inter-individual variability might be present in the kinematics of the squat. Moreover, due to redundancy of the musculoskeletal system, considerable intra-individual variability might also be present. Therefore, the purpose of this study was to elucidate the level of inter- and intra-individual variability in the kinematics of the back squat among competitive weightlifters.
METHODS: Ten competitive weightlifters volunteered for participation in this study. Data were collected by recording six trials at 90% of 1RM in the back squat, with a rest interval of 4-7 min between all sets. Kinematic data were recorded using a synchronized eight-camera movement analysis system. Barbell velocity (VBarbell) and angular velocity for the ankle (VAnkle), knee (VKnee) and hip joint (VHip) were

digitalized and analyzed using Visual3D. The squat was then divided into five lifting phases (Escamilla et al., 2001): I) descent phase, II) acceleration phase, III) sticking region, IV) maximal strength region, and V) deceleration phase. Inter-individual variability was assessed by analyzing inter-individual differences in the velocity curves of VBarbell, VAnkle, VKnee and VHip through a one-way ANOVA using the statistical parametric mapping method (Pataky et al., 2010). Intra-individual variability were assessed by analyzing intra-individual differences in mean standard deviation of VBarbell, VAnkle, VKnee, and VHip for the each of the five lifting phases across the six trials through a one-way ANOVA.
RESULTS: Significant inter-individual differences were identified in VBarbell, VAnkle, VKnee, and VHip ($p \leq 0.05$). Comparing the mean standard deviation of VBarbell, VAnkle, VKnee, and VHip for each lifting phase, revealed significant intra-individual differences in lifting trials at 90% ($p \leq 0.05$).
CONCLUSION: In conclusion, the results of the present study clearly demonstrate that experienced lifters display significant inter- and intra-individual variability in the execution the back squat. This is most likely due to individual differences in for instance anthropometry, morphology and neurophysiology coupled with the redundancy of the musculoskeletal system. Strength coaches should acknowledge the existence of such variability in squatting kinematics and seek to individualize squatting technique accordingly.
REFERENCES:
1. Escamilla, R. F. (2000). Med Sci Sport Exerc. 33. 6. 984-998.
2. Pataky T. C. (2010). J Biomech. 43. 10. 1976–1982

IMPACT OF AN INTENSE 5-DAY TRAINING SESSION ON LOWER LIMBS STIFFNESS IN YOUNG HANDBALL PLAYERS

DURAND, S., ROBICHON, J., BOYAS, S., RAHMANI, A.

LE MANS UNIVERSITÉ

INTRODUCTION: Handball practice requires multiple physical capacities since it places emphasis on running, jumping, sprinting, arm throwing, hitting, blocking and pushing (Gorostiaga et al., 2006). Among all the movements associated to handball practice, the split step warrants specific consideration. This action can be performed during offensive like during defensive phases and will help the players to develop speed and reactivity. Lower limbs stiffness (LLS) can reflect the quality of split step and helps quantifying rebound ability. To study the impact of handball practice on these factors, we evaluate changes in multi rebound performance during a training camp in 36 young handball players from regional to national level.
METHODS: Jumping performances were assessed using Optojump® (Microgate®, Bolzano, Italy) at the beginning and at the end of the 5-day training camp. Results are presented as mean±SD.
A hopping (multi-rebound) test to evaluate LLS. For the hopping test, trial lasted 10s. Participants were asked to keep their knees as stiff as possible during test. The calculation of stiffness (K, expressed in N.m-1) for each impulse was accomplished using the formula developed by Dalleau et al. (2004) with TF and TC (both in seconds) representing respectively the flight and the contact times.
Then the global value of LLS for the test is calculated as the average of values obtained for each impulse during test.
RESULTS: The anthropometric characteristics of the group were: 15±1years, 176±8cm, 68±12kg. They used to train between 3 to 6 hours per week in addition to a match played during the weekend.
Mean global LLS was 22,990±4,571 N.m-1 at the beginning of the training session on Day 1 and 20,382±4,876 N.m-1 at the end of the training session on Day 5 ($p<0.001$). Between the first and the second test session, TF measured during the hopping test decreased from 0.477±0.45 seconds to 0.462 ± 0.45 seconds ($p<0.001$) while TC increased from 0.198± 0.17 seconds to 0.216 ± 0.32 seconds ($p<0.001$).
CONCLUSION: Our study suggests that LLS in young handball players is affected by repeated training sessions as performed during a training camp. This impacts negatively both TF and TC measured during multi rebounds. It reveals that the handball related fatigue affects lower limbs, in blunting muscular hopping qualities. This slows down split steps and diminishes jump performances.
This has to be taken into account during training camp to optimize physical training and prevent injuries.
REFERENCES:
Dalleau, G. Belli, A., Viale, F., Lacour, JR., & Bourdin, M. (2004). A simple method for field measurements of leg stiffness in hopping. International Journal of Sports Medicine, 25(3): 170-176
Gorostiaga, E.M., Granados, C. Ibañez, J., Gonzalez-Badillo, J.J & Izquierdo, M. (2006). Effect of and entire season on physical fitness changes in elite male Handball players. Medicine & Science in Sports & Exercises, 38: 357-366

IMPACT OF A COGNITIVE TASK ON CYCLING FRACTAL PROPERTIES

GILFRICHE, P.1,2, ARSAC, L.M.1, BLONS, E.1, DESCHODT-ARSAC, V.1

UNIV. BORDEAUX

INTRODUCTION: Many periodic motor tasks have been shown to exhibit long-range correlations in time periods, like gait, rowing, and more recently cycling (1). Changes in the realization of a motor task while operating a cognitive task is well known and has been explained via the dual-task paradigm. We have recently shown that fractal properties of walking, marked by the scaling exponent of inter-stride intervals derived by Detrended Fluctuation Analysis (DFA), increased when operating a cognitive task. We hypothesized that inter-cycling intervals (ICI) scaling exponent should be similarly affected when operating a cognitive task.
METHODS: Our study involved 19 participants aged 24.4±2.7 years, asked to cycle for twice 10 minutes on a friction-loaded cycle ergometer, with and without performing a cognitive task. The task (PASAT) was chosen to recruit the prefrontal cortex, to interfere with a supposed central generation of cycling. Inter-cycle intervals (ICI) were computed using a light meter at 1kHz. After identifying two scaling phenomena with DFA, we computed both a short-term scaling exponent αS on box sizes smaller than 8 and a long-term scaling exponent αL on box sizes bigger than 10.
RESULTS: Mean detrended windowed autocorrelation was positive (0.55±0.27 in free cycling situation), indicating emergent timing. Our study exhibits long-term (>10s) fractal properties in ICI, and an increase in αL with cognitive task (1.03±0.13 vs. 1.06±0.17, $p<0.05$). αS was significantly higher than long term scaling exponent αL both in free cycling (1.36±0.23, $p<0.001$) and in cognitive task situation (1.41±0.17, $p<0.001$), and was not significantly impacted by cognitive task (ns).
CONCLUSION: One main finding here is the presence of long-range fractal correlations in ergometer cycling. The observed increase in αL with cognitive task is similar to what has been witnessed in walking. There is an ongoing debate as to the origin of long-range fractal correlations in human locomotion, mostly viewed as an emergent timing (2). This fractality may either have a peripheral origin, with a fractal evolution of the biomechanical oscillator stiffness over time (2), or a central origin, with a Central Pattern Generator: a network of neurons producing a rhythmical output (3). Although the present results do not bring any definitive answer to this debate, it is worth

noting that a central contribution in this intricate network cannot be ignored, as evidenced by the impact of a cognitive load on the temporal structure of the output signal.
1. Warlop T et al., Comput Methods Biomech Biomed Engin 15, 2012.
2. Torre K et al., Motor Control 14, 2010.
3. West BJ & Scafetta N, Phys Rev E 67, 2003.

INTER-RELATIONSHIP OF MEN ARTISTIC GYMNASTIC VAULT RUNNING SPEED ON DIFFICULTY VALUE AND JUDGES SCORES

HE, W.

CHINA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: Vaulting kinematic such as approach running speed, maximum speed on springboard, 1st and 2nd flight time, duration on support table of the artistic gymnastic handspring vault were strongly correlated with vault difficulty value(DV) (Atikovic, 2012) and judges score(FS) (Bradshaw & Sparrow, 2001). However it seem to be reasonable theoretical accepted that once poses superiority of approach speed(AS) will allow higher quality completion of complex acrobatic movement and leading to achieve higher judges score. This study aimed to examine the inter-relationship between AS, DV and FS.
METHODS: The study sample recruited (n=64) handspring vaults from Mens Artistic Gymnastic qualifying round of the 2017 China National Artistic Gymnastics Championship which adopted Code of Points (COP) 2017-2020. Samples were divided into 4 groups based on DV (G1:4.0DV, n= 8; G2:4.8DV, n=34; G3: 5.2DV, n=14; G4: 5.6DV, n=8). A 50Hz JVC PX100 video camera was placed about 50m perpendicular to the vault table. Kinematic data was coded by an experience coder with reliability of Cronbachs Alpha r=0.96 by using Dartfish 2D video analysis software. The approach speed was a product of changes of displacement over time measured from 3rd last step to single leg takeoff toward springboard, whereas FS and DV were official competition score. Spearman Rho correlation was used to examine the relationship and one-way ANOVA analysis was to examine the effect of AS and FS on DV by IBM SPSS 22v statistical software. LSD post hoc analysis were followed if significant different found between DV groups. P value was set at 0.05.
RESULTS: The FS was moderate correlated with AS (rs=0.63) and strong correlated with DV(rs=0.90) significant at $p<0.01$; and moderate correlated between AS and DV (rs=0.60, $p<0.01$). The FS and AS were both significant different between DV group, $p<0.01$. Post hoc test reveal that FS in all DV groups were significant difference from each group (G1=12.74±0.14, G2=13.65±0.19, G3=14.17±0.18 and G4=14.59±0.22). Only G1 (7.24±0.15) and G2 (7.63±0.25) of AS were significant different between all groups, $p<0.001$ while G3 (7.91±0.30) and G4(7.91±0.35) were not significant $p\geq0.05$.
CONCLUSION: The study revealed that the average gymnasts AS on high DV groups were at 7.91ms-1 was slower than the Stuttgart World Championship (8.1ms-1)(Maria, Fernandes, Carrara, Amadio, & Mochizuki, 2016). Thus, further development of the AS might not guarantee better vault performance. Slower AS may risk the gymnasts due to insufficient horizontal velocity for higher DV(Takei, Blucker, Nohara, & Yamashita, 2000). We concluded that the increase of AS may allow higher DV and result better FS, but AS might not be an essential variable for higher DV performance.

MEASURING PERCEIVED MOTOR COMPETENCE: A COMPARISON BETWEEN DIFFERENT INSTRUMENTS.

DE WAELLE, S., DE MEESTER, A., DECONINCK, F., HAERENS, L.

GHENT UNIVERSITY

INTRODUCTION: Previous research has shown physical activity to be beneficial for children's and adolescents' physical and mental health. In addition, research confirmed that higher levels of motor competence are associated with higher levels of physical activity. However, it remains unclear how perceived motor competence (PMC) relates to actual motor competence (AMC) and physical activity. Recently, researchers have been trying to answer this question by using a number of different questionnaires to measure PMC, complicating comparison between different studies. Therefore, this study aims (1) to identify the questionnaire for PMC providing the closest match with AMC, and (2) to examine potential correlates of the relationship between AMC and PMC.
METHODS: We recruited 409 Flemish students from 10 different secondary schools. AMC was measured using the Test of Gross Motor Development-2nd Edition (TGMD-2), PMC was measured using four different questionnaires: the Self-Description Questionnaire (SDQ), the Physical Self-Description Questionnaire (PSDQ), the Physical Self-Confidence Scale (PSC) and the Physical Self-Perception Profile for Children and Youth (PSPP-CY).
RESULTS: The PSDQ ($r=0,481$, $p<0,001$) and SDQ ($r=0,467$, $p<0,001$) showed stronger correlations with the TGMD-2 than the PSPP-CY ($r=0,400$, $p<0,001$) and PSC ($r=0,391$, $p<0,001$). Furthermore, correlations between AMC and PMC differed depending on sex, where boys' PMC showed significantly stronger correlations with AMC than girls' for the SDQ ($p=0,033$) and PSDQ ($p=0,036$). No significant differences between boys and girls were found for the correlations between the TGMD-2 and the PSC or PSPP-CY. In addition, youngsters who completed the TGMD-2 before filling out the questionnaires, showed higher correlations between the TGMD-2 and all questionnaires than those who filled out the questionnaires first, although these results showed no statistical significance.
CONCLUSION: Measuring PMC is challenging and the strength of the correlation with AMC may depend on a number of different factors such as sex and testing order. It seems crucial to take this into consideration when measuring PMC and when conducting research concerning AMC and PMC or the relation between PMC and health related benefits.

Oral presentations

OP-BN37 Neuromechanics of winter sports

KINEMATIC FACTORS INFLUENCING THE TAKE-OFF PERFORMANCE IN SKI JUMPING

MUENCH, M., KULESSA, D.J., LAUBER, B., GEHRING, D., KULLMANN, N., GOLLHOFER, A.

ALBERT-LUDWIGS-UNIVERSITÄT FREIBURG

INTRODUCTION: The take-off is a key component of ski jumping performance because the athlete sets the starting conditions for the subsequent flight (Schwameder, 2009). Due to limited training possibilities on the hill, athletes have to practice take-off imitation jumps in a dry setting. Thus, there is the need to identify important biomechanical parameters of the imitation jumps which might be related to the

actual performance on the hill. Consequently, the aim of the present study was to determine key kinematic factors of the imitation jumps and correlate them with a coach-based assessment of the athletes' proficiency level.
METHODS: Sixteen male ski jumpers competing on different levels performed a number of imitation jumps (squat jumps, imitative squat jumps, jumps from a roller-board) in the laboratory while 3D kinematic motion data was captured. Selected parameters were based on previous experiments like the vertical jumping height, vertical take-off velocity, knee extension velocity and valgus index (Schwameder, 2008; Pauli et al., 2016). Other parameters such as knee-hip-synchronization (total difference of the standardized knee and hip angle 500 ms before take-off) and leaning-forward (maximum distance between the center of mass and ankle midpoint projected on the floor) were included because they were considered to be important by national coaches.
Parameters from all jump conditions were pooled together for correlation analyses with a ranking of the athletes' current proficiency level, which was determined by three national coaches who independently ranked the athletes from 16 (best level) to 1 (lowest). Accordingly, statistical correlations were calculated using the rank correlation after Spearman with a significance level of 5%.
RESULTS: The results show significant correlations between the athletes' proficiency level and the knee-hip-synchronization (r=-.432) and leaning forward (r=.586). Also, vertical take-off velocity (r=.294) and valgus index (r=.540) were significantly correlated with the proficiency level.
CONCLUSION: Based on new biomechanical analysis, the parameters knee-hip-synchronization and leaning forward were developed and prove their relevance for the take-off performance. Moreover, the present results confirm previous findings that a pronounced knee valgus position during the take-off negatively effects the athletes' proficiency level (Pauli et al., 2016) while a high vertical take-off velocity has a positive effect (Schwameder, 2008). Future research should focus both on the new as well as on already known parameters and adjust the training sessions in the dry setting and on the jumping hill accordingly.
REFERENCES:
Pauli et al. (2016). J Strength Cond Res, 30(3), 643-652.
Schwameder H. (2008). Sports Biomech, 7(1), 114-36.
Schwameder H. (2009). Handbuch Sportbiomechanik, 419-434. Schorndorf: Hofmann- Verlag.
Contact: mareike.muench@sport.uni-freiburg.de

ASSESSING VERTICAL FORCE-VELOCITY PROFILES: ARE TWO CONSIDERED LOADS UNDER SPECIFIC CIRCUMSTANCES ENOUGH?

KRÖLL, J., LASSHOFER, M., FRITZ, J., SCHWAMEDER, H.

UNIVERSITY OF SALZBURG

INTRODUCTION: Force-velocity (Fv-) relationships of ballistic push-offs are typically assessed via linear regression of repeated measurements with at least five additional loads [1, 2]. For the purpose of performance assessment, in specific cases, a reduced amount of repeated measures would be advantageous (i.e. test efficiency). Recently high general relationship between a multiple load method and a simple two-load method (0 and 40% body mass) were reported [3]. However, individual differences of up to 10% were reported too, indicating insufficient precision for performance diagnostics efforts. The lack in precision is most likely explainable by investigating average experienced athletes at low additional loads [3]. Therefore, the aim of the actual study was to analyse the effect of reducing the amount of repeated loads on Fv-profiles when exposing well-experienced athletes to high loads (80% body mass).
METHODS: Ten male elite junior ski jumpers (16.7±1.3 years; 1.82±0.05 m; 67.4±4.8 kg) performed squat jumps with additional loads at 0%, 20%, 40%, 60% and 80% of body mass. According to a standard method [2, Fv-profiles represented by F0 and v0], a five load Fv-profile was calculated and subsequently compared to three different two-load profiles (three LP's: 0-40LP, 0-60LP and 0-80LP). For this purpose the two-load profiles accuracy (mean of differences), precision (SD of differences) and correlation coefficient were calculated for F0 and v0.
RESULTS: High accuracy for all two-load profiles were depicted for F0 (abs < 0.16N/kgBM; rel < 0.6%) as well as for v0 (abs < 0.02m/s; rel <0.3%). Regarding to F0, 0-80LP depicted higher precision (abs 0.43N/kgBM; rel 1.5%) compared to 0-60LP (abs 1.01N/kg; rel 3.6%) and 0-40LP (abs 1.28N/kgBM; rel 4.6%). For v0 again 0-80LP revealed best precision scores (abs 0.08m/s; rel 2.5%), followed by 0-60LP (abs 0.24 m/s; rel 6.4%) and 0-40LP (abs 0.30m/s; rel 8.5%). The correlation coefficients for 0-80LP were 0.98 for F0 and 0.99 for v0. For 0-60LP (F0: r=0.91; v0: r=0.94) and 0-40LP (F0: r=0.82; v0: r=0.93) distinct lower values were observed.
CONCLUSION: The distance between the two analysed data points is a decisive factor for applying the two-load method. Even for the referred cohort, who is highly familiar with barbell squat jumps due to their daily training (high execution consistency), the two-load method seems to be sufficient only with very high additional loads (80% body mass). With this distant point, maximum individual differences were below 3.5% throughout. When considering only 40% additional body mass, those maximum individual differences increase up to 10% for F0 and 15% for v0. In conclusion, the two-load method only should be applied when testing athletes with extraordinary experience in loaded jumps by using two points located far distant from each other. A general application of the two-load method as suggested earlier [3], is not supported.
REFERENCES: [1] Samozino P., et al. Med Sci Sports and Exerc 2012; 44: 313-22
[2] Morin J.-B., et al. Int J Sports Physiol Perform 2016; 11: 267-72
[3] Zivkovic M.Z., et al. J Sports Sci 2017; 35: 1287-93

NUMERICAL STUDY OF SKI JUMPING WITH DETAILED BODY MODELING

HU, Q.

CHINA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: At present, ski jumping has become one of the most popular sport in the world with snow, it can prove the individuals ability to fly in the air on a pair of skies. The flight path of a ski jumper is determined by the weight and the aerodynamic forces (lift and drag) acting on the jumper and his equipment, which influence the flight path and thus the jump length in a pronounced way. The athletes can strongly influence the forces by proper movement of parts of their bodies resulting in a changed posture. Ski jumpers have to solve extremely difficult optimization problems in real time in order to optimize their performance. In order to maximize the achievable jump length, the athlete has to vary the angle of attack during the flight and also the configuration of body parts and the skis. The aerodynamic interaction between a ski jumper in flight and the surrounding air is very important for a jumper to fly with a long distance and stable process.
METHODS: In order to study the influence of parameters (such as angle of V style skiing, upwind angle, flying velocity) on the performance of ski jumping, an average man with skiing equipment is modeled with detailed physical characteristics. Facial features and hand fea-

tures are modeled as real as possible. The computational domain contains the human body surface and the region around the jumper, and it is discretized by hexahedron grid and tetrahedron grid using ICEM software. The cell size is between 0.5 and 20 mm. In the region upstream of the ski jumper the cell size is kept at about 20 mm, around hands the cells are about 0.5 mm wide, except in regions of narrow gaps like the armpits and between the legs, where a smaller cell size prevails.In order to capture the expected separation region downstream of the jumper accurately, smaller cell sizes had to be applied. Three dimensional simulation are used to investigate the lift and drag of the jumper. An incompressible air as well as newtonian fluid flow in the absence of external forces are used for the calculation. The flow field around the ski jumper is modelled by the Reynolds-Averaged Navier–Stokes (RANS) equations coupled with the eddy-viscosity SST k-ω turbulence model equations.
RESULTS: A major finding from the present investigations is the relative influence of the skis on the overall aerodynamic forces. In the investigated regime, the relative lift area is significantly larger than the drag area. It has an optimal angle for a jumper to move long distance.
CONCLUSION: The present results suggest that the greater the ski jumpers upwind angle, with respect to the relative flying velocity, the greater the pressure difference between the ski jumper in flight and the surrounding air. Further studies will focus on the dependency of the parameters as control variables, such as angle of V style skiing, upwind angle, flying velocity. It will be possible to optimize different ski jumping styles in different ski jumping hills and investigate different environmental conditions such as altitude , downwind and headwind and crosswinds.

ASSESSMENT OF LIMB SYMMETRY INDEX AS AN INJURY RISK FACTOR IN YOUTH ALPINE SKI RACING

MÜLLER, L.1, HILDEBRANDT, C.1, RASCHNER, C.1, MÜLLER, E.2

1 UNIVERSITY OF INNSBRUCK; 2 UNIVSERITY OF SALZBURG

Introduction: Alpine ski racing is a sport with a high risk of injury at the elite level. In general, lower limb differences of more than 10% are considered to represent risk factors in athletes (McGrath et al., 2016). The role of these asymmetries in the injury prevention in non-dominant sports like alpine ski racing has not been determined, so far. Therefore, the aim of the present study was to assess clinical measures of limb symmetry index (LSI) in performance relevant parameters and the relationship with injuries in youth alpine ski racers.
Methods: A prospective longitudinal cohort design was used. 95 Austrian elite youth ski racers (56 males, 39 females; 9-14 years) were involved in the study. An internet-based database was developed to record traumatic and overuses injuries over two school years. As baseline data, unilateral sports specific performance tests (counter movement jump: CMJ; stability: ST; jump coordination: JC; leg extension strength: LES; Y-Balance: YB) were assessed to define the LSI calculated as the ratio of the dominant leg and the non-dominant leg expressed as a percentage. Multivariate binary logistic regression analyses (dependent variable: traumatic or overuse injury yes/no; independent variable: LSI of performance tests) were performed. The level of significance was set at $p<0.05$.
Results: During the two-year study period 40 traumatic injuries and 9 overuse injuries were recorded, representing a total injury rate of 0.52 injuries / athlete. In mean, the following LSI [%] were calculated: CMJ 112.9 ± 11.4, ST 113.8 ± 14.2, JC 105.3 ± 3.9, LES 110.5 ± 8.3, YB 102.9 ± 2.3. The binary logistic regression analyses revealed that the LSI of LES represents a significant injury risk factor for both traumatic ($p=0.047$; Wald=3.955) and overuse injuries ($p=0.016$; Wald=5.820).
Discussion: In general, small rates of traumatic and overuse injuries were recorded. The in general reported threshold of 10% indicating an elevated injury risk does not seem to be a good indicator of injury risk in a non-dominant sport like alpine ski racing. The regression analyses revealed that only the differences in the LES of more than 10% represented a significant injury risk factor. Injury prevention programs in youth ski racing should therefore focus on the reduction of lower limb strength differences as a modifiable athlete-related risk factor, next to the already investigated modifiable risk factors in youth ski racing such as core strength and neuromuscular control (Müller et al., 2017). However, further research is necessary to assess the role of LSI in injury prevention in adolescent and elite alpine ski racers.
References: McGrath T, et al. (2016). The effect of limb dominance on lower limb functional performance – a systematic review. J Sports Sci, 34, 289-302.
Müller L, et al. (2017). Long-term Athletic Development in Youth Alpine Ski Racing: The effect of Physical Fitness, Ski Racing Technique, Anthropometrics and Biological Matur

MENTAL WORKLOAD AND SPORT-SPECIFIC KNOWLEDGE IN SKI JUMPING PERFORMANCE

HAMMER, T.M.1, INGEBRIGTSEN, J.E.2

1:UIT , 2:NTNU

Introduction: Ski jump performance is largely dependent on the execution of a complex and technically challenging take-off movement performed at high velocity. The genuine risk of physical injury also raises the difficulty and reduces the acceptable margins of error. Ski jumping takes place under serious time constraint, and athletes have little time to process information during performance. Previous studies show that expert athletes can perform their skills with very little cognitive effort (Naito & Hirose, 2014), and this automaticity is thought to be more effective and utilize the body's natural force potential. Expert athletes are also characterized by a greater knowledge about their activity (Williams & Davids, 1995), which makes for a challenging balance between specific knowledge and automatic performance. The aim of this study is to investigate how ski jumpers experience mental workload, in relation to their sport-specific knowledge and level of performance.
Methods: Qualitative interviews were conducted with two national level and two international elite-level ski jumpers to explore their perception of mental workload and their ski jump-specific knowledge. The athletes also responded to a two-question questionnaire at three occasions during their competitive season. The questionnaire measured their perceived mental workload and ski jump specific tasks. Performance was measured by results in subsequent competitions.
Results: Questionnaire and competition results show that the jumpers made their best performances when reporting their respective lowest amount of perceived mental workload. The same was evident in interviews were all informants described their ideal performance state as relaxed, focused with low cognitive effort. There was an evident difference in knowledge, with the national level athletes describing feelings and thoughts, whereas elite jumpers focused on objective information (e.g. forces, mechanical principles) when asked to explain important parameters of ski jumping performance.
Discussion: The results indicate that mental workload is highly relevant for ski jump performance. Workload does not have to be minimal, but structured in a precise and consistent way. Results further point to the importance of the athlete's knowledge, for both mental workload and level of performance. International level athletes are in possession of greater ski jump specific knowledge, efficiently organized. This heightens the quality of their choices and strategies for skill development. The precise nature of this knowledge also seems to promote a precise and stable mental workload enabling automated performance.

References: Naito E, & Hirose S. (2014). Frontiers in human neuroscience, 8, 594-594.
Williams M, & Davids K. (1995). J of sport and exercise psychology, 17(3), 259-259.
Contact: tord.hammer@uit.no

BIOMECHANICAL PERFORMANCE ANALYSIS OF ICE HOCKEY SKATING BASED ON A BODY WORN ACCELEROMETER

STETTER, B.J.1, BUCKERIDGE, E.2, NIGG, S.R.3, STEIN, T.1, SELL, S.1, NIGG, B.M.3
1 KARLSRUHE INSTITUTE OF TECHNOLOGY , 2 LULULEMON , 3 UNIVERSITY OF CALGARY

INTRODUCTION: Previous research on ice hockey skating has shown that biomechanical characteristics can be used to predict skating performance (Buckeridge et al., 2015). In this context, an appropriately large leg power and effective propulsion plays an important role (Renaud et al., 2017, Buckeridge et al., 2015). Advances in sensor technology (i.e. accelerometers) allow player movements in the field to be measured. Hence, the purpose of this study was to quantify stride propulsion based on center of mass (CoM) acceleration in forward skating and to compare differences across skill levels and sprint phases.
METHODS: K-means clustering was used to split twenty-two ice hockey players of different skill level into two groups (low caliber: n=13, high caliber: n=9) regarding their performance times of a 30 m forward skating task. One 3D accelerometer was mounted to the waist at the fifth lumbar spine. A stride specific value was obtained by calculating summed acceleration magnitudes of the three axes, normalized to the stride duration, and defined as stride propulsion (SP). SP was extracted for the 2nd and 6th stride, as they represent the accelerative and constant velocity phases of forward skating, respectively.
RESULTS: High calibers performed the 30 m sprint task in significantly shorter time (mean ± SD: 4.35 ± 0.09 s vs. the low calibers 4.73 ± 0.10 s, $p < 0.05$). A two-way mixed model ANOVA revealed significant group and stride effects, with greater SP for the high calibers in comparison with the low calibers ($p<0.01$, $\eta p2=0.34$) and greater SP for acceleration strides in comparison with constant velocity strides ($p<0.01$, $\eta p2=0.52$).
CONCLUSION: The results of this study are in accordance with the findings of Renaud et al. (2017), which estimated CoM accelerations from motion capture analysis and presented greater center of mass accelerations during skate starts for high caliber players. Additionally, the observed differences between characteristic sprint phases (acceleration & constant velocity) correspond well with the larger plantar push-off force during the initial sprint phase shown by Buckeridge et al. (2015) and underline the increased propulsive demands for a running-like motion compared to a gliding motion. On the basis of our results, the extraction of the SP from a body worn accelerometer seems a valuable approach to provide instant feedback to coaches and athletes to assess individual ice hockey skating performance.
REFERENCES:
Buckeridge E, LeVangie MC, Stetter B, Nigg SR, Nigg BM. (2015). PloS one, 10(5), e0127324.
Renaud PJ, Robbins SM, Dixon PC, Shell JR, Turcotte RA, Pearsall DJ. (2017). Sports Eng, 20(4), 255-266.
CONTACT:
Bernd.stetter@kit.edu

RESEARCH OUTCOMES VS. FEELINGS DURING SKI JUMP LANDING

BESSONE, V.
TECHNICAL UNIVERSITY OF MUNICH

INTRODUCTION: In ski jumping , the role of landing and its preparation plays a central role in improving performance and reducing injuries [1]. However, its importance seems underestimated by athletes and coaches. The author questioned the skiers for understanding their feelings during these phases' execution.
METHODS: The questionnaire included 46 questions, of which 37 related to landing, and was shared and filled online. The questions spaced from the kind of training to the perception of the skiers during the performance.
RESULTS: We interviewed 43 ski jumpers and Nordic combiners <17±4 years> competing at different levels. All the athletes do at least two trainings on the hill per week and jumping at least five times per session. The 49% of the interviewed had at least one injury connected to a bad landing, in particular broken bones, anterior cruciate ligament rupture and ligament contusion. The poll ranked the take-off, in-run, early flight, flight, landing preparation and landing from the most to the least important phase. Experience leads the start of landing preparation for the 43% of the poll . The athletes consider the difficult conditions for performing a parallel leg landing in this order: when the jump is too long, with a bad grooming, lack of visibility and strong wind. The 81% of the pool prefers to land on the mat during summer conditions, the 39% of it feels the highest impact during telemark landing and the 76% on the foot front positioned. In addition, during landing, the 31% of the jumpers feel higher forces on the front foot, the 21% on the rear and the 48% equally distributed.
CONCLUSION: The take-off is the most important phase of SJ performance according to both athletes and researchers [1]. The athletes use PL landing in difficult conditions being easier to perform than telemark [2]. Despite required from the FIS Competition Rules [3], during landing, the body weight distribution is not equal among the feet and among the front/rear parts of the foot as proven by previous studies [4] and perceived by the athletes. The questionnaire was an interesting overview for documenting the feelings of the athletes about landing. This knowledge is an important aspect for focusing further researches and before proposing technical changes to the athletes. However, in order to improve the performance, the athletes should focus on all the phases of SJ, affecting each phase the following one [1].
1. Schwameder, H. Biomechanics research in ski jumping – 1991-2006. Sports Biomech, 2008, 7, 1, pp. 114-136.
2. Hochmuth, G. Telemark Landing, FIS Bulletin. 1999, 137, pp. 29-43.
3. FIS International Competition Rules Ski Jumping. Available online: http://www.fis-ski.com/inside-fis/document-library/ski-jumping/index.html#deeplink=rules
4. Bessone, V. et al. Ski movement during ski jump landing preparation and relation with impact forces, 2018

Oral presentations

OP-PM71 Obesity / diabetes and insulin resistance

THE EFFECT OF FREQUENCY OF INTERRUPTIONS IN SITTING TIME ON POSTPRANDIAL GLUCOSE METABOLISM: A RANDOMIZED CROSSOVER TRIAL

THORSEN, I.K., JOHANSEN, M.Y., BRINKLØV, C.F., PILMARK, N.S., JESPERSEN, N.Z., BENATTI, F.B., DUNSTAN, D.W., KARSTOFT, K., PEDERSEN, B.K., RIED-LARSEN, M.

RIGSHOSPITALET

INTRODUCTION: The primary objective of the trial was to investigate if the frequency of interruptions in prolonged sitting affects postprandial glycemic control in healthy, sedentary, overweight males under isocaloric conditions. The primary hypothesis was that frequent interruptions in sitting time would attenuate the postprandial plasma glucose response to prolonged sitting independent of energy intake or expenditure.
METHODS: Healthy, sedentary, overweight males (n=14) completed four 8-h interventions in randomized order: 1) uninterrupted sitting (SIT), 2) sitting interrupted by 2-min bouts of low-intensity physical activity (LPA; ~30% of VO2max) every 20th minute (INT20), 3) sitting interrupted by 6-min bouts of LPA every hour (INT60), and 4) sitting interrupted by 12-min bouts of LPA every second hour (INT120). During the interventions, standardized test drinks (50E% carbohydrate, 50E% fat) were served in the beginning of and 4 hours into the intervention. The primary outcome was the difference in the 8-h total area under the curve (tAUC) for plasma glucose between the active interventions (INT20, INT60, and INT120) and SIT. Secondary outcomes included the differences in 8-h tAUC for plasma insulin, C-peptide, and lipids, as well as in carbohydrate and fat oxidation between the active interventions and SIT.
RESULTS: The mean differences (95% CI) in tAUC for plasma glucose between SIT and INT20, INT60, and INT120 were -1.9% [-7.4; 3.6], 1.6% [-4.1; 7.3], and 0.5% [-5.0; 6.1], respectively. No difference in tAUC for plasma insulin or lipids were observed between any of the active interventions and SIT (p>0.05). However, the 8-h tAUC for plasma C-peptide was lower during INT20 compared to SIT (-8.3% [-15.8; -0.8]). Carbohydrate oxidation rates were higher during all active interventions compared to SIT (p<0.001), whereas fat oxidation rates were only higher during INT20 compared to SIT (34% [14; 55]).
CONCLUSION: Interrupting sitting with LPA at varying frequencies during an 8-h period did not attenuate the postprandial plasma glucose response to prolonged sitting in healthy, sedentary, overweight men. Nonetheless, frequent interruptions may reduce insulin release (reflected by lower postprandial plasma C-peptide response). Moreover, frequent interruptions in sitting may also induce a shift towards higher fat oxidation rates.

USEFULNESS OF CLINICAL MARKERS OF BODY COMPOSITION AND BODY FAT DISTRIBUTION FOR THE ASSESSMENT OF GLUCOSE METABOLISM OF TYPE II DIABETES PATIENTS

PIMENTA, N.M.1,2, MAGALHÃES, P.3

1: CIPER, FMH-ULISBOA , 2: ESDRM-IPS , 3: ESE-IPB .

INTRODUCTION: Central body fat (BF) distribution has been consistently found related to cardiometabolic risk, particularly glucose metabolism impairment (Sparrow et al., 1986). Lower body markers of BF have been found inversely related to insulin resistance despite overall and central BF (Livingston, 2006). Several novel body indexes and BF markers have been proposed to be useful for clinical practice since. Waist-to-Height ratio is one o such indexes that have been proposed to be superior to other clinical markers of body composition as predictors of cardiometabolic risk, including impaired glucose metabolism (Ashwel et al., 2016). The aim of this study was to determine if, and to what extent, classic and novel clinical surrogates of BF content and distribution, are related with glucose metabolism markers, in type II diabetes mellitus patients.
METHODS: We assessed 124 type II diabetes mellitus patients (57 males, 64±9 yrs, and 67 females, 65±8 yrs), who had been diagnosed for 9±7 yrs. BC and BF distribution assessment consisted of anthropometry, specifically: body circumferences (C), including waist-C and hip-C; body indexes (body mass index; body adiposity index [BAI]; waist-to-hip ratio [WHR] and waist-to-height ratio [WHtR]) and skinfold thickness (SKF), including triceps-SKF, subscapular-SKF, supra-iliac-SKF, thigh-SKF and calf-SKF. Glucose metabolism markers factors included fasting blood glucose and insulin, HbA1c, insulin resistance (HOMA-IR).
RESULTS: Partial and semipartial correlations, controlled for age, sex and BMI (except when BMI was a predictor; in this case waist-C was the controlling variable instead) showed that Hip-C, BAI, (r=0,30 and p<0,01 for both) Subscapular-SKF, Suprailiac-SKF, Thigh-SKF (r=0,22; r=0,20 and r=0,19 respectively; p<0,05) were all related with fasting glycaemia, and subscapular-SKF, supra-iliac-SKF, thigh-SKF and sum of SKF were associated with fasting insulin (r=0,43; r=0,34; r= 0,30; r=0,34, respectively; p<0.01). Thigh-SKF was the only BF marker correlated with HbA1c (r=-0,20; p>0,05). Hip-C, triceps-SKF, thigh-SKF and calf-SKF were all inversely associated, and WHR was positively associated, with HOMA-IR (r=-0,35; r=-0,29; r=-0,39; p<0,01 and r=0,26 and r=-0,27; p<0,05, respectively).
CONCLUSION: Thigh-C was the only BF marker related with all glucose metabolism markers supporting the relevance of this BF marker in these patients, in accordance with previous findings (Livingston, 2006). The present study also suggests peripheral BF may have a protective role against insulin resistance; meaning reduced peripheral BF may increase the risk of insulin resistance in these patients. The present results also suggest overall fat to be most relevant for explaining the variation of fasting glycemia, while subcutaneous fat seems to explain better the variation of fasting insulin. The follow up of these patients will allow the usefulness evaluation of the studied BF surrogates for the prediction of longitudinal variation of glucose metabolism.

SIMVASTATIN, INSULIN RESISTANCE AND EXERCISE TRAINING, THE LIFESTAT STUDY

KUHLMAN, A.B., HANSEN, M., KELLY, B., MIKKELSEN, L.B., REGNERSGAARD, S., NIELSEN, F.H., HEINRICHSEN, S., HELGE, J.W., DELA, F.

UNIVERSITY OF COPENHAGEN

INTRODUCTION: Statins lowers blood cholesterol. Frequent side effects to statin treatment are myalgia, muscle cramps and fatigue. Q10 is produced by the cholesterol metabolic pathway and therefore also lowered by statins. Lowered Q10-production has been suggested to be the background for statin-associated-myalgia. Statins may also increase the risk of type 2 diabetes. Myalgia may attenuate an otherwise physically active lifestyle and further increase the risk of type 2 diabetes.

Research questions: Does statins impair the training response, lowers insulin sensitivity and impair the insulin sensitizing effect of training? If so, can Q10 supplements alleviate this? Here we studied the training response and insulin sensitivity in Simvastatin-treated patients supplemented with Q10 compared with placebo and a control group not receiving any medication.
METHODS: 26 male patients with elevated blood cholesterol was randomized into Statins+Q10 (SQ; n=9), Statins+Placebo (SP; n=10) and placebo+placebo (CON; n=7) and performed 8 weeks of supervised bicycle training, 45 min, 3 times pr. wk. VO2max and maximal workload (Wmax) were measured at baseline, during and after training. Insulin resistance was measured as the glucose infusion rate (GIR, mg/min/kg) with a two-step (80 and 400 mU/m2/min) hyperinsulinemic euglycemic clamp.
RESULTS: Age was similar in the groups (56 ± 3 (SQ), 56 ± 3 (SP) and 63 ± 1 (CON) years (mean ± SE). Body weight did not change with the intervention (data not shown).
VO2max increased (P<0.05) in SQ (from 32±2 to 35±2 ml/min/kg), respectively, but not in SP or CON (from 30±1 and 34±2 to 32±2 and 33±2 ml/min/kg, respectively). Wmax always increased (P<0.05) with training (from 231±13, 252±19 and 265±13 to 274±13, 292±19 and 283±17 Watt in SP, SQ and CON, respectively).
GIR did not increase with training in any group (step 1: 6.9±0.6 vs. 7.0±0.5 (SQ), 7.0±0.5 vs. 7.6±0.9 (SP), 9.1±0.8 vs. 8.4±1.0 (CON); step 2: 10.6±0.5 vs. 10.9±0.8 (SQ), 10.7±0.5 vs. 11.5±0.8 (SP), 11.9±0.8 vs. 12.4±1.0 (CON)).
CONCLUSION: VO2max and Wmax responded to training as expected; lack of significance in VO2max in SP and CON may be due to lack of statistical power. Surprisingly, GIR did not change with the intervention, in spite of clear fitness effect and a supervised training. We found no indications that Simvastatin decreases insulin sensitivity in this 8 week study .

DETERMINE THE EARLY TIME-COURSE OF RESISTANCE EXERCISE TO FAILURE ON MUSCLE STRENGTH, SIZE AND INSULIN SENSITIVITY

ISMAIL, A.D.1,2, WILSON, J.1, JOHNSTON, L.1, GILL, J.M.R., GRAY, S.R.

[1]INSTITUTE OF CARDIOVASCULAR AND MEDICAL SCIENCES, UNIVERSITY OF GLASGOW, UK, [2]FACULTY OF SPORT SCIENCES AND RECREATION, UITM, MALAYSIA

INTRODUCTION: The maintenance of muscle size and function plays an important role in metabolic health, specifically as a risk factor for type 2 diabetes (1). Resistance exercise is efficacious in increasing muscle size and strength and also insulin sensitivity (2). However, the optimal make up (load, number of reps etc.) of resistance training is not yet known and recent evidence has shown that performing resistance exercise to failure, regardless of load, may be optimal. Whether resistance exercise to failure can improve insulin sensitivity remains to be investigated. Furthermore the time-course of the adaptations in muscle strength and size is not known.
The purpose of this study was to determine the effect of resistance exercise to failure on insulin sensitivity and the time-course of changes in muscle strength and size.
METHODS: 10 men (age 36 ± 8, height 175cm ± 8, weight 89kg ± 14, BMI 29 ± 5,) were recruited to the study. Resistance exercise involved training all major muscle groups with 1 set to failure at 80%1RM with 3 sessions per week for 6 weeks. Muscle strength (knee extensor MVC) and muscle thickness (ultrasound) were measured at baseline, week 0, 1, 2, 3, 4, 5, 6 and 3 days after the last session of resistance exercise. An oral glucose tolerance test was performed at baseline and 3 days after the last session of resistance exercise.
RESULTS: Knee extensor MVC increased (P<0.05) over 6 weeks of training from 180.9Nm ± 37.88 to 228.4Nm ± 44.69 with MVC each week higher (P<0.05) than the preceding week. Muscle thickness increased (P<0.05) over 6 weeks of training from 21.5mm ± 3.15 to 23.7mm ± 3.21 with muscle thickness each week higher (P<0.05) than the preceding week. Insulin sensitivity (glucose area under the curve during OGTT) increased (P<0.05) after training from 6.34mmol/L ± 1.05 to 5.91mmol/L ± 1.28.
CONCLUSION: Our data demonstrates that 6 weeks of resistance exercise to failure increases muscle size and strength progressively and results in improved insulin sensitivity.
References:
1. DeFronzo RA, Bonadonna RC, Ferrannini E. Pathogenesis of NIDDM. A balanced overview. Diabetes Care. 1992; 15(3):318-68.
2. Fiatarone MA, Marks EC, Ryan ND, Meredith CN, Lipsitz LA, Evans WJ. High-intensity strength training in nonagenarians. Effects on skeletal muscle. JAMA: The Journal of the American Medical Association. 1990; 263(0098-7484; 22):3029-34.

EFFECTS OF SIX MONTHS SUPERVISED PHYSICAL TRAINING ON MUSCLE STRENGTH AND AEROBIC CAPACITY IN PATIENTS UNDERGOING ROUX-EN-Y GASTRIC BYPASS SURGERY - A RANDOMIZED CONTROLLED TRIAL

MUNDBJERG, H.L., STOLBERG, C.R., BLADBJERG, E.M., FUNCH-JENSEN, P., JUHL, C.B., GRAM, B.

UNIVERSITY OF SOUTHERN DENMARK AND HOSPITAL OF SOUTHWEST JUTLAND

INTRODUCTION: Obesity and physical inactivity are major health problems. Roux-en-Y gastric bypass surgery results in significant weight loss and reduces obesity related morbidity and mortality. Physical activity lowers the risk of cardiovascular disease and premature death. The aims of this study were to elucidate the effects of RYGB followed by six months of supervised physical training on physical capacity.
METHODS: In a randomized controlled trial, 60 participants eligible for RYGB were randomized six months post-surgery to either two weekly supervised physical training sessions for 26 weeks or a control group . The intervention period was divided into three phases lasting from week 1-8, week 9-18 and week 19-26, respectively. For each phase, the intensity for the aerobic training and the muscle strength training was increased. The control group was not offered exercise training but received the hospital's standard treatment for patients undergoing RYGB. Aerobic capacity , muscle strength in shoulder and hip and physical function were measured pre-surgery and 6, 12 and 24 months post-surgery. Furthermore, functional capacity was measured by Sit-to-Stand test and Stair Climb Test.
RESULTS: RYGB per se decreased MS in all tested muscle groups, had no effects on VO2max but improved physical function. After the intervention INT had a significant 0.33 L/min increase in VO2max compared to CON <95% CI: 0.07 - 0.57, P=0.013>. Furthermore, MS in the hip adductor increased significantly with 13 N <95% CI: 3.6 – 22.4, P=0.007> and a between-group difference were found in the Stair Climb Test <0.46 repetitions <95% CI: 0.02 – 0.91, P=0.042>. The effects were not maintained at follow up.
CONCLUSION: Supervised physical training following RYGB improved VO2max, hip MS and physical function, but the positive effects were not maintained at follow-up. While daily life activities may become easier as a result of RYGB, the observed extensive post-operative loss of MS requires more attention to increase the patients physical capacity prospectively. Further research in this field is needed to determine in detail the composition of physical training programs for bariatric surgery patients and how to maintain the positive effects of the intervention after termination of supervision.

Oral presentations

OP-PM73 Sports medicine mixed

DEVELOPING A MOTOR ANALOGY TO PROMOTE SAFER LANDING BY OLDER ADULTS WHO FALL UNEXPECTEDLY

MASTERS, R.S.W., BARBOUR, K., HÉBERT-LOSIER, K., PARSONS, J., PARSONS, M., UIGA, L.

UNIVERSITY OF WAIKATO, WAIKATO DISTRICT HEALTH BOARD, & UNIVERSITY OF AUCKLAND

INTRODUCTION: Most research into falling by older people focuses on prevention of falls. Minimal research has focused on promotion of safer falls (that is, landing in a way that minimises severity of injury). There is little time during a fall to explicitly recall (and process) instructions for safe landing, so our goal is to develop a motor analogy (e.g., Masters et al, 2008) that behaves like a 'fast and frugal' heuristic or rule of thumb (Gigerenzer & Goldstein, 1996). We hypothesise that such an analogy will help an older person de-risk landing in the event of an unexpected fall. In the first stage of the research, we explored the processes of falling and landing, and generated potential ideas for motor analogies, by conducting focus group work with people who had experienced falling or who worked in fall-related disciplines.
METHODS: Focus group interviews were conducted with 19 participants, including older adult fallers, physiotherapists and occupational therapists, martial artists, gymnasts, dancers, parkour enthusiasts and health and safety experts. All participants had significant experience associated with falling or fall prevention. Interviews were recorded, transcribed and then processed independently by two reviewers.
RESULTS: Qualitative data analysis revealed major themes that suggested: (1) a scarcity of formal information to allow specialists to make recommendations about the best way to fall/land (consequently, therapists seldom offer advice about how to fall/land, preferring instead to concentrate on prevention); (2) a safe-landing analogy has considerable appeal as a clinical tool; (3) a safe-landing analogy would need to be processed rapidly enough to be effective in the brief duration of a fall; (4) a safe-landing analogy would need to be relevant to, an understood by, a maximum number of older people; (5) there are many circumstances and environments in which older people fall, so one analogy may not fit all occasions.
CONCLUSION: There was good 'in principle' support for the concept of a motor analogy that facilitates better landing in the event of a fall, but research is needed to establish whether there is a safest way to land and whether analogies can be processed rapidly enough to be used in the event of a fall. There may be no single biomechanical technique that is effective in all fall circumstances (e.g., slip v. trip) or environments (e.g., bathroom v. footpath). Consequently, an analogy that encourages an older person to fall in a manner that is slow, soft and silent (for example) may have greater utility because it facilitates context-specific self-organisation by the motor system.
REFERENCES: Gigerenzer, G. & Goldstein, D.G. (1996). Reasoning the fast and frugal way: Models of bounded rationality. Psychological Review, 103, 650–69.
Masters, et al (2008). Implicit motor learning and complex decision making in time constrained environments. Journal of Motor Behavior, 40, 71-9.

THE EFFECTS OF CUPPING THERAPY ON PHYSICAL PERFORMANCE AND TISSUE OXYGENATION AFTER MUSCLE FATIGUE

HO, H.C., LEE, H.J.

NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: Cupping therapy is commonly applied as an alternative tool in the traditional Chinese medical treatment. It is used mostly on musculoskeletal disease, especially nonspecific neck pain and low back pain. Recently, various athletes have adopted cupping therapy treating musculoskeletal discomforts. However, there is not much research about whether cupping therapy could improve sports performance or accelerate fatigue eliminating. Therefore, the aim of this study was to exam the effects of cupping therapy on physical performance and tissue oxygenation after muscle fatigue.
METHODS: Nine healthy adults (Age:24±2.3 yrs) were volunteered for this study. They were asked to do continuous knee extension to measure peak torque of knee extensor and induce muscle fatigue on the isokinetic dynamometer (Biodex). Fatigue was defined that knee extension torque was smaller than half of the peak torque three consecutive times. In this study, vastus medialis of dominant leg was used for cupping therapy intervention. Near infrared spectrometer (NIRS) was placed 5cm upward from the vastus medialis to collect muscle oxygen saturation (Li, Li, Lin, and Li, 2016) during the whole experiment. Subjects were randomized assigned to control, cupping therapy or cupping therapy combined active recovery group after muscle fatigue. After 5 minutes intervention, they would receive 30 minutes static recovery. Every 5 minutes interval of recovery phase, joint torque and muscle oxygen saturation were be examed. Two way ANOVA was conducted to compare difference between three groups. Bonferroni post hoc was used to further analysis.
RESULTS: There was no significant difference in change of knee extension torques among two different cupping interventions and control group during 30 minutes recovery after muscle fatigue. Tissue saturation index and oxygenated hemoglobin in two intervention groups were significant higher than the control group from intervention to recovery. In contrast, deoxygenated hemoglobin in two intervention groups were significant lower than the control group.
CONCLUSION: In this research, significant difference was found on physiological parameters between cupping therapy intervention and control group. According to past studies, muscle oxygen saturation would significantly decrease during exercise and return to pre-exercise level after exercise. Furthermore, the muscle oxygen consumption after exercise would be higher. Therefore, increasing blood circulation and metabolism by cupping therapy could improve the recovery of muscle (Roberts et al., 2015). The result showed that oxygenated hemoglobin and tissue saturation index in two intervention groups were both higher than control. Therefore, both kinds of intervention could improve blood circulation and tissue oxygen level and further accelerate fatigue eliminating. Thus, cupping therapy could be an optional application to eliminate muscle fatigue after exercises.

PREDICTIVE POWER OF ENTRY TESTS IN BASIC MILITARY TRAINING

BESENIUS, E., MALISOUX, L., BONERT, C., THEISEN, D.

SPORTS MEDICINE RESEARCH LABORATORY, LUXEMBOURG INSTITUTE OF HEALTH

INTRODUCTION: A concerning number of new recruits enrolled in the Luxembourg army do not successfully complete their basic military training (BMT). As a military career is characterized by high physical demands, the selection process of new recruits is strongly based on

physical fitness entry tests. The purpose of this ongoing prospective study is to investigate the predictive power of the physical fitness entry tests in the Luxembourg army for final success in BMT, as well as for the risk of sustaining musculoskeletal (MSK) injuries.
METHODS: A dedicated online Training & Health Monitoring System was used to collect data related to anthropometry (age, height, weight, sex), entry physical fitness tests, injuries assessed by the medical doctor, daily training logs and final evaluations for each recruit. Multiple logistic regressions were used to compute odds ratios (OR) and their 95% confidence intervals (95%CI) to identify risk factors for failure and for sustaining MSK injuries. Significance was set to $p<0.05$.
RESULTS: Preliminary data show that 357 recruits were enrolled in the Luxembourgish army for a 4-month BMT in 2016 & 2017. A total of 349 participants (92% male, 20.8±1.9 years, 176.6±8.0 cm, 73.2±11.6 kg) provided their written informed consent. Entry physical fitness test performances were 606±77 cm for 3 kg ball throwing, 63±9 sit-ups/2 min, 53±10 push-ups/2 min, 224±20 cm for the standing broad jump, 4.7±0.3 s for a supine start 30-m sprint test and 11.2±1.2 min for the 2400 m endurance run.
In total, 133 recruits (38%) did not succeed in their BMT: 27 (8%) due to medical reasons, 60 (17%) for personal motives, 28 (8%) because of failure in the final exams and 18 (5%) due to dismissal for disciplinary reasons.
A total of 215 MSK injuries were recorded for 141 recruits. The knee was the most concerned location with 91 injuries (42%), followed by the ankle (n=40; 18%). Muscle strains were the most common type of injury (n=47; 22%), followed by tendon strains (n=43; 20%) and joint sprains (n=41; 19%). Injuries lasted between 1 and 52 days (mean 7.7 days) and occurred mostly during marching (n=47; 22%), running (n=30; 14%) and field training (n=26; 12%).
Recruits successfully finishing their 4-month BMT recorded in average 289 hours of physical training.
Multiple regressions using sex, age, height, weight and the six physical fitness entry tests revealed the following results: Age (year; OR=1.18; 95%CI=1.02 to 1.36; p=0.02) and the performance in the entry endurance test (min; OR=0.72; 95%CI= 0.57 to 0.92; $p<0.01$) were associated with the risk for failing the BMT, with the younger recruits and the poorest endurance performers being at higher risk for failure. No significant association with MSK injuries was found based on the present preliminary dataset.
CONCLUSION: Preliminary data of this ongoing prospective study suggests that endurance capacity is the main predictor for successful completion of BMT. Other, potentially more discriminant tests should be studied as success predictors.

THE WITHIN-SUBJECT CORRELATION BETWEEN SALIVARY IGA AND MEASURES OF INTERNAL AND EXTERNAL LOAD IN ELITE SOCCER PLAYERS

FIGUEIREDO, P.1,2, NASSIS, G.3, BECKERT, P.1, MARTINHO, C.J.1, REBELO, P.1, GASPAR, J.1, BRITO, J.1

1: FPF , 2: CIDESD-ISMAI , 3: ASPETAR

INTRODUCTION: Salivary secretory immunoglobulin A (sIgA) provides a non-invasive assessment that may be useful to monitor soccer players responses to training along with measures of training load. There are seldom attempts to quantify the association between sIgA and measures of training load, but these are limited by suboptimal statistical approaches, including pooling of the data and sample mean correlations. In repeated-measures studies, it is important to quantify within-subject correlations, by modelling the longitudinal dataset as a whole and reducing the variation between subjects. Therefore, the aim of this study was to quantify the correlation between the sIgA and measures of internal and external load in elite soccer players during training.
METHODS: Saliva samples of 18 elite male soccer players were collected in four consecutive days (prior to breakfast) of the preparation camp for Rio 2016 Olympic Games. Internal training load was quantified using the session rating of perceived exertion (s-RPE) and external training load via GPS pods.
Within-subject correlation coefficients between training load parameters and next day sIgA were calculated (Bland and Altman, 1995), and magnitude of relationships were assessed according to Hopkins et al. (2009).
RESULTS: In general, internal training load presented a smaller association with sIgA than some of the external load variables explored. The within-subject correlations between sIgA and training load variables were of moderate to large magnitude (s-RPE, r = -0.39; total distance covered, r = -0.55; number of accelerations, r = -0.52, number of decelerations, r = -0.48), except for high-speed distance covered (r = -0.23), number of sprints (r = -0.18), and distance covered per minute (r = 0.01).
CONCLUSION: This study showed moderate to large associations between sIgA and internal and external load variables considering a within-subjects design. Total distance covered, which is typically considered a measure of training volume, had a large negative correlation with sIgA response. The trivial to small associations with distance covered per min and high-speed distance covered suggest that sIgA is not related to training intensity. Thus, sIgA might be more responsive to training volume rather than intensity, despite the associations detected for accelerations and decelerations.
The within-subject correlations used in the current study may give a more accurate and useful representation of the relationship between sIgA and internal and external load variables to strategically individualize optimal preparation in elite soccer players.
REFERENCES:
Bland JM, Altman DG (1995). BMJ, 310 (6977), 446.
Hopkins W, Marshall S, Batterham A, Hanin J (2009). Med Sci Sports Exerc, 41, 3-13.
CONTACT:
pedro.figueiredo@fpf.pt

Oral presentations

OP-PM45 Sleep

IMPROVING SLEEP IN PROFESSIONAL RUGBY PLAYERS: A PILOT INTERVENTION STUDY

MAHONY, L., LYONS, D., BIGGINS, M.

CONNACHT RUGBY, GALWAY; RUGBY PLAYERS IRELAND, DUBLIN; SCHOOL OF ALLIED HEALTH, UNIVERSITY OF LIMERICK

INTRODUCTION: Poor sleep quality is prevalent in elite athlete populations (Shearer et al., 2015) and calls have been made to educate athletes on how to improve their total sleep time, sleep/wake schedules and overall sleep hygiene (Swinbourne et al., 2015). The purpose of this study was to evaluate the effectiveness of a sleep intervention in professional rugby players. Sleep was measured using the Pittsburgh Sleep Quality Index (PSQI) questionnaire (Buysse et al., 1989).

METHODS: A sample of professional rugby players (n=50, age 26.4 ± 2.9, weight 102.5kg ± 11.5, height 186.5cm ± 7.4) completed the PSQI mid-way through their season. The results of the survey were reported to the players and a sleep intervention program was developed to inform players on the importance of sleep for performance and recovery. This program consisted of two one-hour education workshops focusing on the link between sleep habits and performance (workshop 1) and good sleep hygiene (workshop 2). Information awareness posters were developed, and players were advised to target 2-3 behaviours. The PSQI questionnaire was repeated after 6 weeks (n=48).
RESULTS: At baseline 72% of the players (n=36) were classified as poor sleepers (PSQI ≥ 5). Post intervention, 52% of players (n=25) were classified as poor sleepers. Baseline and post intervention PSQI scores were 5.8, (SD±2.07) and 5.0, (SD±2.35). There was a statistically significant difference in sleep quality in groups pre and post intervention (p=0.02).
CONCLUSION: The incidence of poor sleep is high amongst professional rugby players in season. Significant improvements can be made through education and increased awareness. Simple actions that players can put in place to improve sleep include adjusting bedtime to suit training schedules, making use of naps and 'banking' sleep prior to travel.
Objective sleep measurements such as actigraphy watches, alongside questionnaires, could improve the quality of data gathered and provide further significant insights into actual sleep patterns of professional rugby teams in Ireland.
References: Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ (1989) The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research, Psychiatry Res. 28(2):193-213
Shearer, D.A., Jones, R.M., Kilduff, L.P. & Cook, C.J. (2015) Effects of competition on the sleep patterns of elite rugby union players, European Journal of Sport Science, 15:8, 681-686
Swinbourne, R, Gill, N., Vaile, J & Smart, D. (2015) Prevalence of poor sleep quality, sleepiness and obstructive sleep apnoea risk factors in athletes, European Journal of Sport Science, 16:7, 850-858
Contact: Laura.mahony@connachtrugby.ie

THE EFFECTS OF NAPPING AFTER SLEEP DEPRIVATION ON AUDITORY REACTION TIME AND SPECIFIC SPORT SKILLS IN MALE COLLEGIATE SOCCER PLAYERS.

RAMYARANGSI, P.1, SIRIPORNPANICH, V.2, WIDJAJA, W.1, AJJIMAPORN, A.1

MAHIDOL UNIVERSITY

INTRODUCTION: Soccer players are frequent traveling because of the competition that may affect sleep quantity and quality, resulting from the lower ability of physical performance (Richmond et al., 2007). Recently, improvement of cognitive performance after napping (brief sleep) has been reported in healthy males (Waterhouse et al., 2007). However, whether napping after sleep deprivation can have benefits on reaction time and sport skills in soccer players is unclear. The aim of this study was to examine the effects of sleep condition on auditory reaction time (ART) and soccer skills in male collegiate soccer players.
METHODS: Eleven male collegiate soccer players (age 20±2 years, non-habitual nappers) participated in a randomized repeated measures design study. The participants recorded the ART using oddball paradigm which they were instructed to respond as quickly as possible to the rare high-pitch sound (25%) presented via a headphone and then performed specific sport skills test including Loughborough Soccer Shooting Test (LSST) and Loughborough Soccer Passing Test (LSPT) after undergoing three sleep conditions; normal sleep (NS), sleep deprivation (SD, sleep 3 hours) and napping after sleep deprivation (NaSD, sleep 3 hours and nap after lunch for 20 minutes).
RESULTS: This study demonstrated significantly longer ART to respond to the target during the auditory oddball paradigm after SD (P=0.006) and NaSD (P=0.009) compared to NS. For soccer skills, the penalty time of LSPT decreased after NaSD compared to NS (P=0.011) and SD (P=0.038). In addition, the performance time of LSPT decreased after NaSD than SD (P=0.044). The time of the LSST was similar between conditions (P>0.05).
CONCLUSION: Delayed ART indicates the slower speed of processing in attention pathway after SD and NaSD conditions. Shorter duration of LSPT but not LSST indicates that gross motor performance of soccer players may be partially improved after napping. Therefore, this study suggests that a 20-min nap after lunch following sleep deprivation had partial beneficial effects on specific soccer skills, but not attention.
References: Richmond, L. K., B. Dawson, G. Stewart, S. Cormack, D. R. Hillman and P. R. Eastwood (2007). Journal of Science and Medicine in Sport 10(4): 252-258.
Waterhouse, J., G. Atkinson, B. Edwards and T. Reilly (2007). Journal of Sports Sciences 25(14): 1557-1566.
Contact: RAMYARANGSI P.: Papatsorn.ram@student.mahidol.ac.th
AJJIMAPORN A.: g4036011@gmail.com

THE EFFECTS OF ONE-NIGHT SLEEP DEPRIVATION AND ONE-NIGHT SLEEP RECOVERY ON ENDURANCE PERFORMANCE

GATTONI, C., O'NEIL, B.V.2, MARCORA, S.1

UNIVERSITY OF KENT

INTRODUCTION: It has been demonstrated that sleep deprivation (SD) negatively affects endurance performance (Martin 1981; Martin and Chen 1984; Oliver et al. 2009; Azboy et al. 2009); however, no data are available on how long it takes to recover from SD as yet. Therefore, the aim of the study was to investigate the acute effects of SD and sleep recovery (SR) on endurance performance by evaluating exercise performance changes. The final results of this study might provide relevant information on the potential applications of SR in endurance performance.
METHODS: Twenty men amateur cyclists/triathletes (means ± SD: age 30.7 ± 8.1 yr, body mass 73 ± 10 kg, height 1.77 ± 0.09 m, VO2max 54.2 ± 4.8 ml/kg/min) were randomly allocated to two groups (SD and Control (CON)) and tested over three consecutive days. After baseline testing on Day 1, subjects in the SD group were asked not to sleep for 25-h (SD condition) on Day 2, and then sleep normally the following night (SR condition) (Day 3). Subjects in the CON group were required to sleep normally throughout the entire experiment and to attend the same testing sessions. Endurance performance during a 20-min Time-Trial (TT) was measured after 40 minutes of cycling at 60% of their VO2max. Continuous EEG measurements were collected throughout the entire cycling test.
RESULTS: Ratings of sleepiness revealed a trend for a significant effect of SD (group x day interaction) (P = 0.059). However, a preliminary 2-way mixed model ANOVA (group x day) revealed no significant effect of SD on TT work (group x day interaction) and no main effect of group. A pairwise comparison revealed a main decline on Day 2 (Day 1 297.5 ± 9.9 kJ, Day 2 283.3 ± 9.9 kJ, P = 0.001) and a trend for a main improvement on Day 3 compared to Day 2 (Day 3 291.8 ± 10.4 kJ, P = 0.086). EEG results will be provided in a second moment.

CONCLUSION: In conclusion, one night of SD might not be enough to impair endurance performance in men amateur cyclists/triathletes. Consequently, the following night of sleep would not be needed to recover from 25-h SD. However, the current results are partial and further data needs to be collected to draw a firmer conclusion on the role played by SD and SR on endurance performance.
REFERENCES:
Martin JB. Effect of sleep deprivation on tolerance of prolonged exercise. Eur J Appl Physiol 47: 345-354, 1981.
Martin JB and Chen HI. Sleep loss and sympathoadrenal response to exercise. Med Sci Sport Exer 16: 56-9, 1984.
Oliver SJ, Costa JSC, Laing SJ, Bilzon JL, Walsh NP. One night of sleep deprivation decreases treadmill endurance performance. Eur J Appl Physiol 107: 155-161, 2009.
Azboy O, Kaygisiz Z. Effects of sleep deprivation on cardio-respiratory functions of the runners and volleyball players during rest and exercise. Acta Physiol Hung 96(1): 29-36, 2009.

EFFECT OF VIGOUROUS LATE-NIGHT EXERCISE ON SUBSEQUENT SLEEP ARCHITERCTURE AND CORE BODY TEMPERATURE

ALOULOU, A., DUFOREZ, F., NEDELEC, M.
INSTITUT NATIONAL DU SPORT DE LEXPERTISE ET LA PERFORMANCE

INTRODUCTION: Sleep is well recognized as one of the most important component of the recovery process among athletes (Venter, 2014). Press demands from media require elite athletes to perform several night-time competitions throughout a season, which may have consequences for both sleep and recovery. It is currently not known to what extent athletes sleep quantity and quality are impaired following night exercise. The aim of this study was to assess the effect of late-night high-intensity intermittent exercise on sleep architecture and core body temperature (CBT).
METHODS: In a randomized counterbalanced order, twelve well-trained male runners (age: 32 ± 5 years; VO2max: 68 ± 6 mL/min/kg; MAS: 18 ± 1.5 km/h), accustomed to train in the evening, completed a trail run simulation (TRAIL) (start at 21:00) and a control condition (CONT). The simulation lasted 48 minutes and was composed of 5 consecutive blocks (Adapted from Hausswirth et al., 2011). Each block of 9 minutes included 3min downhill (-12.5%), followed by 3min intermittent run on the flat (0%) and 3 min uphill (+10%). The exercise intensity was individualized to each participant according to his MAS. After each condition, a full laboratory sleep analysis with polysomnography and CBT analysis was performed. Markers of muscle damage (maximal voluntary contraction [MVC], plasma creatine kinase [CK] and subjective ratings) were recorded before, immediately after exercise (post), post 24 h, and post 48 h.
RESULTS: The TRAIL induced a high level of fatigue and significant muscle damage. A reduction of MVC, an increase in CK activity and muscle soreness were observed in TRAIL compared to CONT until post 48h ($p<0.05$). However, no differences were observed in sleep variables, i.e. sleep efficiency, sleep onset latency, wake after sleep onset, fragmentation index, total sleep time and time spent in each sleep stages during the whole night. Compared to CONT, TRAIL significantly increased CBT immediately after exercise ($p<0.01$). CBT rapidly fall down after TRAIL and no significant difference between the two conditions was observed twenty minutes after exercise.
CONCLUSION: Sleep architecture is not affected by vigorous late-night exercise for well-trained athletes accustomed to train in the evening. The exercise-induced increase of CBT does not delay sleep onset nor affect the sleep architecture.
REFERENCES:
Hausswirth, C., Louis, J., Bieuzen, F., Pournot, H., Fournier, J., Filliard, J. R., & Brisswalter, J. (2011). Effects of whole-body cryotherapy vs. far-infrared vs. passive modalities on recovery from exercise-induced muscle damage in highly-trained runners. PLoS ONE, 6(12), e27749.
Venter, R. E. (2014). Perceptions of team athletes on the importance of recovery modalities. Eur J Sport Sci, 14 Suppl 1, S69-76.

THE RELATIONSHIP BETWEEN OBJECTIVE MEASURES OF SLEEP AND TRAINING LOAD ACROSS PHASES OF THE AMERICAN COLLEGIATE FOOTBALL SEASON

FULLAGAR, H., SAMPSON, J., MCKAY, B., DELANEY, J., MURRAY, A.
UNIVERSITY OF TECHNOLOGY SYDNEY

INTRODUCTION: American collegiate football players endure a prolonged recovery process with perceptions of wellness taking >4 days to return to pre-game levels[1]. Furthermore, it is known that 60% of college students suffer from poor sleep quality[2] which along with schooling and athletic expectations for student-athletes, suggests ACF players may be an at sleep-risk cohort. However, objective evidence of sleep patterns in ACF players is limited and we are unaware of any study that has examined the relationship between sleep and training load, across the ACF season. Thus, this study investigated the relationship between objective measures of sleep and training load across different phases of the season in ACF players.
METHODS: Twenty-three ACF players <21.1±1.2 years; 108.0±20.0 kg> participated in this descriptive, observational design in the 2017 season. Objective sleep parameters from wrist-watch actigraphy and daily training output data from accelerometry were collected during Off-season, Camp , In-season and School phases . The relationships between each sleep/training parameter and phase were assessed using linear mixed models. A magnitude-based approach was employed where effects were considered real if the likelihood of the effect being greater than 0.20 exceeded 75%, 95% and 97% for likely, very likely and almost certainly, respectively.
RESULTS: Total minutes in bed were likely lower during Camp and In-season compared to Off-season phases <40 minutes, ES=-0.35, 91%; 42 minutes, ES=-0.37, 93% respectively>. Total sleep time was also likely shorter in Camp <41 minutes, ES=-0.35, 91%> and In-season <56 minutes, ES=-0.48, 99%> compared to the Off-season. When accounting for changes in PL between phases, sleep latency was likely increased <1.01, ES=0.52, 89%> during the School phase.
CONCLUSION: Sleep time is reduced during periods of intensified training in ACF players, however these differences between season phases are dissipated when accounting for changes in external load. Variation to training schedules during phases may also account for these differences in sleep parameters and should be a focus of future research. The increase in sleep latency within school phases is also noteworthy and may have important practical considerations for coaches when prescribing training and/or recovery.
References: 1. Fullagar, et al. Int J Sports Physiol Perform. 2017. 12<9>:1264-1266
2. Lund, et al. J Adolesc Health. 2010 Feb; 46<2>:124-32.
Contact: Hugh.Fullagar@uts.edu.au

THE EFFECTS OF GAMES AND TRAVEL ON SUPER RUGBY PLAYERS. IS SLEEP THE KEY?

LO, M., AUGHEY, R.J., HOPKINS, W.G., STEWART, A.

VICTORIA UNIVERSITY

INTRODUCTION: Travel across time zones can have detrimental effects on athletes. Regular air travel is common in sport. The aim of this study was to understand the extent to which travel affect sleep, wellness, training and performance of Super Rugby players.
METHODS: 122 players from 4 professional Super Rugby teams were monitored during the 2017 Super Rugby season for games played in their own country (home and away) and overseas. Participants' sleep was monitored using sleep logs, and wrist activity monitors. Training, wellness and key performance indicators (KPIs) data were provided by the teams. Changes in sleep and wellness were calculated in comparison to baseline for the pre-game, game and post-game days for the matches played locally using a mixed linear model. The estimate changes from baseline were also calculated for the period spent overseas and, when possible, upon return, including changes in training. Changes in KPIs for overseas, and upon return games were calculated using a generalized linear mixed model. Number of time zones crossed, direction of travel and number of days post travel were included as co-variables.
RESULTS: Sleep and wellness are reduced around game time (up to 134 min and 30.7 points less) and when overseas (up to 64 min and 41.5 points less). Even if teams seem to modify training whilst overseas, seemingly to address travel, players' performance was poorer overseas and upon return. For instance, Positive KPIs (a combination of number of carries, defenders beaten and clean breaks) reduced up to 28.5%, whilst Negative KPIs (number of missed tackles, turnovers and penalties conceded counted together) increased up to 76.5% in comparison to local games
CONCLUSION: The changes in wellbeing, sleep and performance confirm that several psychological and physiological stressors can negatively affect rugby players around game time (Juliff et al., 2015) and after trans-meridian travel (Fowler et al.,2017; Kolling et al., 2017). Although important, it seems that sleep disruption is not the main reason behind poorer performance with travel. Further research should identify strategies to enhance performance, health and wellness of rugby players or other athletes when travelling across time zones for competition.
REFERENCES:
Fowler PM, McCall A, Jones M, Duffield R. (2017). J Sci Med Sport, 20(4), 322-327.
Juliff LE, Halson SL, Peiffer JJ. (2014). J Sci Med Sport. 18(1), 13-18.
Kolling S, Treff G, Winkert K, Ferrauti A, Meyer T, Pfeiffer M, Kellmann M. (2017). J Sports Sci, 35(22), 2240-2248.
CONTACT:
Michele.lo@live.vu.edu.au

THE RELATIONSHIP BETWEEN SERUM VITAMIN D LEVELS AND SLEEP QUALITY AMONG SEDENTARY PEOPLE AND RUNNERS

VAISBERG, M.1, SANTOS, J.M.B.1, LUNA JUNIOR, L.A.1, FOSTER, R.2, VIEIRA, R.P.2, KATEKARU, C.M.

FEDERAL UNIVERSITY OF SÃO PAULO<1> NOVE DE JULHO UNIVERSITY <2>

INTRODUCTION: Sleep is a functional state, reversible and cyclical.[1] In this report, the Pittsburgh Sleep Quality Index (PSQI) have been used to appraise the topic quality of sleep[1]. One of the most important roles of vitamin D is to control the inflammatory response due to its strong immunomodulatory activity[3]. In addition, a recent research has presented that vitamin D also influences the sleep quality. The aim of this report is to analyze if serum vitamin D levels can influence the sleep quality among runners and sedentary people
METHODS: Fifty-three individuals living in the city of São Paulo were recruited, being twenty-seven runners and twenty-six sedentary. All participants responded PSQI, which can demonstrate the sleep quality of the individuals and attributed a scale 1 to 3 in the PSQI result to be statistically analyzed; the scale 1 was attributed to "good sleep quality", scale 2 as "bad sleep quality" and scale 3 as "indication of sleep disorders". Furthermore, they also went through a peripheral blood analysis to measure vitamin D. Mann-whitney tests with a significance level of 5% were used for data analysis. Not to mention, the study is following the conditions of the ethics committee on human research of the Federal University of São Paulo under number 049494/2016
RESULTS: We found a decrease in vitamin D ($p = 0.01$) in the sedentary group when compared to the runner group. The analysis of the Pittsburgh questionnaire revealed a worsening of sleep quality in the sedentary group compared to the runners ($p = 0.005$)
CONCLUSION: Studies have implied that low vitamin D predisposes to sleep disorders, and comparing our results with those research studies we can state that the statements are truthful. However, the prevalence of bad quality sleep was significantly lower between runners, which can lead to a positive effect of exercising in preventing this sleep disorders. Our results suggest that vitamin D levels and the quality of sleep are correlated. In conclusion, we could say that the exercising has a relevant and significant role in the quality and improvement of the sleep pattern.

Oral presentations

OP-PM58 Physical activity: children

CROSS-SECTIONAL ASSOCIATIONS OF OBJECTIVELY-MEASURED PHYSICAL ACTIVITY AND SEDENTARY TIME WITH BODY COMPOSITION AND CARDIORESPIRATORY FITNESS IN MID-CHILDHOOD: THE PANIC STUDY

COLLINGS, P.J., WESTGATE, K., VÄISTÖ, J., WIJNDAELE, K., ATKIN, A.J., HAAPALA, E.A., LINTU, N., LAITINEN, T., EKELUND, U., BRAGE, S., LAKKA, T.A.

UNIVERSITY OF CAMBRIDGE

INTRODUCTION: The minimum intensity of physical activity (PA) that is associated with favourable body composition and cardiorespiratory fitness (CRF) remains unknown. The objective of this study was to investigate cross-sectional associations of PA and sedentary time (ST) with body composition and CRF in mid-childhood.
METHODS: PA, ST, body composition and CRF were measured in a population-based sample of 410 children (aged 7.6 ± 0.4 years). Combined heart-rate and movement sensing provided estimates of PA energy expenditure (PAEE, kJ/kg/day) and time (min/day) at multiple fine-grained metabolic equivalent (MET) levels, which were also collapsed to ST and light PA (LPA), moderate PA (MPA) and vigorous PA (VPA). Fat mass index (FMI, kg/m2), trunk fat mass index (TFMI, kg/m2) and fat-free mass index (FFMI, kg/m2.5) were derived

from dual-energy X-ray absorptiometry. Maximal workload from a cycle ergometer test provided a measure of CRF (W/kg FFM). Linear regression and isotemporal substitution models were used to investigate associations.
RESULTS: The cumulative time above 2 METs (221 J/min/kg) was inversely associated with FMI and TFMI in both sexes ($p < 0.001$) whereas time spent above 3 METs was positively associated with CRF ($p = 0.002$); CRF increased and adiposity decreased dose-dependently with increasing MET levels. ST was positively associated with FMI and TFMI ($p < 0.001$) but there were inverse associations between all PA categories (including LPA) and adiposity ($p = 0.002$); the magnitude of these associations depended on the activity being displaced in isotemporal substitution models but were consistently stronger for VPA. PAEE, MPA and to a greater extent VPA, were all positively related to CRF ($p = 0.001$).
CONCLUSION: PA exceeding 2 METs is associated with lower adiposity in mid-childhood, whereas PA of 3 METs is required to benefit CRF. VPA was most beneficial for fitness and fatness, from a time-for-time perspective, but displacing any lower-for-higher intensity may be an important first-order public health strategy.
Full-text citation: Collings PJ, Westgate K, Väistö J, Wijndaele K, Atkin AJ, Haapala EA, et al. Cross-Sectional Associations of Objectively-Measured Physical Activity and Sedentary Time with Body Composition and Cardiorespiratory Fitness in Mid-Childhood: The PANIC Study. Sports medicine. 2017 2017/04/01;47(4):769-80.

OBJECTIVELY ASSESSED PHYSICAL ACTIVITY OF PRIMARY SCHOOL CHILDREN IN GERMANY WITH AND WITHOUT MIGRATION BACKGROUND

KOBEL, S., KETTNER, S., STEINACKER, J.M.

ULM UNIVERSITY

INTRODUCTION: Obesity in combination with physical inactivity is one of the leading public health challenges in recent years. Already, many children are not sufficiently active whereas children with migration background appear to be even less active and at higher risk of developing obesity. In order to avoid possible health inequalities, this has to be investigated further. Therefore, this study evaluated amounts and intensities of objectively assessed physical activity in primary school children with and without migration background.
METHODS: A sub-sample of 273 children <7.1±0.6 years, 53% male> taking part in a large school-based intervention wore a multi-sensor device for six days in order to assess their physical activity objectively. 27% were classified as having a migration background. Physical activity was grouped in light <1.5-3 MET> and moderate to vigorous 3 MET> intensities. Weight status was determined during a school visit on the basis of BMI percentiles . Data collection took place prior to any intervention.
RESULTS: On a daily average, children without migration background spent 138.2±62.6 min in MVPA; children with migration background spent significantly less time in MVPA <121.7±54.9 min, $p \leq 0.01$>. On weekends, this amount decreased significantly for children with and without migration background <112.3±66.0 min, $p \leq 0.01$>, but especially for children with migration background <97.7±56.7 min, $p \leq 0.01$>. Moreover, children with migration background displayed significantly higher BMIPCT <55.7±29.6 vs. 44.3±26.8, respectively; $p \leq 0.01$> and were significantly more often overweight and/or obese <13.5% vs. 8.6%, respectively; $p \leq 0.02$>.
CONCLUSION: The results of this study extend the current literature by providing an objective analysis of children's time spent in MVPA. Primary school children with migration background are less physically active than their German counterparts and are more often overweight and therefore at a higher risk of related secondary diseases. This should particularly be considered for interventions in order to tailor programmes that children and parents with migration background engage in sufficient physical activity.

STUDY ON PHYSICAL ACTIVITY AMONG 6-TO-19 YEARS OLD CHINESE CHILDREN AND ADOLESCENTS: A NATIONAL REPRESENTATIVE CROSS-SECTIONAL STUDY IN CHINA

WANG, M.

CHINA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: Physical fitness declining and lacking of physical activity (PA) become prevalent among Chinese children and adolescents. And there are differences of PA between areas, urban and rural. The purpose of the national cross-sectional study on Chinese children and adolescents was to analyze the level and pattern of PA of Chinese children and adolescents, so that to provide scientific support for the government to make the policy and strategy for children and adolescents' physical activity and fitness.
METHODS: Investigation on physical activity and health behavior for Chinese children and adolescents was conducted in 2016. The multi-stage and PPS Sampling method were used. The questionnaires on PA behavior and health behavior were made according to Chinese children and adolescent's study and life. 46970 school students aged 6-19 yrs in 10 provinces of China were sampled, including male 24152 and female 22818.
RESULTS: Almost all students aged 6-19 yrs had physical activity weekly. More than 70% of children and adolescents had 3 days a week doing MVPA at least 60 minutes per day. And 11.6% of students had 5 days a week engage in MVPA at least 60 minutes per day, including male 14.3%, female 8.3%, and Urban 12.1%, rural 8.3%, and 11.2%, 13.9%, 13.5% and 11.1% in grade 1-3, 4-6, 7-9, 10-12, respectively.
However, according to Global Recommendations on Physical Activity for Health in school-aged children, the ratio to reach the recommended was quite low. The proportion of children and adolescents doing MVPA at least 60 minutes daily was only 2%, and there was significant gender difference ($P < 0.01$). The proportion of male reached the recommended amount of 2.9%, the female was only 1.0%. No matter in urban and rural, male had slightly higher ratio than the female, and the order of proportion for children and adolescents to reach the recommendation was: urban male> rural male > rural female > urban female, and the ratio of students in primary school was higher than the ratio of students in middle school, the students in higher grades of elementary school had the highest radio, the radio of students in high school was the lowest.
The proportion of students having VPA at least 3 times per week was 20.6%, including male 23.2% and female 17.4%. For the urban students, the proportion of reaching recommendation of doing VPA at least 3 times each week were 16.5%, 27.2%, 28.1%, 19.8% in grade 1-3 of primary school, grade 4-6 of elementary, junior middle school and high school children respectively, for rural students, corresponding proportion were 18.3%, 23.3%, 24.6% and 23.3% respectively.
It is important to note that more than 35% of the children and adolescents had only 1 day engaged in VPA per week, more than 25% of the children didnt have VPA or had VPA less than 1 times a week. The youth of higher grade in primary school and junior high school stage had 3 days or more doing VPA per week, the proportions were higher than the proportion in others.
CONCLUSION: The level of PA among Chinese children and adolescent was relatively low, male was better than female, the students in higher grade of elementary school and the junior middle school were the most active. The PA level of urban children and adolescents were slightly better than the rural.

ASSOCIATION OF SPORT PARTICIPATION, SEDENTARY BEHAVIOR, SLEEP AND AEROBIC FITNESS AMONG CHINESE CHILDREN

HE, G., LI, J.C., ZHU, Y.L., JI, G., WANG, C.

CAPITAL UNIVERSITY OF PHYSICAL EDUCATION AND SPORTS

INTRODUCTION: The positive impact of physical activity on children's aerobic fitness has been well documented. But the influences of other health-related behaviors, such as sedentary behavior and sleep, are unclear. The purpose of this study was to investigate the simultaneous association of sports participation, sedentary behavior, sleep and aerobic fitness in children.
METHODS: Participants of this study were 441 children (mean age = 8.3 ± 0.9 years) in grade 1 to 3 from four primary schools in Beijing, China. Among which, 49.7% were boys. Children's daily sport time, sedentary time, and sleep time were reported by parents. Body weight and height were measured by researchers. Aerobic fitness of children was estimated by the Progressive Aerobic Cardiovascular Endurance Run (PACER) test. Maximum oxygen uptake (VO2max) was calculated based on the PACER test results according to the formula by Leger et al. (1988). Linear regression models were performed separately for boys and girls to examine the association of behavioral variables (sport time, sedentary time, and sleep time) with VO2max. Level of statistical significance was set at 0.05.
RESULTS: The average VO2max of the overall sample is 48.7 ± 2.9 ml/Kg/min. Children spend an average of 8.9 ± 0.6 hours, 51.1 ± 44.0 minutes, and 190.8 ± 115.1 minutes daily on sleep, sports, and sedentary behaviors, respectively. After adjusting for age and body mass index, sport time (β = 0.159, p = 0.028) is associated with VO2max in boys; whereas sedentary time (β = 0.280, p = 0.000) is related to VO2max in girls. Sleep time is not found to associate with VO2max in both genders.
CONCLUSION: Sport participation and sedentary time have impacts on children's aerobic fitness. These impacts may vary between genders. Gender specific investigation of relationship between health-related behaviors and children's fitness level are warranted in future studies.

EFFECT OF SEX, BODY MASS INDEX AND PHYSICAL ACTIVITY LEVEL ON PEAK OXYGEN UPTAKE AMONG 14-19 YEARS OLD ADOLESCENTS

WELDE, B.1, HANDEGÅRD, B.H.1, MORSETH, B.1, LAGESTAD, P.2

1UIT THE ARCTIC UNIVERSITY OF NORWAY, TROMSØ, NORWAY; 2NORD UNIVERSITY, LEVANGER, NORWAY

INTRODUCTION: It is recognized that peak oxygen uptake (VO2peak), the highest rate at which oxygen can be consumed during exercise, is the best single measure of young people´s cardiorespiratory fitness. Low cardiorespiratory fitness and inadequate physical activity may be associated with an unhealthy cardiovascular disease risk profile even in children and adolescents. Few longitudinal studies have examined differences in VO2peak during adolescent years while taking the potential effect of physical activity into account. To examine the effect of sex, body mass index (BMI) and physical activity level on longitudinal changes in VO2peak in Norwegian adolescents, 14 to 19 years old boys and girls were studied once a year for six years.
METHODS: In total, 116 Norwegian adolescents (61 boys and 55 girls, age at entry: 14.0±0.5 yr, weight: 54.2±10.9 kg, height: 1.63±0.08 m (mean±SD)) were tested for directly measured VO2peak every spring from the year they entered secondary school at 8th grade until they finished 3rd grade at high school. Height, weight and VO2peak were measured by standardized procedures, while data about physical activity level were obtained using a self-administered questionnaire. Multiple regression and linear mixed model analysis were used to examine the relationships between VO2 peak, age, sex, BMI and physical activity level.
RESULTS: Sex, BMI and the number of exercising days per week significantly and uniquely explained VO2peak, and collectively these predictors explained 58-71% of the variance in VO2peak at the different age levels. The rate of change in VO2peak over the 14–19 years age range showed a slight increase over the first three or four years, followed by a slight decrease. This pattern was most evident for boys. There was no significant gender differences in the association between VO2peak and physical activity level over time. The strength of association between VO2peak and physical activity level varied over time. The physical activity level explained nearly 30% of the total variance in VO2peak for 15 year-olds, while the corresponding figure for 18 year-olds was less than 9%.
CONCLUSION: This study confirms the importance of sex, BMI, and physical activity level as highly significant and independent predictors of aerobic capacity among adolescents. Taking the decrease in VO2peak from 17 years of age into account, the findings point to the importance for adolescents to maintain a high physical activity level, emphasizing activities that increases the aerobic capacity.

THE PROSPECTIVE ASSOCIATION BETWEEN CLUB SPORTS PARTICIPATION, MEDIA CONSUMPTION AND MOTOR COMPETENCE IN AUSTRIAN MIDDLE-SCHOOL STUDENTS

DRENOWATZ, C., GREIER, K.

UNIVERSITY OF EDUCATION UPPER AUSTRIA; UNIVERSITY OF INNSBRUCK

INTRODUCTION: Low levels of physical activity (PA) and poor motor competence (MC) are becoming increasingly prevalent in young populations. Given the inverse association between PA and MC with various health outcomes and overall well-being, this development has a profound impact on future public health. The present study examined the association between motor development, participation in club sports and media consumption over a 4-year period in Austrian middle school students.
METHODS: A total of 213 10-year-old students (57% male) were followed over a 4 year period. Every year participants completed the German motor test 6-18 and self-reported participation in club sports and media consumption. In addition, body weight was measured without shoes and participants wearing gym clothes at every measurement time. Cross-sectional and longitudinal associations between club sports participation, media consumption and MC were examined via multivariate analysis of covariance, adjusting for body weight.
RESULTS: At baseline 42% of the students reported participation in club sports, which increased to 55% at 4-year follow-up. Club sports participation and low media consumption were associated with lower body weight. Cross-sectional analyses did not show any interaction effects of media consumption and club sports participation on MC. Club sports participation and media consumption, however, had significant main effects on MC, independent of body weight. Similarly, no interaction effects of media consumption and club sports participation on the development of MC occurred over the 4-year observation period. Club sports participation, however, was associated with greater improvement in sprint and lower improvement in flexibility. High media consumption was associated with lower improvement in sideways jumping and 6-minute run. Higher MC at baseline was also associated with a greater likelihood for continued participation in or starting club sports while there was no association between baseline MC and change in media time.
CONCLUSION: Club sports participation provides a viable option to increase PA and reduce sedentary behaviors in middle school students. In order to facilitate participation in club sports, a sufficient level of MC, however, appears to be necessary. As beneficial effects of

high MC are independent of body weight, the development of motor competence should be emphasized at young ages in order to promote an active lifestyle throughout childhood and adolescence.

Oral presentations

OP-SH15 Physical education, gaming and social influences

CONTRIBUTION OF PHYSICAL EDUCATION ON PHYSICAL ACTIVITY: COMPARISON BETWEEN REGULAR AND SPECIAL CLASSES

BLAIS, D., GIRARD, S., LEMOYNE, J.
UNIVERSITÉ DU QUÉBEC À TROIS-RIVIÈRES

Introduction: Several studies highlight the benefits of physical activity especially for students from special classes (Bailey, 2006; Côté et al., 2009). However, the majority of adolescents are not sufficiently active (ParticipACTION, 2016). Physical education represents a good opportunity to encourage students to adopt an active lifestyle. According to the achievement goal theory (Elliot, 1999), the motivational climate and the perceived competence in physical education determine students' achievement goals which, in turn, are related to their attitudes toward physical activity. To our knowledge, no study based on this theory has examined these relationships in physical education with regard to the type of classes (regular or special). Hence, the objectives were: 1- to examine the relationships between, on the one hand, motivational climate, perceived competence and achievement goals in physical education and, on the other hand, attitudes towards physical activity and the physical activity level, and 2- to verify if these relationships are invariant according to the type of classes (regular or special).
Methods: Data was drawn from 277 students (M age = 13.55 ± 0.89, boys = 61.2%, regular classes = 50.2%). Participants completed self-reported questionnaires on two different occasions to measure the variables targeted by the study objectives. Afterwards, a path analysis was conducted to test the hypothetical model, then, invariance analyses allowed us to verify the differences in the final model according to the type of classes.
Results: The final model ($\chi 2 = 15.75$, df = 11, p = .15; CFI = .99; TLI = .98; RMSEA = .05 [.00-.09, p = .53]) revealed that: 1- physical activity was predicted by attitudes toward physical activity (+); 2- attitudes toward physical activity were predicted by mastery climate (+), mastery goals (+), perceived competence (+) and performance-avoidance goals (-), and 3- achievement goals were predicted by the corresponding climate (+). The invariance tests revealed that students from special classes perceived a higher performance climate.
Discussion: Our results highlight the importance of establishing a mastery climate and developing the students' perceived competence in physical education in order to increase their physical activity level. The results also suggest that physical education teachers might focus more on competition with students from special classes. However, the statistical invariance of the final model supports the importance of teaching in a similar way with both types of classes.
References: Bailey, R. (2006). J Sch Health, 76, 397-401.
Côté, S. M. et al. (2009). J Child Psychol Psychiatry, 50, 1201-8.
Elliot, A. J. (1999). Educ Psychol, 34(3), 169-189.
ParticipACTION (2016). Report Card on Physical Activity for Children and Youth.
Contact: Dominique.Blais@uqtr.ca
Stephanie.Girard3@uqtr.ca
Jean.Lemoyne@uqtr.ca

A STUDY ON THE CHARACTERISTICS OF SCHOOL PHYSICAL EDUCATION IN SENEGAL

FELIX, D., KAZUHIKO, S.
HIROSHIMA UNIVERSITY

Introduction: The Sustainable Development Goals states that sports contribute to the promotion of quality and learning of education. In most African countries, physical education (PE) lessons are not conducted in accordance with the curriculum (Hardman et al., 2005). According to an international survey of physical education, Africa's implementation rate in 2000 was the lowest in the world at 25%. Although the implementation rate has greatly increased, it still remains low as compared with other developing countries (UNESCO, 2014). It is presumed that the importance of school PE in Africa is becoming more apparent. Senegal is one country where the promotion of PE has increased, partially due to cooperation with Japan (Sawamura, 2000; Saito, 2006). However, there is still a scarcity of studies on Senegalese physical education and sports. The purpose of this study was to clarify the current state of and explore issues of school PE in Senegal.
Methods: Information obtained from Senegal's education curriculum framework and physical education syllabus was reviewed to determine the standing of PE in the general curriculum and to have a closer view of the goals and content composition of PE in primary and secondary schools. Beyond the legal context of PE, interviews were conducted at the ministry of education as well as at the 2 main institutions (INSEPS & CNEPS) where future PE teachers receive their formation. Regarding the state of implementation of PE, we observed the educational environment and lessons of primary and secondary schools in Senegal. Additionally, the situation in the field was compared with the prescribed content of the curriculum.
Results: The government has lofty goals for sports education in Senegal and the significance of PE is stated in the curriculum, the reality of PE classes at the school level encounters many limitations. Dispute between ministries, ever shrinking financial support from the government to schools, demographic pressure on existing school infrastructure along with the reduction of PE teacher's training are just few of the challenges that affect negatively the quality of physical education nation-wide.
Discussion: It was to be expected that Senegalese physical education regulations and policies could be significantly different from the actual conditions of PE in schools. However, the complexity of the situation makes it hard to simply point a blaming finger at one or two elements of the entire educational apparatus dealing with immense economic and demographic pressure. Nonetheless, a number of key issues urgently need to be addressed in order to improve the quality of PE in Senegalese schools.

LEVELS OF PHYSICAL ACTIVITY AND SOCIAL SUPPORT PERCEIVED IN ADOLESCENTS

SANZ-MARTÍN, D.1, RUIZ-TENDERO, G.1, FERNÁNDEZ-GARCÍA, E.1

COMPLUTENSE UNIVERSITY OF MADRID

Introduction: One of the main health problems in Western societies is low levels of physical activity (McKenzie, Crespo, Baquero, & Elder, 2010), especially among adolescents (Sanz, 2017). Physical activity is determined by various factors (Sallis, Prochaska, & Taylor, 2000). The purpose of this study was to analyse the type of relationship between levels of physical activity in adolescents and the support they perceive from family and friends regarding such activity.
Methods: The sample comprised 694 adolescents in the province of Soria, Spain (21.5% of the total population of school adolescents). The Four by one-day Physical Activity Questionnaire (Cale, 1993) was used to quantify the level of physical activity. To assess the level of support perceived from family and friends regarding physical activity the Parent Support Scale and Peer Support Scale was used (Prochaska, Rodgers, & Sallis, 2002). To calculate the relationship between the variables, Pearson's correlation coefficient was calculated.
Results: The results show the existence of positive weak to moderate correlation, and significant ($p \leq .001$), between the average daily energy expenditure of the students and the support perceived from family and friends. The same type of link was found with moderate-vigorous average daily energy expenditure and moderate-vigorous duration of physical activity in adolescents, compared with social support perceived.
Conclusion
It was observed that there is a significant link between healthy levels of physical activity in adolescents and the support that they perceive from family and friends, which is consistent with other studies (Craggs et al., 2011, and Sallis et al., 2000).
References: Cale, L. (1993). Monitoring Physical Activity in children (Doctoral Dissertation). Retrieved from: Loughborough University Institutional Repository.
Craggs, C., van Sluijs, E. M. F., Corder, K., Panter, J. R., Jones, A. P., & Griffin, S. J. (2011). Do children´s individual correlates of pyhsical activity differ by home setting? Health y Place, 17(5), 1105-1112. doi: 10.1016/j.healthplace.2011.05.013
Prochaska, J. J., Rodgers, M. W., & Sallis, J. F. (2002). Association of parent and peer support with adolescent physical activity. Research Quarterly for Exercise and Sport, 73(2), 206-210. doi: 10.1080/02701367.2002.10609010
Sallis, J. F., Prochaska, J. J., & Taylor, W. C. (2000). A review of correlates of physical activity of children and adolescents. Medicine & Science in Sports & Exercise, 32(5), 963-975. doi: 10.1097/00005768-200005000-00014
Sanz, D. (2017). Moderate-vigorous physical activity levels of adolescents of the municipality of Soria. Sportis Scientific Journal, 3(1), 100-122. doi: 10.17979/sportis.2017.3.1.1738

Oral presentations

OP-SH04 Sport Management and law 2

COLLABORATIVE MODEL BETWEEN FITNESS CENTRES AND UNIVERSITIES: THE CASE STUDY OF UNIVERSIDAD EUROPEA AND HOLMES PLACE

FERNÁNDEZ-LUNA, A., DE LA RIVA, L., FELIPE, J.L., GARCÍA-UNANUE, J., BURILLO, P., SÁNCHEZ-SÁNCHEZ, J.

UNIVERSIDAD EUROPEA

COLLABORATIVE MODEL BETWEEN FITNESS CENTRES AND UNIVERSITIES: THE CASE STUDY OF UNIVERSIDAD EUROPEA AND HOLMES PLACE
Fernández-Luna, A.1, De La Riva, L.1, Felipe, J.L.1, García-Unanue, J.1, Burillo, P.1, Sánchez, J.1 1: Universidad Europea de Madrid (Madrid, Spain)
Introduction: As part of a growing trend toward greater collaboration between academia and industry (Barnes, Pashby & Gibbons, 2002), universities have an excellent opportunity to develop win-win strategies with renowned fitness centres. As an example of this, Universidad Europea of Madrid developed a research project for Holmes Place fitness centres in Madrid and Barcelona. The goal was for Universidad Europea to measure the rate of interest and the satisfaction level of Holmes Place clients with a recently implemented service called Clinic. This is a premium fitness evaluation service that helps clients to achieve their fitness goals by offering five assessments: Medical Welcome Session, Nutrition, Posture, Physio and Running.
Methods: Surveys were collected from 736 Holmes Place clients. 76 of them were Clinic clients, while the other 660 were potential clients who had never used that service. All of the respondents reported their demographic characteristics, sports practice, training frequency and length of membership. Specifically, Clinic clients reported their satisfaction with the service, while potential clients expressed their rate of interest in Clinic. The data collected were analysed using QuickTapSurvey software.
Results: 89.67% of respondents were potential clients. Among them, the percentage of clients who were interested in trying each of the assessments was 78.64% for the Medical Welcome Session, 82.42% for Nutrition, 84.09% for Posture, 82.27% for Physio and 55.61% for Running. On the other hand, 10.33% of respondents were Clinic clients. The Net Promoter Score (Reichheld, 2003) in these clients was 50. The percentage of satisfied clients for each of the assessments was 93.94% for the Medical Welcome Session, 94.59% for Nutrition, 84.62% for Posture, 92.59% for Physio, and 76.92% for Running.
Conclusion
The majority of Clinic clients were satisfied with this service, but these clients represented a small fraction of all Holmes Place members. As a result, Universidad Europea suggested to Holmes Place Senior Team that they improve the Clinic promotional strategy. This collaborative model allowed Universidad Europea to team up with a prestigious firm, while Holmes Place was able to detect the main issues related to its services, in order to improve them.
References: Barnes, T., Pashby, I., Gibbons, A. (2002). European Management Journal 20(3), 272-285.
Reichheld, F. F. (2003). Harvard Business Review, 81, 46-54.
Contact: alvaro.fernandez2@universidadeuropea.es

CONCEPTUALISING SPORT AND SPORT BETTING MANIPULATION: TYPOLOGIES, POLICIES AND PRACTICES

HARVEY, A.

SWANSEA UNIVERSITY

Sports and sports betting manipulation and associated behaviours pose significant threats to the social and cultural value of sport and to the viability of the global sports and gambling industries that are worth hundreds of billions of Euros respectively. These threats lie along a spectrum from relatively benign infractions against rules laid down by sports governing bodies, to major international criminal activity to fix sporting contests. To date, attempts to describe the multiplicity of threats have been largely under-conceptualised and no typology has been agreed by national, sporting and gambling authorities.
This paper has three objectives. Firstly, making use of a review of known cases and original empirical research that was undertaken for an EU-funded project to tackle match-fixing which was led by FIFPro (1), the world professional footballers union, I will develop an empirically detailed and analytically robust typology of the full spectrum of threats by manipulation to sports, to betting, to both and, in some cases, to neither, but which nevertheless represent behaviours that are still believed to pose a general threat to sport and/or betting integrity. Secondly, making use of published sources, I will map the actors involved to date in confronting sports and sports betting manipulation, including, inter alia, international and national public authorities, law enforcement bodies, sports and gambling organisations, INGOs and the media. Thirdly, by comparing the typology of manipulation with the map of actors, I will identify which organisations are best placed to tackle which type of manipulation, where gaps exist in the landscape of actors committed to the protection of sport and betting, and a tentative outline of the ways in which those actors can work together, thus enabling an efficient use of resources and capabilities.
(1) See Harvey and Levi, Dont Fix It: Players Questionnaire and Results, FIFPro: Hoofddorp, 2014.

DEVELOPMENT AND EVALUATION OF THE COACH-ATHLETE RELATIONSHIP ENHANCEMENT INTERVENTION

KUIT, W., WATSON, M.B., SLOGROVE, L., SUTTON, A.

NELSON MANDELA UNIVERSITY

INTRODUCTION: An expanding body of sport psychology theory and research has highlighted the central role of the coach-athlete relationship in the performance, satisfaction and well-being of both coaches and athletes. Models have been developed that identify the key dimensions of CAR quality and the interpersonal behaviour that maintains it, but there remains a need for interventions that support coaches and athletes to optimise their interpersonal skills. This can be done by harnessing recent advances in personality theory which emphasise a more holistic and developmental view of the person and provide a basis for greater mutual understanding and adaptive interpersonal behaviour change in the CAR.
METHODS: The aims of this study were to develop the Coach-Athlete Relationship Enhancement intervention through an integration of the Enneagram personality typology with current models of the CAR, and then to evaluate the impact of the CARE intervention on CAR quality. Sixty-two university level athletes and their nine coaches participated in the study.
RESULTS: Quantitative and qualitative results indicate that the CARE intervention significantly enhanced CAR quality, including direct and meta perceptions of closeness, commitment and complementarity, as well as co-orientation. Intervention outcomes included enhanced mutual understanding in the CAR, enhanced self-awareness, enhanced team relationships, and adaptive interpersonal behaviour change. These outcomes were associated with a shared awareness between coaches and athletes of their Enneagram personality type traits and motivations. Coach-athlete relationship quality was further enhanced by re-constructing coaches' and athletes' personal narratives based on self-descriptions of Enneagram type strengths, and a redefinition of individuals' core motivations to incorporate adaptive interpersonal behaviour change.
CONCLUSION: The study shows how holistic and developmental views of personality can be integrated with current models of the CAR, practically applied to enhance CAR quality, and facilitate a range of adaptive interpersonal outcomes in the sport context. The study also highlights promising avenues of interpersonally-focused sport psychology research and practice.

IMPROVING COLLECTIVE EFFICACY IN SPORT TEAMS: THE EFFECTIVENESS OF A ROLE CLARIFICATION INTERVENTION

ZAVADSKA, A., COENEN, J., SCHNEIDER, J., BROICH, F., PELS, F.

GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: Collective efficacy (i.e. a group's belief to achieve a common goal; Bandura, 1998) is an important predictor of performance in team sports (Carron et al., 2002). Role clarification (RC) is a determinant of collective efficacy (CE) and can have a detrimental effect on performance in sport settings (Beauchamp et al., 2002). Therefore, the purpose of the study was to examine the impact of a RC intervention on collective efficacy. It is assumed that a RC intervention improves CE more than a control intervention.
METHODS: The sample consisted of 31 participants (age: M = 20.68 years, SD = 4.48; sex: 13 females, 18 males) from two sport teams (basketball, volleyball). The sport teams underwent two interventions at an interval of one week: a RC intervention (exploring roles and responsibilities within each team; 120 minutes) and a control intervention (breathing techniques; 90 minutes). CE was measured using the Collective Efficacy Questionnaire for Sports (Short, Sullivan & Feltz, 2005). RC was assessed using the Role Ambiguity Scale (Rizzo, House, & Lirtzman, 1970) with higher values reflecting role clarification. Data were collected prior to the first intervention (t0), between the first and the second intervention (t1), and after the second intervention (t2). Data were analyzed using Friedman tests and Wilcoxon Signed-Ranks tests due to non-normal distributions.
RESULTS: Results showed a change in CE over time ($\chi2(2) = 13.66$ $p = .001$). In more detail, there was a significant increase from t0 ($M = 6.97$, $SD = 1.00$) to t1 ($M = 7.34$, $SD = 0.71$; $Z = -2.542$, $p < .05$) and from t1 ($M = 7.34$, $SD = 0.71$) to t2 ($M = 7.66$, $SD = 0.79$; $Z = -2.483$, $p < .05$). With regard to RC, there was also a significant change over time ($\chi2(2) = 7.71$ $p = .021$). More specifically, there was an increase from t0 ($M = 6.49$, $SD = 0.85$) to t1 ($M = 6.82$, $SD = 1.01$; $Z = -2.196$, $p < .05$) and from t1 ($M = 6.82$, $SD = 1.01$) to t2 ($M = 6.95$, $SD = 0.99$; $Z = -1.996$, $p < .05$).
Discussion:
The findings of this study indicated that there was an overall increase of collective efficacy over time which might have occurred due to the simultaneous increase in role clarification. Evidently, the RC intervention helped athletes to understand their scope of responsibilities within the team. The control intervention possibly made athletes strengthen their belief of the team's ability to achieve a common goal.

References:
Bandura, A. (1998). Personal and collective efficacy in human adaptation and change. Advances in psychological science, 1, 51-71.
Beauchamp, M. R., Bray, S. R., Eys, M. A., & Carron, A. V. (2002). Role ambiguity, role efficacy, and role performance: Multidimensional and mediational relationships within interdependent sport teams. Group Dynamics: Theory, Research, and Practice, 6(3), 229.
Carron A. V., Colman M. M., Wheeler J., Stevens D. (2002). Cohesion and performance in sport: a meta-analysis. J. Sport Exerc. Psychol. 24, 168–188.

15:30 - 17:00

Invited symposia

IS-PM10 The liver - a major contributor to exercise adaptations?

ROLE OF PGC-1A IN EXERCISE-INDUCED ADAPTATIONS IN THE LIVER

PILEGAARD, H.

UNIVERSITY OF COPENHAGEN

Exercise-induced autophagy and endoplasmatic reticulum (ER) stress have been suggested to be required for both acute metabolic adjustments and adaptations to exercise training. However the regulation of exercise-induced hepatic autophagy and the unfolded protein response (UPR) as well as the impact of autophagy and ER stress for hepatic adaptations with exercise training is not fully resolved. ER stress reflects an imbalance between the capacity of ER to fold proteins and unfolded protein response (UPR), while autophagy removes dysfunctional proteins and recycles cellular components. Furthermore, the transcriptional coactivator PGC-1α has been suggested to play a role in mediating exercise training-induced metabolic adaptations in the liver. The impact of hepatic PGC-1α on exercise-induced regulation of UPR and autophagy in the liver will be presented. Moreover, results from studies examining the effect of liver PGC-1α knockout on HFD-induced hepatic changes and the importance of liver PGC-1α in exercise training-induced prevention of HFD-induced changes with focus on ER stress and autophagy will be presented. In addition, the impact of age and lifelong exercise training on hepatic autophagy and UPR will be shown. Finally, results from studies investigating the potential role of muscle PGC-1α in the regulation of acute and exercise training-induced metabolic adaptations in the liver will be presented.

METABOLITES AND THE HEPATIC RESPONSE TO EXERCISE

WEIGERT, C.

UNIVERSITY OF TÜBINGEN

Regular physical activity is known to have multiple health benefits including prevention of type 2 diabetes and cardiovascular diseases. The liver plays a central role in the maintenance of glucose and lipid homeostasis and there is growing evidence that exercise-induced adaptations in the liver are crucial for the health benefits of exercise. The most prominent long-term effect is the reduction of non-alcoholic fatty liver disease, a major risk factor for diabetes and cardiovascular diseases. To get a global and unbiased view on the exercise-induced alterations of hepatic metabolism and function we performed LC- and CE-MS metabolomics analyses of arterial and liver vein plasma samples obtained from exercising humans. The data indicate an important contribution of the liver to the changes in the plasma metabolite and lipid pool during and following exercise by a tissue-specific release or uptake of several compounds and suggest a muscle-liver cycle not only for lactate. In a systems biology approach we analyse the OMICs data sets together with alterations in the hepatic transcriptome in response to acute exercise and training to unravel novel mechanisms of exercise adaptation and prevention of disease. The lecture presents novel insights into the effects of exercise on liver metabolism and function relevant for the development of intervention strategies.

EXERCISE-INDUCED HEPATOKINES

PLOMGAARD, P.

RIGSHOSPITALET

During the last decade tissue-specific signal molecules have been identified from both the adipose and muscle tissues. Recently the term "hepatokine" has emerged as hormone-like molecules released from the liver. An acute bout of exercise is a strong stimulus of hepatokine release and several candidates have been identified. We have investigated whether FGF21, follistatin and angiopoietin-like protein 4 are exercise-induced hepatokines in humans. All increase in the circulation in the hours after an acute bout of exercise, but with different kinetic profiles. The biological function of FGF21, follistatin and angiopoietin like 4 are very different. FGF21 has beneficial metabolic properties and when administered to patients with type 2 diabetes a reduction in both blood glucose and body weight occurs. Follistatin is known from reproductive physiology, however follistatin has also been identified as the endogenous antagonist of myostatin. Myostatin is released from the skeletal muscle tissue and inhibits muscle hypertrophy. An impact of follistatin on skeletal muscle has been observed in mice over-expressing follistatin specific in the skeletal muscle as they develop a marked muscle hypertrophy. Angiopoietin-like protein 4 is involved in the lipid metabolism and has been found to inhibit LPL. Investigating the arterial-to-hepatic vein difference in healthy male subjects performing an exercise bout revealed a release of both FGF21, follistatin and angiopoietin like 4 from the hepato-splanchnic bed. Increasing the glucagon-to-insulin ratio in resting male subjects increased the plasma level of FGF21, follistatin and angiopoietin like 4 with a similar kinetic as observed with exercise. In contrast inhibiting the increase in the glucagon-to-insulin ratio during an exercise bout blunts the increase in FGF21 and angiopoietin like 4 and reduces the exercise-induced increase in follistatin. Thus the glucagon-to-insulin ratio seems at least in part to be important for the regulation of these hepatokines during exercise. These finding conjecture that the liver could mediate some of the systemic beneficial effects observed with exercise.

Oral presentations

OP-PM08 PERIODIZED AND HIT TRAINING

EFFECTS OF LINEAR AND DAILY UNDULATING PERIODIZED RESISTANCE TRAINING ON MYOKINES AND MAXIMAL STRENGTH LEVELS IN UNTRAINED WOMEN

NIKSERESHT, M.1,2, HAFEZI-AHMADI, M.2, NIKSERESHT, M.

1: ILAM BRANCH, ISLAMIC AZAD UNIVERSITY, ILAM, 2: ILAM UNIVERSITY OF MEDICAL SCIENCES, ILAM, 3: MAZANDARAN UNIVERSITY, BABOLSAR,

INTRODUCTION: It has been shown that resistance training (RT) improves metabolic profiles, body composition and physical fitness in obese individuals. Studies have presented that periodized RT has better physiological adaptations compared to nonperiodized, but there is limited research directly comparing different types of periodization. Thus, the aim of this study was to compare the effects of linear (LP) and nonlinear (NLP) RT on myokines and maximal strength levels in overweight/obese women.
METHODS: Twenty-five untrained women first were matched by maximal oxygen uptake (VO2max, 31–42 ml/kg/min), age (28–46 years), and body mass index (26–32 kg/m2) and then randomly assigned to LP (n = 8), NLP (n = 9) and control (CON, n = 8) groups. The trained groups performed 3 weekly sessions for 12 weeks. The NLP program varied training biweekly during weeks 1-6 and on a daily basis during weeks 7-12. The LP program included a pattern of intensity and volume changes every 4 weeks. Serum samples were used to measure interleukin (IL-7), IL-15, insulin growth factor-1 (IGF-1) and insulin levels. The concentrations were measured in duplicate by enzyme-linked immunosorbent assay before and after training. The VO2max, skeletal muscle mass (SMM) and 1-repetition maximum (1RM) for the exercises of bench press (BP) and leg extension (LE) were assessed. A 2-factor repeated-measure analysis of variance was used to determine the differences between interventions and across time.
RESULTS: After the training period, serum IL-7, IL-15 and IGF-1 levels did not significantly change compared with CON; however, IL-7 and IGF-1 increased significantly in both trained groups compared to the baseline. The NLP was effective at improving VO2max, SMM/weight ratio and insulin levels compared to the CON; but, no significant difference was observed in these variables between the two training groups. The LP and NLP presented significant 1RM strength gains in BP and LE compared with CON; interestingly, the increase was significantly higher with NLP than with LP for BP. No significant change was observed in the CON for all variables (except for IGF-1; that increased significantly compared to the baseline).
CONCLUSION: In conclusion, both LP and NLP are effective, but NLP may lead to greater gains in 1RM for BP, VO2max and SMM/weight ratio after a 3 months training. The NLP also seems to be more effective at reducing insulin levels. Therefore, women who are overweight/obese can use both the LP and NLP to increase maximal strength, although it seems that the NLP may have better aerobic capacity and anti-diabetic effects.

EFFECTS OF BLOCK-PERIODIZED VS. NON-PERIODIZED STRENGTH TRAINING ON PHYSICAL FITNESS, ATHLETIC PERFORMANCE, AND BODY COMPOSITION IN ELITE YOUNG CANOEISTS

GÄBLER, M., PRIESKE, O., WARNKE, T., HORTOBÁGYI, T., GRANACHER, U.

UNIVERSITY OF POTSDAM

INTRODUCTION: High performance in canoe sprint requires athletes to sustain high power output over a prolonged period of time. Strength training is an effective means to improve performance, physical fitness, and body composition in young athletes. The oscillatory nature of training stimulus in the form of block-periodization compared with a monotonic, non-periodized stimulus allows athletes to recover between training blocks. Therefore, we hypothesize that block-periodization vs. non-periodized strength training is more effective to improve elite young canoe sprint athletes' physical fitness, canoe sprint performance, and body composition.
METHODS: Twenty-two elite young sprint canoe athletes were divided over a control group (CG, 6 girls, 8 boys; 12.8±0.7 y; 0.3 y after peak height velocity [PHV]) during the first year and an intervention group (IG, 6 girls, 7 boys; 13.1±0.5 y, 0.6 y after PHV) during the second year of the study. Each group was tested before and after 26 weeks of training for physical fitness (i.e., hand grip strength, trunk muscle strength [Bourban test], bench press and bench pull exercise [work over 2 min], balance [Y-balance test lower and upper quarter; YBT-LQ/UQ]), body composition, and athletic performance (on-water 250 m and 2000 m time trials). CG trained 8 h/week for 26 weeks consisting of endurance training specific (12%) and not specific to canoeing (40%), and non-periodized muscular endurance training (48%). IG had non-periodized muscular endurance training replaced by block-periodized strength training including 4 weeks of general physical preparation, 7 weeks of hypertrophy training, 3 weeks of power training, and 3 weeks of power endurance training. Other training contents and training volume were matched between IG and EG.
RESULTS: In this abstract, we present performance changes only for CG, because IG has not yet completed the intervention. Data collection will be completed in April 2018 and all data will be presented at the ECSS congress. CG improved handgrip strength (+4.6 kg, $p<0.01$, ES [Cohen's d]=0.96), Bourban ventral test (+28 s, $p=0.01$ $d=0.89$), 2000 m time trial (-43 s, $p=0.01$, $d=0.43$), bench pull (+1.3 kW, $p<0.01$, $d=0.86$), bench press (+0.6 kW, $p=0.01$, $d=0.51$), and muscle mass (+1.9 kg, $p<0.01$, $d=0.51$). Performance did not change in YBT-UQ, YBT-LQ, and the 250 m time trial (all $p>0.05$).
CONCLUSION: Training and/or growth/maturation contributed to the observed improvements in body composition and performance in the CG. However, due to higher intensities in strength training and recovery between training blocks, we expect IG vs. CG to increase physical fitness more. Given the role muscular strength plays in performance, we expect correlated gains in physical fitness, body composition and in the 250 and 2000 m time trials.

KEEP IT SHORT AND SWEET? EFFECTS OF A HIGH-INTENSITY FUNCTIONAL CIRCUIT TRAINING ON MOTOR FUNCTION AND EXERCISE MOTIVATION IN UNTRAINED ADULTS

WILKE, J., KAISER, S., KALO, K., MORATH, C., ENGEROFF, T., NIEDERER, D., VOGT, L., BANZER, W.

GOETHE UNIVERSITY FRANKFURT

INTRODUCTION: Only a small share of the world's population meets current physical activity guidelines, which recommend regular engagement in endurance, strength, and neuromotor exercise. As lack of time represents a major cause of inactivity, multidimensional training methods with short duration may provide a promising alternative to classical, volume-oriented approaches focusing on only one

biomotor ability. This trial examined the effects of a high-intensity functional circuit training (HIFCT) program on motor function and motivation to exercise in healthy, untrained adults.
METHODS: Thirty-three physically inactive participants (25±5 yrs, 12 males) were randomly allocated to two groups exercising for a period of six weeks. The intervention group (HIFCT, n=20) 3×/week performed functional whole-body exercises (e.g. Squats, Step-Ups, Burpees) in a circuit format. Each 15-minute workout was composed of repetitive 20s all-out bouts with 10s breaks. In the comparison group (moderate aerobic exercise, MAE, n=13), the participants walked 3×/week for 50 minutes at moderate intensity. Motor outcomes measured were cycling endurance capacity (respiratory threshold, maximum work load), maximum strength (leg and chest press), postural control (force plate), and jump capacity (counter-movement jump, single leg hop for distance). Additionally, exercise motivation was assessed using the self-concordance index.
RESULTS: In comparison to MAE, HIFCT enhanced maximum leg strength (between-group difference of relative pre-post changes of 5.0%), shoulder strength (7.6%), endurance workload (5.0%; p<.05), as well as motivation to exercise (+5.5 points on the self-concordance index (p<.05). No between-group differences were found for postural control and jump capacity (p>.05).
CONCLUSION: Despite considerably shorter training duration, HIFCT increases motor function and motivation to exercise more effectively than MAE. Further research should investigate the long-term adherence to the program and its effectivity in other settings.

EVALUATING THE INTERNAL RESPONSE TO REPEATED-SPRINT TRAINING USING DIFFERENTIAL RPE: A PRELIMINARY INVESTIGATION IN SOCCER PLAYERS

MCLAREN, S.J., TAYLOR, J.M., MACPHERSON, T.W., SPEARS, I.R., WESTON, M.
TEESSIDE UNIVERSITY

INTRODUCTION: Changes in the internal response to an external training stimulus may be indicative of an athlete's fitness or fatigue. Differential ratings of perceived exertion (dRPE) enhance the precision of internal load quantification (Weston et al., 2015), yet little is known of how these measures change over a period of training adaptation. We therefore aimed to evaluate the within- (i.e. set-to-set) and between-session changes in dRPE across a repeated-sprint training (RST) intervention that was successful for improving a range of fitness components in soccer players (Taylor et al., 2016).
METHODS: Fifteen semi-professional soccer players completed 6 RST sessions over a 2-week period. The training programme consisted of 3 (sessions 1–3) or 4 (sessions 4–6) sets of 7 maximal effort sprints, with 20 sec and 4 min recovery between sprints and sets, respectively. Players were assigned to either a straight-line (n = 8; 30-m) or change of direction (n = 7; 2 × 10-m with a 180° turn) training group. Heart rate (HR; presented as % maximum heart rate) was recorded throughout each session and dRPE (presented in arbitrary units) for breathlessness (RPE-B) and leg muscle exertion (RPE-L) were collected via the CR100 scale ~2 min after each set. Data were analysed using mixed effects linear models, with magnitude-based inferences subsequently applied.
RESULTS: Mean ± SD set dRPE and HR were 47 ± 10 (hard) for RPE-B, 39 ± 9 (somewhat hard) for RPE-L, and 79 ± 7%. The difference between RPE-B and RPE-L was possibly moderate (8; ±90% confidence limits 7). Within-session changes in RPE-B were large in session 1 (15 per set; ±2), moderate in sessions 2 to 5 (7 to 9; ±2), and small in session 6 (6; ±2). For RPE-L, within-session changes were large in session 1 (15; ±3) and moderate in sessions 2 to 6 (7 to 8; ±2). The within-session changes in HR were trivial in sessions 1 to 5 (1 to 2 % points per set; ±1) and small in session 6 (2; ±3). When compared with session 1, the magnitude of within-session changes was substantially lower (small to moderate differences) in session 2 to 6 for RPE-B (-5 to -9 per set; ±2) and RPE-L (-6 to -8; ±2). No substantial between-session differences were evident for within-session changes in HR (0 to 1 % points per set; ±1).
CONCLUSION: Changes in dRPE, but not HR, are evident following a 6-week RST intervention that improved the fitness of soccer players, with the magnitude of within-session increments reducing across the programme. These changes could reflect training-induced adaptations, thus providing evidence for the sensitivity and usefulness of dRPE for monitoring training in soccer. Finally, players perceive the demands of RST to be greater for central, rather than peripheral, exertion, which may allude to specific training-induced adaptations. Relations between dRPE and training outcomes therefore warrant further investigation.
REFERENCES: Weston et al. (2015). J Sci Med Sport, 18(6), 704–708.
Taylor et al. (2016). Int J Sports Physiol Perform, 11(8), 998–1004.

TRAINING INTENSITY DISTRIBUTION ANALYSIS BY RACE PACE APPROACH IN WORLD-CLASS DISTANCE RUNNERS.

KENNEALLY, M., CASADO ALDA, A., SANTOS-CONCEJERO, J.
UNIVERSITY OF THE BASQUE COUNTRY

INTRODUCTION: Optimal Training Intensity Distribution (TID) in endurance running remains a much debated topic (1,2). The description of training intensity zones has classically been done using physiological parameters (2), and ranges from 3-7 zones within the literature (2). A recent review by the current authors (1) has proposed a novel way to describe training intensity zones. The zones are based on proportions of an athletes actual or target race pace. The rationale for this approach is based in the notion that race pace itself represents the intensity which optimally stresses the relevant physiological systems at any given point in time. Thus the aim of this paper was to analyse the training of a group of world-class athletes over a 12 month period, using this approach to identify whether their training is organised into zones as described.
METHODS: We took the training logs of both the male and female athletes and organised the data into 5 zones based on percentages of race pace, which were chosen arbitrarily. Volume, number of sessions and time spent in each zone was calculated. The analysis spanned all traditional phases of a training cycle; general preparatory, specific preparatory and competitive, so the data was further analysed based on these phases. Physiological and anthropometric data were also collected three times over the timeframe studied in a number of athletes, and where possible physiological zones were created and compared to the race-pace based zones. Session intention was also recorded.
RESULTS: The analysis showed that when the training of this group of elite distance runners is considered relative to their race pace, a pyramidal type training intensity distribution is seen, regardless of phase of training. This pyramidal distribution was also preserved across athletes competing at different race distances, ranging from 800m to 10000m. However, the absolute training intensities of this group were similar for athletes competing over different distances, and as a result, differences were seen in the volumes in respective relative zones. Longer distance athletes (5-10km) tended to have more volume in their higher relative intensity zones than shorter distance athletes (800-1500m), although both preserved pyramidal distributions.
CONCLUSION: This study demonstrates that Training Intensity Distribution can be considered relative to race pace as a valid method of analysis. It also identifies relative differences in the training of longer and shorter distance athletes, despite similar absolute training. The zones used in this study were arbitrarily chosen and further work is required to optimise what percentage of race pace should delineate

these zones. Further study, focussing on comparison of the effect of physiological zones vs race-pace based zones on physiological parameters and performance, would also improve the understanding of this topic.

Oral presentations

IS-EX02 ECSS-JSPFSM exchange symposium: Skeletal muscle as an endocrine organ -20 years of myokines

EVIDENCE FOR ACUTE CONTRACTION-INDUCED MYOKINE SECRETION BY C2C12 MYOTUBES

FURUICHI, Y.

TOKYO METROPOLITAN UNIVERSITY

Myokines have received attention as secretory factors in skeletal muscle cells and are related to exercise-induced health benefits in various organs. Myokine secretion is thought to be regulated by muscle contraction, but this hypothesis has not been confirmed. We sought to present evidence that acute contractions induced myokine secretion and to investigate the secretory mechanism of skeletal muscle cells.
We used murine-derived C2C12 skeletal muscle cell line to eliminate contamination with proteins produced by non-muscle cells. Cultured myotubes were contracted by electrical stimulation systems established by our group (Manabe et al. 2012), and secreted proteins in conditioned media were compared between basal and contracted conditions. Importantly, we noticed that changes in the cell culture medium unexpectedly triggered the release of large amounts of proteins from the myotubes, and these proteins obscured the contraction-induced myokine secretion. Once protein release was abolished, the secretion of interleukin-6 (IL-6), the best-known regulatory myokine, increased in response to a 1-hour contraction evoked by electrical stimulation.
We used pharmacological inhibitors of muscle contraction and examined whether contraction-induced IL-6 secretion disappeared following treatment with these inhibitors to identify the specific mechanism regulating contraction-induced IL-6 secretion in skeletal muscle cells. Contraction-induced IL-6 secretion was inhibited by EGTA, which chelates intracellular calcium, while the blockage of physical movement by the addition of BTS, a specific inhibitor of myosin ATPase, did not inhibit IL-6 secretion. Thus, calcium flux, rather than contraction itself, triggers contraction-induced IL-6 secretion.
Since we established the experimental conditions for secretion induced by acute contraction, we investigated whether the secretion of previously reported myokines was regulated by muscle contraction. IL-15 secretion by C2C12 myotubes increased in response to acute contraction. Surprisingly, contraction-induced IL-15 secretion was completely abolished by the BTS. Based on these data, IL-15 secretion is regulated by a different mechanism than IL-6 secretion. Our established experimental condition is suitable not only for the discovery of novel contraction-induced myokines but also for the dissection of the regulatory mechanism underlying myokine secretion.
We concluded that acute muscle contraction apparently promotes the secretion of some myokines, and our newly established experimental model will enable researchers to adopt a proteomic approach to identify new myokines secreted in response to muscle contraction. The identification of new myokines and an understanding of their regulatory mechanisms will be useful in the field of sports and health sciences.

ROLE OF LOCAL STEROIDOGENESIS IN SKELETAL MUSCLE

AIZAWA, K.

INSTITUTE OF SPORT

INTRODUCTION: The plasticity of skeletal muscle facilitates adaptation to various stimuli. Sex steroid hormones play critical roles in regulation of metabolism and function in skeletal muscle. Skeletal muscle has recently been identified as an endocrine organ. Sex steroid hormones are produced by various peripheral target tissues including the kidney, liver, and brain in addition to endocrine organs such as the testis or ovary.
METHODS: Sex steroid hormones are synthesized from cholesterol by steroidogenic enzymes, such as 3β-hydroxysteroid dehydrogenase , and 17β-HSD, with testosterone being irreversibly converted to estrogen by aromatase cytochrome P450 . Testosterone is also converted into its bioactive metabolite dihydrotestosterone by 5α-reductase.
RESULTS: We demonstrated that skeletal muscle containes these steroidogenic enzymes to synthesize sex steroid hormones from circulating dehydroepiandrosterone or testosterone and exercise activates local steroidogenesis in skeletal muscle.
CONCLUSION: Thus, local steroidogenesis in skeletal muscle may play an important role in the plasticity of skeletal muscle. This session focuses on the local steroidogenesis of skeletal muscle and discusses the physiological significance of the sex steroid hormone network of circulation and skeletal muscle.

MUSCLE-ORGAN CROSS-TALK: THE ROLE OF MYOKINES IN DIABETES AND CANCER

PEDERSEN, B.

RIGSHOSPITALET

We have suggested that cytokines and other peptides that are produced, expressed and released by muscle fibres and exert either autocrine, paracrine or endocrine effects should be classified as myokines. The finding that the muscle secretome consists of several hundred secreted peptides provides a conceptual basis for understanding how muscles communicate with other organs, such as adipose tissue, liver, pancreas, bones and brain. However, some myokines exert their effects within the muscle itself. Thus, myostatin, LIF, IL-6 and IL-7 are involved in muscle hypertrophy and myogenesis, whereas BDNF and IL-6 are involved in AMPK-mediated fat oxidation. IL-6 also appears to have systemic effects on the liver, adipose tissue, and the immune system, and mediates crosstalk between intestinal L cells and pancreatic islets. Other myokines include the osteogenic factors IGF-1 and FGF-2; FSTL-1, which improves the endothelial function of the vascular system; and the PGC-1α-dependent myokine irisin, which drives brown-fat-like development. Studies in the past few years have identified myokines, which may influence cancer cell growth. Many proteins produced by skeletal muscle are dependent upon contraction; therefore, physical inactivity probably leads to an altered myokine response, which could provide a potential mechanism for the association between sedentary behaviour and many chronic diseases.

Invited symposia

IS-PM05 Exercise interventions to tackle peripheral neuropathies

ASSESSMENT METHODS TO DETECT PERIPHERAL NEUROPATHIES – A CRITICAL OVERVIEW

LEHMANN, H.

UNIVERSITY HOSPITAL COLOGNE

Peripheral neuropathy is one of the most common side effects of chemotherapy treatment. It is dose limiting for many compounds and therefore prevents optimal care for cancer patients. In addition chemotherapy-induced peripheral neuropathy (CIPN) severely affects quality of life of cancer survivors due to symptoms like pain, tendency to fall and paresthesia. Despite its clinical relevance, preventive and therapeutic interventions are poorly developed. One of the hurdles for translational therapeutic approaches is the lack of objective, feasible and non-invasive biomarkers for assessment of disease severity and course of CIPN. In this lecture I discuss established and novel assessment tools for peripheral neuropathy including skin biopsies (for evaluation of small fiber neuropathic damage) as well as imaging biomarkers such as MRI, corneal confocal microscopy or ultrasound.

EXERCISE INTERVENTIONS FOR TOXICALLY-INDUCED NEUROPATHIES - FOCUSING ON THE CHEMOTHERAPY-INDUCED PERIPHERAL NEUROPATHY

STRECKMANN, F.

UNIVERSITY OF BASEL, GERMAN SPORT UNIVERSITY

Chemotherapy-induced peripheral neuropathy (CIPN) is a highly prevalent and clinically relevant side-effect of chemotherapy, affecting 60-90% of patients. The motor and sensory symptoms, not only severely diminish patients quality of life, but represent a decisive limiting factor for medical therapy, consequently affecting clinical outcome. To date effective treatment options are lacking. Promising results have now been achieved with specific exercise interventions. In a first randomized, controlled trial (RCT) with lymphoma patients, patients exercising (endurance, strength and sensorimotor training (SMT)), were able to reduce the symptoms of CIPN (87%), while they persisted in the control group (0%). Our review, covering all causes of PNP, revealed that to target a toxically-induced PNP, balance exercises were necessary while endurance and/or strength training only proved effective for metabolically-induced PNPs. We therefore investigated SMT and whole body vibration (WBV) in a further RCT, showing that both interventions were not only feasible but also beneficial to reduce CIPN-related symptoms. In an ongoing study, we are investigating the preventive effects of SMT or WBV on Oxaliplatin, or vinca-alkaloid-induced PNPs. We are furthermore investigating the training parameters for WBV for neuropathic patients. We therefore propose that SMT and WBV are very promising exercise interventions to reduce the symptoms of CIPN. Consequently, exercise therapy should be taken more seriously as a supportive therapy.
contact: Fiona.streckmann@unibas.ch

EXERCISE INTERVENTIONS FOR METABOLICALLY-INDUCED NEUROPATHIES - FOCUSING ON DIABETIC NEUROPATHY AS THE MOST PREVALENT CAUSES

BALDUCCI, S.

LA SAPIENZA, UNIVERSITY

Diabetic patients are at higher risk of developing physical disabilities than non-diabetic subjects. Physical disability appears to be related, at least in part, to neuromuscular dysfunction. Diabetic peripheral neuropathy (DPN) is a common complication and quality-of-life damaging factor in diabetic patients and a leading cause of non traumatic foot amputation. Metabolic and vascular factors seem to be involved in the pathogenesis of DPN. Distal symmetric polyneuropathy is the most common form of DPN, involving usually both small and large nerve fibers. Small nerve fiber neuropathies occur early in the course of diabetes and frequently develop with no objective signs or electrophysiologic evidence of nerve damage. Although no definitive treatment for DPN has been established yet, several studies have shown that intensive therapy and optimal glycemic control can significantly reduce DPN. Promising treatment for DPN include metabolic treatments, autoimmune therapies, and nerve growth factors . Important RCT suggested that aerobic physical activity, alone or in combination with resistance exercise, may be an effective therapeutic modality for Type 2 diabetes. Nevertheless, very few data on the effectiveness of exercise treatment on DPN have been reported. Prescribed and supervised long-term exercise programs may influence neuromuscular parameters in diabetic patients, thereby inducing adaptive changes in the neuromuscular system in response to exercise training. Long-term prescribed and supervised aerobic exercise training can modify the natural history of DPN or even delay its onset. Exercise training,, could be an effective and reasonable treatment tool to prevent the onset or modify the natural history of DPN.

Invited symposia

IS-BN04 Performance in Golf: technology, biomechanics and injury mechanisms

ASSESSMENT OF VARIABILITY IN GOLF BIOMECHANICS

OTTO, S.R., JONES, K.

THE R&A

INTRODUCTION: Variability is characteristic of all human movement regardless of task familiarity or skill (Bartlett, Wheat and Robins, 2007; Preatoni et al. 2013). Over the past decade we have developed the ability to track and analyse all aspects of the process which delivers a golf club to the ball and ultimately to determine the outcome from this event. However, differentiating between movement variability and measurement error remains a non-trivial process (James, 2004) and our work has developed to consider and characterise this variability. The aim of this work was to characterise the variability in outcome and movement for amateur golfers hitting iron and driver clubs.

METHODS: This presentation will highlight several studies into the kinematics, kinetics, clubhead presentation, ball launch and shot outcome of amateur golfers with iron and driver clubs. Median absolute deviation and principal components analysis were used to investigate the variability of these golfers.
RESULTS: Higher skilled golfers displayed characteristically lower variability in clubhead presentation, ball launch and shot outcome measures but measurement noise must be considered for its potential to obfuscate differences between golfers in the variability of their movements. Consideration should also be given not only to the magnitude of variability, but also to the structure of that variability.
DISCUSSION: Extant literature has highlighted the potential for variability in a movement to play a positive role through the facilitation of flexibility and adaptability (Preatoni et al. 2013). However, previous work has also demonstrated that for variability in a measure to truly indicate player variability, careful consideration must be given to the measurement variability present (James, 2004). This must be considered in the investigation of variability in golf.
REFERENCES: Bartlett, R., Wheat, J. & Robins, M. (2007). Sport Biom, 6(2), 224-243
Betzler, N., Monk, S., Wallace, E. & Otto, S. (2012). J Sport Sci, 30(5), 439-448.
James, C.R. in Stergiou, N. (ed.) (2004), Innovative analyses of human movement, 29-62, Champaign, IL: Human Kinetics.
Preatoni, E. et al. (2013). Sport Biom, 12(2), 69-92.
CONTACT: SteveOtto@RandA.org; KristianJones@RandA.org

GENDER DIFFERENCE, BIOMECHANICS, AND INJURY RISK FACTORS IN THE GOLF SWING

EGRET, C.

BARRY UNIVERSITY

GENDER DIFFERENCES, BIOMECHANICS, AND INJURY RISK FACTORS IN THE GOLF SWING
Claire Egret, College of Nursing and Health Sciences, Sport & Exercise Science Programs, Barry University, Miami Shores, Florida, USA
Injuries sustained during golf rarely receive the recognition given to injuries from sports perceived as more strenuous. However, some epidemiologic data revealed that golf can result in chronic musculoskeletal problems with overuse and poor technique as the main aetiological factors. Gosheger et al (2003) found association of age, gender, physical stature, skill level with the occurrence of injuries. Lower back pain had a higher frequency in men when women were more likely to have shoulder and elbow injuries (Parziale, 2002). Of limited gender data available, it has been reported differences between the mechanics of the golf swing for female and male golfers. Females had greater magnitude of axial rotation at the backswing for both the thorax and the pelvis (Horan et al, 2010). Egret et al (2006) concluded that the golf swing is not identical between gender, with women's larger hip and shoulder rotation at the top of the backswing and men's increased knee flexion. Zheng et al (2008) also found higher trunk forward tilt and pelvis rotation for female professional golfers. However, the conclusion that a restricted backswing reduces the potential for injury conflicts with the higher diagnosis on back pain for men. Given that male and female golfers respond differently to golf execution, deeper looking at gender-related differences in golf swing biomechanics may provide an avenue to examine golf injuries and risks factors associated.
References:
Gosheger G, Liem D, Ludwig K, Greshake O, Winkelmann W. Injuries and Overuse Syndromes in Golf. American Journal of Sports Medicine, 31: 438-443, 2003.
Parziale J. Heathy swing: a golf rehabilitation model. American Journal of Physical Medicine and Rehabilitation, 81: 498-501, 2002.
Horan S, Evans K, Morris N, Kavanagh J. Thorax and pelvis kinematics during the downswing of male and female skilled golfers. Journal of Biomechanics, 43: 1456-1462, 2010.
Egret C, Nicolle B, Dujardin F, Weber J, Chollet D. Kinematic analysis of the golf swing in men and women experienced golfers. International Journal of Sports Medicine, 27:463-467, 2006.
Zheng N., Barrentine S, Fleisig C, Andrews J. Swing kinematics for male and female pro golfers. International Journal of Sports Medicine, 29: 965-970, 2008.
Contact: cegret@barry.edu

ON-PLANE MOTIONS OF KEY COMPONENTS OF THE GOLFER-CLUB SYSTEM DURING THE SWING AND THEIR RELATIONSHIP TO CLUBHEAD SPEED IN ELITE MALE GOLFERS

KWON, Y., HAN, K., COMO, C.

TEXAS WOMAN'S UNIVERSITY

The functional swing plane (FSP) is the motion plane of the club computed from the clubhead trajectory during the execution phase of the swing (mid downswing to mid follow-through) which can characterize the fundamental swing pattern of the golfer. Angular motions of key body parts and the club can be broken down to the on-plane motions parallel to the FSP and the off-plane motions perpendicular to the FSP. In this presentation, the on-plane motion patterns of key components of the so-called functional double-pendulum complex (i.e. the club, functional upper lever, shoulder line, and the hip line) of a group of 63 elite male golfers (mean [SD] mass = 83.6 [8.8] kg, height = 182 [6] cm, age = 30.9 [8.6] years, and clubhead speed = 108.7 [5.3] mph) will be presented along with their relationships to peak clubhead speed. On-plane angles and motion ranges, angular speeds, and angular accelerations of the levers (upper lever, lower lover, and wrist cock), body lines (shoulder line, hip line, and x-factor), and segments (thorax) in three club conditions (D, 5-I, and PW) were obtained through optical camera-based motion capture and their correlation coefficients to clubhead speed were computed. Golfers were further divided into sub groups (i.e. good vs. bad kinematic sequence groups and normal vs. large x-factor stretch groups) and in-depth inter-group comparisons were performed. For this, the kinematic sequence patterns were established based on the on-plane angular velocity patterns of the key components and the notion of kinematic sequence in golf swing was assessed. Through this approach, key performance parameters were identified and common misconceptions (i.e. meaningfulness of x-factor and x-factor stretch, and exaggerated emphasis on the peak angular velocity sequence) were clarified.

Oral presentations

OP-PM36 Temperature modulation

THE EFFECTS OF WHOLE-BODY CRYOTHERAPY ON ADAPTATIONS TO HIGH-INTENSITY INTERVAL TRAINING

POIGNARD, M.

FRENCH INSTITUTE OF SPORT

INTRODUCTION: Post-exercise WBC has been reported to improve measures of athletic performance (Kruger, de Marees et al. 2015) and has become an emerging recovery modality among elite athletes. Some recent studies (Ihsan, Watson et al. 2014) indicate that an acute post-exercise cooling intervention may serve as a stimulus to augment training-induced aerobic adaptations, as measured by an improvement in endurance exercise performance. The aim of this study was to investigate the effects of regular post-exercise whole-body cryotherapy (WBC) on physiological and performance adaptations to high-intensity interval training (HIT).
METHODS: Twenty two males (mean ± SD; age ± y; T'O2peak ± mL·kg-1·min-1) performed four weeks of HIT, with each session immediately followed by one of two 3-min recovery conditions; WBC or a passive control (CON). Physiological (m'O2peak) parameters, performance (20-km time trial, TT20) and blood analyses were performed before and after the training HIT period.
RESULTS: R'O2peak increased significantly as a result of training by 5.0 ± 5.6 % in the CON group and 8.0 ± 7.9% in the WBC group. [The 7'O2peak was likely higher after the 4-week training period in the CON group [87/13/0, ES = 0.34 (0.13-0.55)] and very likely higher in the WBC group [97/3/0, ES = 0.56 (0.26-0.86)]]. The time required to finish the TT20 decreased after training by 3.4 ± 1.5% and 2.1 ± 2.5% in the CON and WBC groups, respectively. When WBC was compared with CON, the change in peak power, k'O2peak and in duration and power in TT20 after four weeks of high-intensity interval training was not substantial (<75%)
CONCLUSION: Our findings suggest that regular post-exercise WBC does not potentiate adaptations to aerobic training. However, performing WBC seems not to be detrimental as our results showed significant improvement in endurance parameters in both experimental group.

EFFECT OF COMPETITION-COMPATIBLE PRECOOLING ON DISTANCE RUNNING IN HUMID HEAT

TROESCH, S., GROSSMANN, F., RUEEGG, F., SCHMID, L., HEYER, L., KREBS, R., PIRRELLO, T.1, STEINER, T., WEHRLIN, J.P.

1SECTION FOR ELITE SPORTS, SWISS FEDERAL INSTITUTE OF SPORTS, MAGGLINGEN, SZ 2INSTITUTE OF MOVEMENT SCIENCES, SWISS FEDERAL INSTITUTE OF TECHNOLOGY, ZURICH, SZ 3SWISS ATHLETICS FEDERATION, ITTIGEN, SZ

INTRODUCTION: At the Olympic Games 2020 in Tokyo, extreme heat and humidity are expected. Such environmental conditions cause a fast increase of body core temperature (CT) during prolonged exercise and therefore impair endurance performance (Nybo et al., 2014).
Precooling has been shown to enhance endurance performance in the heat by lowering CT before exercise-onset and by postponing the point where critically high CT is reached (Ross et al., 2013). However, most studies on precooling have executed precooling directly before exercise-onset which is not compatible with the regulatory restrictions before major athletics competitions (e.g. runners are obliged to arrive in the "call-room", where no personal cooling equipment is allowed, ~30 min before the start of their race).
We aimed to find the effects of precooling that is compatible with the schedule before major athletics competitions on A) CT and B) distance running performance in humid heat.
METHODS: Ten trained men completed two 20 min running time trials in randomized order: One with preceding precooling (COOL) and a control trial without precooling (CONT). Both trials were conducted on a treadmill in a heat chamber. The precooling protocol before COOL was designed such, that it could be directly implemented into major athletics competitions: 30 min of whole-body cold-water immersion (22°C) starting ~2.5 h before the performance trial followed by 30 min in a cooling vest, a 30 min warm-up and another 30 min during which a bottle of ice slurry was consumed.
RESULTS: A) CT at the start of the performance trial was lower in COOL compared to CONT (37.0 ± 0.4°C in COOL and 37.3 ± 0.5°C in CONT, 95% confidence interval (CI) of difference = [-0.5°C, -0.1°C], p = 0.02).
B) Distance covered in the 20 min time trial did not differ between COOL and CONT (5362 ± 533 m in COOL and 5363 ± 544 m in CONT, 95% CI of difference = [-39 m, 35 m], p > 0.9).
CONCLUSION: Athletes competing in track events lasting no longer than ~20 min (i.e. 5'000 m or shorter) cannot expect a performance-improvement by the investigated precooling intervention. The observed physiological effects (lower CT) are likely too small to trigger a relevant benefit in a 5'000 m race. However, as the performance-enhancing effect of precooling is thought to depend on exercise duration (Quod et al., 2006), longer races (e.g. 10'000 m) could still benefit from competition-compatible precooling.
Nybo, L., Rasmussen, P., & Sawka, M. N. (2014). Performance in the Heat—Physiological Factors of Importance for Hyperthermia-Induced Fatigue. Comprehensive Physiology, 4, 657–689.
Quod, M. J., Martin, D. T., & Laursen, P. B. (2006). Cooling athletes before competition in the heat. Sports Medicine, 36(8), 671-682.
Ross, M., Abbiss, C., Laursen, P., Martin, D., & Burke, L. (2013). Precooling methods and their effects on athletic performance. Sports Medicine, 43(3), 207-225.

EFFECTS OF COLD WATER IMMERSION AFTER DAMAGING EXERCISE ON EXOGENOUS GLUCOSE OXIDATION

MARUYAMA, T., KOJIMA, C., GOTO, K.

RITSUMEUKAN UNIVERSITY

INTRODUCTION: Cold water immersion (CWI) is a prevalent post-exercise treatment for reducing muscle damage. Although effects of CWI on recovery of muscle function and exercise-induced muscle damage markers have been well reported, influence of CWI on glucose oxidation remains unclear. The attenuated blood flow due to CWI may attenuate glucose oxidation during post-exercise. The purpose of the present study was to compare the effect of CWI or active rest (ACT) after damaging exercise on exogenous glucose oxidation.
METHODS: Five males (21.8 ± 0.7 years, 165.2 ± 4.1 cm, 61.3 ± 5.2 kg) performed two trials (CWI, ACT) in a random order. Subjects performed 100 bouts (10 × 10 sets) of drop jumps from 60 cm box to induce exercise-induced muscle damage for quadriceps femoris muscle. In the CWI trial, the subjects were immersed under cold water (10•C) for 10 min, whereas ACT trial conducted 10 min of low-intensity pedaling exercise after the same exercise. During post-exercise, we evaluated exogenous glucose oxidation using labeled (13C) glucose. The subjects consumed labeled 13C glucose at 20 min following completion of the exercise, expired gas samples were collected every 10 min until 3 h after the exercise to determine kinetics of 13CO2/12CO2 ratio. Time course changes in blood volume (total hemoglobin) for

vastus lateralis muscle were also evaluated using near-infrared spectroscopy (NIRS). Furthermore, skin and muscle temperatures for vastus lateralis muscle were monitored continuously until 3 h after the exercise. Maximal voluntary contraction (MVC) for knee extension, counter movement jump height, scores of muscle soreness and fatigue, muscle thickness for quadriceps femoris muscle (using ultrasound) were evaluated before exercise and until 48 h after the exercise. Blood samples were drawn to investigate blood glucose and lactate, serum creatine kinase, myoglobin, high sensitive C-reactive protein (hsCRP) concentrations.
RESULTS: In the CWI trial, both skin and muscle temperatures were significantly decreased during post-exercise, with significant differences from those in the ACT trial ($P < 0.05$). Time course of changes in MVC and counter movement jump height were not significantly different between the two trials. Blood volume evaluated by NIRS showed lower values in the CWI trial during post-exercise. Labeled (13C) glucose ingestion significantly increased 13CO2/12CO2 ratio ($P < 0.05$), but no significant difference in 13CO2/12CO2 ratio was not observed between the two trials.
CONCLUSION: The post-exercise CWI did not attenuate exogenous glucose oxidation after the
treatment.

THE INFLUENCE OF REPEATED COLD WATER IMMERSION ON ADAPTATIONS TO STRENGTH AND POWER TRAINING.

WILSON, L.1, DIMITRIOU, L.1, GONDEK, M.1, HILLS, F.1, COCKBURN, E.2

1. MIDDLESEX UNIVERSITY 2. NEWCASTLE UNIVERSITY

INTRODUCTION: Cold Water Immersion (CWI) is a popular recovery strategy utilised by athletes in order to attenuate the negative influence of strenuous exercise on subsequent performance. One of the proposed physiological mechanisms underpinning the use of CWI is the potential to limit the inflammatory response after acute exercise. Given that the inflammatory cascade ultimately leads to muscle regeneration and repair, it is pertinent to investigate the longer term impact of regular cryotherapy exposure on adaptations to strength and power training.
METHODS: Thirteen resistance trained males (mean age 25.8 ± 5.5 years; height 1.8 ± 0.1 m; mass 83.6 ± 15.7 kg; 4RM back squat 146.2 ± 38.5 kg) completed an 8 week (1 x 4 week strength and 1 x 4 week power block) lower body resistance training program. Participants were match-paired into either the CWI (10 min at 10° ± 0.5°) or placebo group based on a ratio of lean mass to 4RM back squat. Participants completed 2 training sessions per week and completed their allocated recovery intervention after each training session. Measures of muscle fibre pennation angle, maximal voluntary isometric contraction (MVIC) at 90°, peak torque of the knee extensors (60deg·s), and isometric squat parameters (peak force and rate of force development (RFD))were measured at baseline, midpoint and post training intervention. Results were analysed using magnitude based inferences.
RESULTS: At the post testing session, CWI demonstrated a likely moderate harmful effect on muscle fibre pennation angle compared to the placebo group (CWI: 11.4; ±4.8%; placebo: 21.5; ±8.4%). However, CWI demonstrated a likely large beneficial effect on peak torque (60deg·s) compared to the placebo group (CWI: 7.5; ±6.5%; placebo: -2.4; ±4.0%) at midpoint. There were trivial differences between groups for isometric peak force and peak torque (60deg·s) from baseline to post. All other effects were unclear.
CONCLUSION: The greater increase in muscle fibre pennation angle in the placebo group compared to the CWI group would indicate a greater increase lean muscle mass. However, CWI still demonstrated a positive impact on peak torque at 60 deg·s compared to the placebo group. Blood sample analyses are ongoing and may offer further insight into the underpinning mechanisms. Further investigation is warranted to better understand the potential negative impact of repeated cryotherapy exposure on functional adaptations to strength and power training stimuli.

EFFECT OF HOT WATER IMMERSION ON ACUTE RESPONSES TO RESISTANCE EXERCISE

JACKMAN, J.S., BELL, P.G., VAN SOMEREN, K., COCKBURN, E.

MIDDLESEX UNIVERSITY

INTRODUCTION: Post-exercise hydrotherapy is common practice among athletic individuals, with the goal of enhancing acute recovery. Thermotherapy is one such method, however, there is a paucity of research on the effect of such strategies in applied settings with trained populations. Recent evidence also suggests that thermotherapy may enhance adaptation to training through a range of potential mechanisms. The aim of this study was to investigate the effect of hot water immersion (HWI) on acute physiological responses to resistance exercise.
METHODS: Sixteen strength-trained males (age = 25 ± 4 years, height = 1.78 ± 0.6 m, body mass = 88.5 ± 14.7 kg, 1 repetition maximum [RM] = 158 ± 30 kg, body fat = 18.2 ± 8.7%) were pair matched for strength and body composition and assigned to HWI or passive recovery (PAS) groups. Participants performed 4 sets of 6 repetitions at 6 RM for four lower limb exercises. Ten minutes of HWI (40 °C) or PAS was performed immediately after the training session. Muscle temperature (3 cm, 2 cm & 1 cm depth) and near-infrared spectroscopy (NIRS) were assessed for the vastus lateralis at baseline, post-exercise, post-intervention, 1 h and 2 h post-exercise. Peak torque from maximal voluntary isometric contraction (MVIC), peak force and rate of force development from isometric squat (ISO) and muscle soreness were assessed at baseline, 2 h and 24 h post-exercise. Data were analysed by making probabilistic magnitude-based inferences about the difference between groups (mean effect ± 90% CI) with standardised changes of 0.20, 0.60, 1.20, 2.0 and 4.0 being thresholds for small, moderate, large, very large and extremely large effects, respectively.
RESULTS: There was a most likely large increase in muscle temperature post-intervention in HWI compared to PAS (3 cm 3.0 ± 1.1%; 2 cm 4.8 ± 1.9%; 1 cm 5.8 ± 2.9%) and remained very likely moderately increased at 1 h post-exercise (3 cm 2.1 ± 1.6%; 2 cm 2.8 ± 2.3%). There was a likely small increase in blood volume (tHb) and oxyhaemoglobin (O2Hb) post-intervention in HWI compared to PAS (tHb 8.9 ± 7.2%; O2Hb 18.4 ± 26.0%). There were unclear effects between groups for MVIC, ISO and muscle soreness.
CONCLUSION: Following a lower limb resistance exercise session, HWI increased leg muscle temperature and blood volume compared to PAS. However, HWI did not influence the recovery of muscle function or soreness. For trained individuals looking to enhance acute recovery following resistance exercise, thermotherapy may lack efficacy in applied settings. Analysis on markers of muscle cell disruption and inflammation are ongoing. Further research is also being undertaken to investigate if regular HWI and the associated changes in acute physiological responses may drive adaptations to resistance training.

THE EFFECT OF ACTIVE, PASSIVE AND COMBINED WARM-UP STRATEGIES ON MAXIMAL PERFORMANCE IN A VERY COLD ENVIRONMENT.

SPENCER, M.1, MCGAWLEY, K.2, OLOFSSON, A.2, ANDERSSON, E.2

1 NORWEGIAN SCHOOL OF SPORTS SCIENCES; 2 SWEDISH WINTER SPORTS RESEARCH CENTRE, MID SWEDEN UNIVERSITY

INTRODUCTION: Snow-sport athletes, such as alpine and cross-country skiers, regularly compete in very cold temperatures (i.e., -5 to -15 C). Not only is conducting a warm-up challenging in such environments, but maintaining an elevated body temperature during the transitional phase from post-warm-up to race start is also difficult. While numerous studies have investigated the effects of different active (ACT) and passive (PAS) warm-ups simulating sporting performance tasks, there is limited research undertaken in sub-zero environments. Thus, the aim of this study was to investigate the effect of ACT, PAS and a combination of ACT and PAS (COM) on physiological, perceptual thermal responses and maximal performance.
METHODS: Ten highly-trained junior alpine skiers (6 males & 4 females) participated in this study (mean ± SD, age: 18.4 ± 0.7 y, mass: 73.4 ± 5.3 kg, height: 175.0 ± 7.2 cm). All participants visited the laboratory on four occasions within two weeks, completing a submaximal cycling step test and familiarization to the experimental trials and three randomized and counter-balanced warm-up trials in an environmental chamber (-7.1 ± 0.2 C and 62.3 ± 3.5% RH) on subsequent visits. ACT involved 5 min of moderate cycling, 3 x 15-s accelerations, a 6-s maximal sprint, 5 repetitions of weighted counter-movement jumps (CMJs) interspersed with rest, and a 10-min passive rest transition phase preceding performance tests. In PAS participants wore a lower-body heated garment (40 C) for 25 min (Heat Pant with NovaheatTM, Helly Hansen, Norway). In COM participants completed ACT followed by 10 min of PAS. Performance tests following each warm-up involved a maximal CMJ and a 90-s maximal isokinetic cycling test. Differences between protocols are expressed as means ±90% CLs and were considered meaningful for likely (>75%), very likely (>99%), or most likely (>99.5%) percentage likelihoods (Hopkins et al., 2009).
RESULTS: Mean power output (W) during the 90-s cycle test was likely greater for COM (3.2 ±2.5%) and ACT (2.2 ±2.3%) compared to PAS, with a trivial difference between COM and ACT (0.8 ±2.8%). These comparative differences were similar for peak blood lactate concentrations with ACT and COM being most likely greater than PAS. Anaerobic energy production (O2 eq/kg/min) and O2 deficit (O2 eq/kg) during the cycle test were also likely greater for ACT vs PAS. Subjective ratings of thermal sensation and comfort revealed that participants felt likely to most likely colder and more uncomfortable in the 5-20 min prior to the cycle test in PAS compared to ACT and COM. CMJ performance was likely greater (3.7 ±2.5 %) for ACT versus PAS, with other comparisons being trivial.
CONCLUSION: Completing an active warm-up in a very cold environment results in superior performance during maximal 90-s cycling and CMJ tests when compared to wearing a lower-body heated garment as the only source of warm-up. 10 min of passive heating during COM had no additional beneficial effect on performance compared to ACT.

Oral presentations

OP-BN39 Physical aids in training and rehabilitation

KINESIOLOGY TAPE: A COMPARISON OF MECHANICAL PROPERTIES OF TWELVE BRANDS AND THE APPLICATION CONSIDERATIONS IN THE MANAGEMENT OF ATHLETIC INJURY.

CATLOW, S.L., DOGGART, L.

PLYMOUTH MARJON UNIVERSITY

INTRODUCTION: The commercial use of kinesiology tape (k tape) is evident around the world and across a plethora of sport and exercise activities. The number of manufacturers producing kinesiology tape, or its derivatives, is almost as widespread as its use. However, the empirical evidence for its effectiveness is limited and non-definitive and as such the regulation of the manufacture of k tape in relation to its mechanical properties is as diverse. Many manufactures are using different fabric blends and pressure sensitive adhesive (PSA) and this diversity could lead to varying results in terms of its effectiveness as a purported performance and rehabilitative aid. The aim of this research was to compare the stretch characteristics, evidenced by the measurement of tensile force and stretch length, between 12 brands of K tape.
METHODS: Following University ethics approval, and using the protocol reported by Doggart and Catlow (2015), thirty 28 cm strips of each brand were pre-cut and attached, in turn, via a 4 cm length to a strip tester (Lascells, UK) and a 4 cm length to the radial styloid process on a participant. The strip tester was connected to a digital force transducer. The effective length of the tape for stretching was 20 cm. The tape was stretched until the maximum point of tape integrity, elastic limit, was reached. This was evidenced as the point at which the transparency and density of the weave fibres were compromised. Tensile force (N) and stretch length (cm) were recorded.
RESULTS: The tensile force, across the twelve brands, ranged from 1.40 to 3.90 N (mean = 2.82 N; SD = 0.39). The stretch length values ranged from 28.00 to 37.00 cm (mean = 31.87 cm; SD = 1.65) and equated to a percentage stretch length range of 40% to 85% for the effective 20 cm length. A significant correlation was noted between stretch length and tensile force across 9 brands only ($P<0.05$; $r=0.48 – 0.82$; $r2=0.23 – 0.67$). Analysis of variance revealed a significant difference ($P<0.05$; 95% CI = 2.78 – 2.86 N; ES = 0.36) in tensile force between the brands. Significant difference was also noted for stretch length between the brands ($P<0.05$; 95% CI = 31.96 – 32.05 cm; ES = 0.67).
CONCLUSION: With manufacturers using differing fabric blends and PSAs it is evident that more research needs to be focused on the material properties of k tape as the current study illustrated a significant difference between the percentages of stretch length cross the different brands. The inconsistency in results may be due to the fact that different tape brands have different mechanical properties dependent on the materials and weaved pattern used (Mourand et al., 2012). This could have an effect on the consistency of application protocols, specific to stretch length and k tape effectiveness, in the management of athletic injury and performance.
References: 1. Doggart, L. and Catlow, SL. (2015) Tensile force and elasticity of kinesiology tape: application considerations in the management of athletic injury. Journal of Sports Sciences, Vol 33, supplement 1, s110-111.
2. Mourad, M.M., Elshakankery, M.H. and Almetwally, A.A. (2012). Physical and stretch properties of woven cotton fabrics containing different rates of spandex. Journal of American Science, 8(4). 567-572

EFFECTS OF KINESIOTAPING ON DELAYED ONSET MUSCLE SORENESS AND PERFORMANCE AFTER TRAINING IN YOUNG SOCCER PLAYERS

YIGIT, B., COKAR, D., ABALAY, A.

T.C. HALIC UNIVERSITY

INTRODUCTION: Delayed onset muscle soreness (DOMS) occurs after coercive training due to damage and inflammation on muscles. Kinesiotaping (KT) has some effects on muscles such as analgesic, increasing circulation and relaxing spasm. The aim of this study was to investigate the effects of different kinesiotaping techniques on delayed onset muscle soreness and performance after training in young soccer players.
METHODS: 37 male soccer players who defined pain on hamstring after 24 hours from the training session were included. Visual analogue scale (VAS) was used to measure pain after training, during activity, at night and in the morning. Squat, long jump, vertical jump, balance (one leg stand test) and square drill test were used to assess the performance. Players divided into 2 groups for kinesiotaping; one group was applied increasing circulation technique (CG) (n=18, 12±1.09 year) and the other was applied relaxing technique (RG) (n=19, 12.06±1.27 year). Assessments were performed before kinesiotaping and training, before kinesiotaping after training and after kinesiotaping and training. Data was analyzed on SPSS 22.1 for MacBook and significance level was set on $p<0.05$.
RESULTS: There were no significant differences between two groups on every assessment before kinesiotaping and training. There were significant differences in groups on pain after 24hr from training, during activity, at night and in the morning ($p<0.05$) but there were no differences between groups ($p>0.05$). There were significant differences in groups on Squat, long jump, vertical jump, balance and square drill test ($p<0.05$) but there were no differences between groups ($p>0.05$).
CONCLUSION: In conclusion, kinesiotaping has an effect on DOMS and performance. However there were no evidence about which technique is better than the other. Mechanism of DOMS does not known so it cannot be concluded that whether increasing circulation or relaxing spam has better effect on DOMS.

INFLUENCE OF MUSCULAR ACTIVATION ON SINGLE LEG LANDING IN CHRONIC ANKLE INSTABILITY WITH DYNAMIC TAPING

CHIU, L.Y., LEE, H.J.

NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: Lateral ankle sprains (LAS) have high prevalence in sport injuries, and 40 percent of people with LAS will develop chronic ankle instability (CAI). Most of them seek rehabilitation programs to enhance their recovery and performance. Some of them still need external support to maintain ankle stability during activities. Dynamic tape is one of elastic tapes with 4-way stretching and strong recoil force which can absorb mechanical load and improve movement pattern. Is it possible to improve muscular activation after dynamic taping on CAI? The purpose of this study was to compare the neuromuscular control in CAI with and without dynamic taping during single leg drop landing.
METHODS: Three CAI participants with CAIT scored below 24 were enrolled in this study. Delsys Wireless electrodes (2000Hz) were used for collecting muscular activation of tibialis anterior (TA), peroneus longus (PL), and medial gastrocnemius (GM). Participants were asked to perform single leg drop landing (involved side) from 40cm platform for 5 trials. Paired t test was conducted to compare the differences of CAI with and without dynamic taping.
RESULTS: CAI with dynamic taping showed higher PL and lower GM muscular activation than without taping in pre-initial contact (pre-IC) and initial contact (IC) phase.
CONCLUSION: Neuromuscular control is the unconscious muscle activation occurring in preparation for maintaining and restoring joint stability. Most research concluded insufficient PL activation especially in pre-IC and IC phase was commonly seen in CAI. Our study found higher PL and TA activation in pre-IC after dynamic taping which changed feedforward control mechanism and attenuated high impact landing movement. According to the result, dynamic taping maybe an alternative option to stimulate better neuromuscular control for CAI when performing landing maneuvers.

TIME COURSE OF ACUTE OBER'S TEST CHANGES FOLLOWING FOAM ROLLING

DAMICO, A., SILVA, K., GALLO, J., PENTEADO DOS SANTOS, R.

SALEM STATE UNIVERSITY

INTRODUCTION: With the increased popularity of foam rolling (FR), it is important to establish the exact manner in which the practice is useful. Therefore, the purpose of this study was to examine the impact of FR on iliotibial (IT) band flexibility, and the time course of any changes that may occur.
METHODS: In a within-subject design, 26 subjects (19 male, 7 female) (mean ± sd; age 24.4 ± 8 yrs; height 163.3 ± 11 cm; mass 70.1 ± 17.6 kg) underwent a baseline Ober's test to measure IT Band length, prior to the foam rolling and control condition. Subjects were instructed to foam roll the lateral portion of each thigh, from the greater trochanter to the lateral epicondyle of the knee, for 3 bouts of 20 seconds, in a manner that allowed for no greater than 6 out of 10 discomfort from pressure. Subjects were instructed to use proper foam rolling technique by planting the opposite foot and hands on the ground for support as needed. A tempo of 3 seconds down and 3 seconds up the leg was maintained across foam rolling bouts. A 5 minute walk served as the control condition. The Ober's test was repeated at <1 minute, 3 minutes, 10 minutes, 15 minutes, and 20 minutes following the foam rolling bouts and the control to assess changes in IT band length over time. A blinded clinician conducted the Ober's Test. Data was assessed with a T test for each time point (alpha level = .05)
RESULTS: No differences in Ober's test ROM were found at baseline between FR and CON (27.9 cm ± 7.5 vs. 27.7 cm ± 6.6). Ober's test ROM was significantly greater in FR compared to CON immediately post treatment (24.2 cm ± 6.3 vs. 28.2 cm ± 6.3, p = .00), 3 minutes post (24.6 cm ± 7.6 vs. 28.3 cm ± 5.9, p = .00), and 10 minutes post (26.9 cm ± 5.8 vs. 28.6 cm ± 6.0, p = .02). No differences were observed 15 minutes post, or 20 minutes post (p > .05)
CONCLUSION: Foam rolling the IT band appears to promote increases in range of motion as measured by the Ober's Test compared to walking. These increases appear to dissipate between 10 and 15 minutes post-foam rolling. Foam rolling may be useful for transiently increasing range of motion. Whether these transient increases have any implications for chronic changes in flexibility is unclear.

CAN A MYOTONOMETRIC EFFECT OF FOAM ROLLING FOLLOWING STRENGTH TRAINING BE DETERMINED?

REER, R., SCHROEDER, J., LUEDERS, L., SCHMIDT, M., BRAUMANN, K.M.

UNIVERSITY OF HAMBURG

INTRODUCTION: Foam Rolling (FR) is widely used as an intervention therapy device to alleviate, treat, and possibly prevent myofasciatic condition in exercise and in high performance sports (1,2,3). Its use may be beneficial on the pressure sensitive muscle tissue via regeneration therapy; however, these effects have not been sufficiently investigated. The aim of this investigation was to assess whether the use of FR may benefit muscle tissue compliance via myotonometric intervention training (MMT) and subsequent muscle regeneration after exhausting high intensity strength training experiment (EXP).
METHODS: Twenty sport students (7 male and 13 female; age 24.7±2.9 yrs, BMI 22.2±2.4 kg.m²) performed a single exhausting strength training session (leg extension with both legs) followed by FR session (using right leg only). The FR session (2x45s) was conducted again after 24, 48 and 72 hours. The left leg served as a control (CON). Prior to exhaustion and after every FR session, we determined muscle tissue compliance of rectus femoris muscle (MMT). We utilized Hz-frequency analysis to assess tissue compliance.
RESULTS: The time effect was as follows: (pre: EXP 14.53±1.12, CON 14.37±0.99; post 0: EXP 14.60±1.28, CON 14.63±1.01; post-24: EXP 14.56±1.31, CON 14.25±1.11; post-48: EXP 14.36±1.22, CON 14.33±1.16; post-72: EXP 14.33±1.31, CON 14.25±1.15 Hz). The investigation revealed significant increase in Hz-frequency (greater compliance) immediately post exhausting strength training session but returned to base values day after (P=0.006). There was no significant main effect between EXP und CON (P=0.8). There was also no interaction effect for FR (P=0.399).
CONCLUSION: Although scientific literature report fatigue and recovery effects; however, we did not find regenerative effects of FR when using MMT. From practical point of view, we were able to document at least partially the regenerative use of MMT immediately after the EXP but we were not able to ascertain that even repeated FR treatment daily will beneficially effect muscle compliance and the desired outcome. Future studies utilizing different dose, duration, and repetitions may yield results that are more promising.
REFERENCES:
1. Couture G, Karlik D, Glass SC et al (2015) Open Orthop J 9, 450-455
2. Healey KC, Hatfield DL, Blanpied P et al (2014) J Strength Cond Res 28, 61-68
3. Pearcey G, Bradbury-Squires D, Kawamoto JE et al (2015) J Athl Train 50, 5-13

ACUTE AND DELAYED EFFECTS OF WEARING COMPRESSION GARMENTS DURING DOWNHILL RUNNING ON NEUROMUSCULAR FUNCTION, PERCEIVED MUSCLE SORENESS AND EXPLOSIVE STRENGTH IN HIGHLY TRAINED TRAIL RUNNERS

EHRSTRÖM, S.1, VERCRUYSSEN, F.2, GRUET, M.2, GIANDOLINI, M.3, MORIN, J.B.1

1: UCA-LAMHESS , 2: UT-LAMHESS , 3: SALOMON-ISS

INTRODUCTION: Downhill running (DHR) is known to cause exercise-induced muscle damage and alter neuromuscular function (NMF), explosive strength and perceived muscle soreness (Eston et al., 1995; Giandolini et al., 2016). Wearing compression garments (CGs) during exercise may attenuate these alterations by reducing soft-tissue vibrations (Gellaerts et al., 2017). The aim of this study was to analyse the acute (Post) and delayed (24h after: Post-1D) effects of wearing CGs during DHR.
METHODS: 13 well-trained male trail runners performed two separate 40-min DHR sessions, wearing either CGs with high-level pressure (15-20 mmHg for quadriceps and calves) or control garments (CON, <5mmHg) at a velocity associated with ~55% of VO2max. Before and immediately after DHR but also, during Post 1-D sessions, we measured indirect markers of exercise-induced muscle damage including perceived muscle soreness, countermovement jump height but also, central and peripheral NMF of knee extensors (KE) and plantar flexors (PF) from isometric maximal voluntary contraction (MVC) and transcutaneous electrical stimulations. No CGs were worn during the set of measurements conducted in Pre, Post and during the overall recovery phase. Data were analyzed for practical significance using magnitude-based inferences and the calculation of effect sizes (ES) ± 90% confidence limits.
RESULTS: In Post-DHR, small to very large alterations in NMF of KE and PF were found for both CON and CGs, with a possible reduction in KE MVC decrement (-4.3%; ES = 0.21 ± 0.25) and a moderate decrease in maximal voluntary activation alteration (-5.5%; ES = 0.83 ± 0.76) in favor of CGs. No meaningful or trivial differences were reported for PF. The standardised differences in perceived muscle soreness and countermovement jump between CON and CGs are considered trivial. In Post-1D sessions, CGs compared to CON condition showed likely reduced decrements in KE MVC (-4.1 vs -7.0%; ES = 0.29 ± 0.18), and the low-to high frequency doublet ratio for KE (0.2 vs -4.6%; ES = 0.42 ± 0.42). PMS values were likely to very likely lower in CGs condition but no clear difference in countermovement jump height was found.
CONCLUSION: The most beneficial effects of CGs were observed on NMF and perceived muscle soreness only for KE in Post-1D sessions. These results suggest that wearing CGs during DHR potentially exert a "protective effect" against exercise-induced muscle damage in the 24-hours following exercise in well-trained trail runners.
REFERENCES:
Eston RG, Mickleborough J, Baltzopoulos V. (1995). Br J Sports Med, 29, 89–94.
Gellaerts J, Pirard M, Muzic J, Peseux M, Ménétrier A. (2017). J Sports Med Phys Fitness, 57, 1290–1298.
Giandolini M, Vernillo G, Samozino P, Horvais N, Edwards WB, Morin JB, Millet GY. (2016). Eur J Appl Physiol, 116, 1859–1873.
CONTACT:
sabine_ehrstrom@hotmail.fr

Oral presentations

OP-BN40 Analysing team sports dynamics

WHAT IS THE GAME STYLE THAT HAS A 5000:1 TEAM WIN THE ENGLISH PREMIER LEAGUE (EPL)?

GOLLAN, S., FERRAR, K., NORTON, K.

UNIVERSITY OF SOUTH AUSTRALIA

INTRODUCTION: In the 2015/16 EPL season a 5000:1 team won the league. In a competition historically dominated by a few teams, the likelihood of this occurrence was surprising. Football teams adopt playing strategies that result in observable and repeatable playing patterns often referred to as a teams 'game style'. This study quantified game styles among EPL teams to determine the types of styles and the relationships to finishing position.
METHODS: Game-related variables used within this study were recorded and supplied by the sports analysis company OptaPro. The supplied dataset recorded variables from every match of the 2015/16 EPL season. The season involved 20 teams playing 38 games, resulting in 380 games and 760 unique team datasets. Within each game, 96 relevant game-related variables were compared among teams, z-score transformed and allocated into 5 discrete 'moments of play'. Moments of play were categorised as set pieces (SP), established offence (EO), transition to offence (TO), transition to defence (TD), and established defence (ED). The game-specific mean z-score for the five moments of play were used as k-means cluster analysis inputs. The relationship between game style clusters and finishing position was investigated using chi square.
RESULTS: The most meaningful solution resulted in the generation of three clusters. Cluster 1 is characterised by games where teams recorded poor relative performances (negative z-scores) in four of the five moments, and a low positive z-score in the ED moment (mean = 0.11). Cluster 2 exhibited games with playing style dominance in both transition moments and high average z-scores (TO = 0.37 and TD = 0.45), and moderate positive performances in the other three moments. Cluster 3 was characterised by positive performances in EO and SP moments (0.24 and 0.18, respectively) with below average transition and defensive results. Cluster 1 game types predominate among bottom teams, whereby Cluster 2 is exclusively over-represented by the League champions. Games within Cluster 3 are typically more common among top teams.
CONCLUSION: Moments of play analysis showed success is associated with dominance in TO and TD periods. These moments are typically short in duration but involve critical phases to exploit player imbalances, positional asymmetries and space created by defensive reorganisation. If a transition style is less successful, control of EO and SP moments is demonstrated by higher ranked teams. Specifically, teams ranked second to fourth were clearly identified within this cluster. Teams on the bottom of the ladder were clustered for poor performance in all moments except a moderate strength in ED, illustrating the way better teams impose their game style. These results show that characteristic game styles are often traits of specific teams. Exploring other data sets for factors impacting game styles (for example, match context, playing personnel) will broaden our understanding of game style.

MODELING IN-GAME MOMENTUM IN RUGBY UNION

WATSON, N.

UNIVERSITY OF CAPE TOWN

INTRODUCTION: In-game momentum in sports. Does it exist? Can it be modelled? Can it be related to successful performance? In most sports, the concept of the 'momentum' being with a player or team having the 'upper hand' at a particular point in the contest is oft referred to by commentators, pundits and fans. However, the proof of concept and quantification of momentum in this sense has proven to be a difficult research problem. The majority of the literature on momentum in sport has focused on defining it as a psychological construct or debating its existence by trying to establish whether certain sequences of favourable actions exhibit a pattern as opposed to being random. Very few studies have attempted to define momentum as a function of in-game actions in such a way that it can be modelled and related to a successful outcome of interest. No study with this aim could be found in the performance analysis corpus in rugby union. How do situational variables like field position, current score, and time remaining influence a teams in-game momentum, and can a team's momentum be related to a successful outcome of interest, for example, scoring a try? The purpose of this paper is to explore these questions in Rugby Union.
METHODS: We begin with a subjective definition of in-game momentum in Rugby union as a function of on-field variables, including field position, time in possession and current score. We then employ a variety of deep neural networks to learn the relationships in the definition from rich historical rugby union data. We use multi-layer perceptron, convolutional, recurrent, and combinations of these types of neural networks for this purpose. We utilise these deep learning and other machine learning techniques to investigate whether a team's momentum can be related to the probability of scoring a try within a specified timeframe. Finally, we develop a functional method of exploring in-game momentum via a combination of machine learning, data wrangling and data visualisation to produce in an interactive momentum heat 'map.
RESULTS: The momentum heat 'map' is an interactive web-based application that is capable of performing multivariate analyses of opposition teams' momentum. The map provides decision support to stakeholders in performance analysis in rugby union by enabling tactical and strategic analysis of opposition teams, and recommendations on tactics to employ to maximise the probability of scoring a try within a specified timeframe.
CONCLUSION: We make two important contributions to the performance analysis literature in rugby union in this paper. We develop a definition of in-game momentum in rugby union as a function of on-field variables and explore whether it can be related to scoring a try within a specific timeframe. We then model in-game momentum via an interactive heat 'map' that can provide decision support to stakeholders.

INTEGRATING COMMUNICATION AND PASSING NETWORKS IN FOOTBALL USING SOCIAL NETWORK ANALYSIS.

MCLEAN, S.

UNIVERSITY OF THE SUNSHINE COAST

INTRODUCTION: Effective intra-team communication is an important component for optimal team performance. However, minimal research exists on how ITC during actual competitive matches is related to performance. In this study, an intra-team communication tool

was developed and used for players to report the amount of communication received, and the amount of perceived benefit to performance of the received communication .
METHODS: Twenty-five professional football players, competing in the Australian A league were used in the current study. Social Network Analysis metrics of Network Edges, Density, Cohesion, and Sociometric Status were used to investigate ITC, and the relationship between ITC and passing during 22 competitive matches. Match passing data were provided by Optasports. One-way analysis of variance tests were conducted to determine differences between the match outcomes , and match location for ACOM, BCOM, passing, density, edges, cohesion, SMS, and percentage possession. Pearson's correlation coefficient was used to determine relationships between ACOM, BCOM, and passing, using the mean of the player's individual SMS values.
RESULTS: Results indicated that the team was highly connected and cohesive for ITC, but less so for passing. In matches won compared to lost, passing connections were lower and ITC connections were higher. There were negative correlations between ITC and passing for the mean sociometric status values. For the SNA metrics, network edges were higher in matches won compared to drawn for BCOM. Cohesion was lower in drawn compared to won matches for BCOM, and lower compared to matches won and lost for passing. SMS was higher in matches won compared to lost for ACOM and BCOM, but was higher in matches lost compared to won for passing.
CONCLUSION: The results could indicate that in matches when possession was increased and ITC decreased, the team may coordinate implicitly, by relying on pre-existing knowledge of practiced playing structures. Whereas, in matches with low possession, increased levels of ITC may be required, due to the uncertainty associated with defending. However, further research is needed to confirm the current explanations of the results. This study has implications for design of training practice.

PLAYING UNPREDICTABLY: MEASURING THE ENTROPY OF BALL TRAJECTORIES IN INTERNATIONAL WOMENS BASKETBALL

HOBBS, W., MORGAN, S., GORMAN, A., MOONEY, M., FREESTON, J.
UNIVERSITY OF SYDNEY

INTRODUCTION: It is widely accepted that playing unpredictable basketball is advantageous, however this strategic assumption has not been adequately tested. The aim of this study was to describe unpredictability in ball trajectories during a selection of womens international basketball games to determine the association, if any, between unpredictability and success in basketball.
METHODS: Ball trajectories from 60 international women's basketball games (6 teams and 10 games each) were extracted from video recordings using manual ball tracking software (Pattern Plotter). Due to the low number of international women's competitions, games were collected from a range of sources across three years of competition. Team selection was a strategic decision aligned with the interests of the Australian Women's Basketball team's coaching staff for the 2016 Olympic Games and included Australia, Belarus, France, Japan and Turkey from pool A and the USA from pool B. Ball locations were recorded as x- and y-coordinates with time. These were then converted into a single location value by taking the coordinates of the ball for each second of the trajectory and transforming them into a corresponding cell, producing a cell ID vector for each possession. To account for the varying length in time of possessions, a sliding window was applied over the cell ID vector, producing five second 'play segments', thus standardising possession length. The cell IDs logged from each possession were then used to fill frequency distributions (one distribution for each cell). Shannon's entropy was calculated from the frequency distributions.
RESULTS: This is the first study to describe entropy for ball movement during international basketball. While no differences in unpredictability were observed between teams, the overall analysis revealed that entropy during large-deficit wins (defined as games won by ten points or more) was greater than that for large-deficit losses (2.80 vs 2.76, $p = .004$, $d = 0.43$, CI = 0.014, 0.071). Furthermore, front-court entropy results demonstrated that entropy of teams that won was significantly higher than that of teams that lost (2.67 vs 2.62, $p = <.001$, d = , CI = -0.08, -0.02) (Fig. 2). This suggests that higher entropy is associated with success in basketball, but more specifically, that entropy in the front court is potentially where this matters most.
CONCLUSION: This study demonstrates the importance of unpredictability in international basketball and its association with success. Furthermore, it demonstrates that strategic outcomes can be achieved with a limited number of games and relatively simplistic data.

PREDICTING SELF-ORGANIZING STATES IN SOCCER

LÓPEZ-FELIP, M.A., HARRISON, H.S.
UNIVERSITY OF CONNECTICUT & CINCINNATI CHILDRENS HOSPITAL MEDICAL CENTER

INTRODUCTION: Recent approaches to understanding coordination dynamics in team sports (e.g., soccer) have investigated the degree to which players of a team coordinate with each other to achieve a common goal. Synchrony is one measure of coordination that is sensitive to contextual variables such as a teams role (possession or recovery of the ball) and the teams location on the field. Nevertheless, these measures are purely descriptive, and we know little about how informative they are for predicting the future course of the match. Hence, the aim of this study was to determine whether the current degree of synchrony can predict transitions between states.
METHODS: Players position data (x,y coordinates on the pitch) were collected via GPS (15 Hz) for the entire first half of a professional soccer match. We analyzed the degree of synchronization via Kuramoto order parameter (cluster amplitude) r, (high synchronization = 1) . Then, time series of synchrony were segmented according to whether the team was in possession (P) or recovery (R) of the ball and whether they were centered in the attacking or defending half of the field (i.e., 1 or 2 respectively), creating a total of four possible states. Every such segment was associated with the state that followed, in order to determine the relationship between current synchronization and future states.
RESULTS: Mean team synchronization across segments ranged from 0.724 to 0.998. Averaged by type of transition, the highest synchrony (0.985) was associated with the transition from state R2 to P1, and the lowest synchrony (0.925) was associated with the reverse transition (P1 to R2). Two GLMM models were constructed to predict the half and role of the next segment. Both models found a significant main effect of synchronization after taking into account the current state of the team. Specifically, lower synchrony was predictive of taking possession (beta = -12.8, SE = 5.3, $p < .05$) as well as approaching the goal (beta = -40.9, SE = 11.8, $p < .05$).
CONCLUSION: Previous analysis using the Kuramoto order parameter revealed that synchronization differed according to whether a team was in possession or recovery of the ball. Here, we show that as synchrony decreases, the probability of a team to take possession of the ball increases as well as to move closer to the attacking goal. Therefore, synchrony not only reflects the current state of gameplay, but it also is predictive of upcoming changes in possession and field position. Synchronization arises from self-organizing processes that underlie team behavior, and thus provides a window to understanding critical moments during gameplay.

THE SECRET OF SUCCESSFUL POSSESSIONS IN PROFESSIONAL SOCCER: EXPLOITING HOLES IN THE DEFENSE

GOES, F.R., BRINK, M.S., ELFERINK-GEMSER, M.T., LEMMINK, K.A.P.M.
UNIVERSITY OF GRONINGEN

INTRODUCTION: To score goals you first have to recover the ball from the opponent and move the ball into a zone from where you can become dangerous and create scoring opportunities. The attacking 3rd of the field can be regarded as such a zone (Link, Lang & Seidenschwarz, 2016). Since spatial organisation at the initiation of possessions seems to be a key aspect of success, it would be interesting to study the spatial organisation prior to possession. Thus, the aim of the current study is to analyse spatiotemporal characteristics in the 5 seconds prior to the initiation of successful and unsuccessful possessions.
METHODS: The analysis was based on position data of players and ball during 250 ball possessions (124 for team A and 126 for team B), extracted from the first half of a professional Dutch soccer match. A ball possession was initiated at the moment that the first player of a team has control over the ball and ends when a player of the other team controls the ball. Successful possessions were classified as those possessions that at some point during a possession resulted in ball control in the attacking 3rd of the field. Team centroids, interline coordination and stretch indices of both teams were computed, and used to compare spatiotemporal characteristics of successful (81) and unsuccessful (169) possessions at 5s, 3s and 1s prior to the initiation of possession.
RESULTS: The attacking team's centroid was positioned further forward at 5 seconds (+12.3±2.8m, $p < .01$), 3 seconds (+14.3±2.8m, $p < .01$), and 1 second (+16.5±2.8m, $p < .01$) before gaining successful possessions. Furthermore, the distance between the attacking team's offensive line and the opposing team's defensive line was smaller at all time points (-1.4±0.4m, $p < .01$). On the other hand, the opposing team's length (-10.1±1.6m, $p < .01$) and width (-3.14±1.2m, $p < .01$) were smaller at all time points, while the distance between their midfield and offensive line was increased, especially at 3 seconds (+2.4±0.7m, $p < .01$) and 1 second (+3.0±0.8m, $p < .01$) prior to successful possessions.
CONCLUSION: Results indicate that prior to gaining successful possessions teams tend to move forward, pressure the opposing team, and exploit holes within the lines of the defense and on the sides of the field. Furthermore, the opposing team is organized more compact while giving away space within their lines, and the attackers of the opposing team seem less involved in defense. On the other hand teams seemed to be pushed back under pressure of the opponent prior to unsuccessful possessions. These findings indicate that gaining territorial advantage before gaining ball possession, and pressuring the opponent are essential for successful possessions. In other words, the key to gaining successful possessions might be in the prevention of successful possessions of the opponent.
Link, D., Lang, S., & Seidenschwarz, P. (2016). Real time quantification of dangerousity in football using spatiotemporal tracking data. PLoS ONE 11, e0168768.

Oral presentations

OP-BN38 Central drive and motor performance

DOES VIDEO GAME-BASED TRAINING FACILITATE CENTRAL DRIVE TO ANKLE DORSIFLEXORS IN ELDERLY?

DE BRUIN, E.D., PATT, N., GENNARO, F.
INSTITUTE OF HUMAN MOVEMENT SCIENCES AND SPORT, ETH

INTRODUCTION: Previous studies highlighted that video games designed for training purposes improve walking [1,2] and effect on the brain [3,4]. Here we explore the hypothesis that video game-based training necessitating subject's ability to lift the toes and to place the feet on different target zones as a requirement to successfully play the game leads to changes in the central motor drive to tibialis anterior motor neurons.
METHODS: 20 older adult (78.9 ± 8.3 years) trainees were involved for 12 weeks. EMG from left and right Tibialis Anterior (TA) were evaluated at intervals of 6 weeks; first test 6 weeks before training, second test before training initiation, third test at training end; a design controlling for inter-subject variability. Intramuscular coherence was measured during self-paced over ground walking in both left and right leg under single- (ST) and dual-task (DT) conditions. EMG-EMG intramuscular coherence was calculated in the beta and gamma frequency bands.
RESULTS: Complete data sets were available for 19 individuals. No significant effect was observed for training in the coherence of the beta frequency band Right leg ST [$F(2,35)= 0.24$, $p=0.79$]; Right leg DT [$F(2,36)= 0.23$, $p=0.79$]; Left leg ST [$F(2,50)= 0.47$, $p=0.63$]; Left leg DT [$F(2,51)= 0.4$, $p=0.67$]. No significant effect was observed for training in the coherence of the gamma frequency band Right leg ST [$F(2,33)= 1.27$, $p=0.29$]; Right leg DT [$F(2,36)= 0.08$, $p=0.92$]; Left leg ST [$F(2,42)= 0.32$, $p=0.73$]; Left leg DT [$F(2,43)= 0.32$, $p=0.73$].
CONCLUSION: The video game-based training had no effect on the beta and gamma band frequencies and, therefore, on the neural drive to the TA muscle in self-paced over ground walking older adults. This result might be indicative for the assumption that ageing rather causes changes in the motor cortex and to a lesser extend in the spinal cord [5]. Further studies investigating the mechanisms influencing neural drive and coherence measures through training in various (neurological) populations and more impaired older adults are warranted. In these studies a focus on clinical relevance should be considered as well.
[1] Pichierri et al. Clin Interv Aging 7: 175-184, 2012; [2] Pichierri et al. BMC Geriatr 12: 74, 2012; [3] Eggenberger et al. Front Aging Neurosci 8: 66, 2016; [4] Schättin et al. Front Aging Neurosci 8: 278, 2016 ; [5] Clark & Taylor. Curr Aging Sci. 4(3): 192–199, 2011.

CENTRALLY CONTROLLED MOTOR STRATEGIES GOVERN BILATERAL DEFICIT

MILLER, S.C., KARAI, H., LETCH, P.
QUEEN MARY UNIVERSITY OF LONDON

INTRODUCTION: Bilateral deficit (BLD) is a phenomenon when a two-limb performance is lower than that of the combined individual limbs. It has been shown in various movement types, along with some reports of bilateral facilitation (BLF) occurring i.e. two-limb performance greater than that of the combined individual limbs. Many studies have investigated the differences occurring between the bilateral (BL) and unilateral (UL) movements, suggesting many factors i.e. psychological, task related, physiological and neurophysiological (1). However, focus has been on the differences between BL and UL movements. Here, we investigated similarities between BL and UL, with the premise that this may direct us to reasons why deficits occur.

METHODS: 13 university students performed UL and BL countermovement jumps (CMJ) with a self-selected depth. Kinetic (Kistler 9281 force plates under each foot) and 3D kinematic (Qualisys motion capture) data were collected (2000 and 500 Hz, respectively), and then analysed in MATLAB. A combination of intraclass and Pearson correlations, and paired t-tests were analysed collectively to assess similarities between UL and BL CMJ. This analysis was performed comparing individual legs across UL and BL, in addition to comparing individual legs from UL with combined left and right legs from BL.
RESULTS: Left and right UL CMJ heights were 49.4 and 47.8% of BL, respectively. This resulted in BL height being no different to the combined left and right UL CMJ height (p=0.47). However, BLD ranged from -23.8% (BLD) to 25.0% (BLF).
A key finding was that total eccentric leg stiffness was similar between BL CMJ (i.e. both legs combined) and the right UL (ICC=0.751, R2=0.586) and left UL (ICC=0.833, R2=0.752). Changes in leg length and force during the eccentric portion were not similar across the different jumps (p<0.001), however they were highly correlated (R2>0.55 for change in leg length and R2>0.73 for change in force).
CONCLUSION: Previous research has suggested multiple potential reasons as to why BLD or BLF occurs. These have been associated with both muscular force as well as neural explanations. We found a potential mechanism as to how the two components relate. We propose that motor control of the two movements (UL and BL) both utilised a pre-defined strategy associated with the start of the jump. With this strategy driving the stiffness of the system during the first portion of the movement, this resulted in differences in muscle-tendon kinetics, resulting in differing kinematic patterns produced in BL and UL CMJ, and also between the right and left UL movements (2).
REFERENCES: 1. Škarabot et al (2016). European Journal of Applied Physiology, 116, 2057-2084.
2. Gheller et al (2015). Human Movement Science, 42, 71–80.
Contact: Stuart.miller@qmul.ac.uk
@Stuart_Miller

ACUTE EFFECT OF NORADRENERGIC MODULATION ON MOTOR OUTPUT AND CORTICOSPINAL EXCITABILITY

KLASS, M.1, ROELANDS, B.2, MEEUSEN, R.2, DUCHATEAU, J.1
1UNIVERSITÉ LIBRE DE BRUXELLES AND 2VRIJE UNIVERSITEIT BRUSSEL , BELGIUM

INTRODUCTION: Despite an extensive literature in animals on the role of the noradrenergic system in the control of many higher functions (arousal, attention, sensory integration, etc. [1]) and in modulation of spinal excitability [2], very little is known on noradrenergic actions on the motor system and the functional consequences in human. Therefore, the aim of present study was to investigate the role of noradrenergic modulation in the control of motor output, by comparing the acute effect of Reboxetine (REB), a noradrenaline reuptake inhibitor, to a placebo (PLA) on knee extensors performance and corticospinal and spinal excitability.
METHODS: Eleven young males took part in two randomized experiments during which they received either 8 mg of REB or a PLA. The torque produced during a maximal voluntary contraction (MVC) and its variability, quantified as the coefficient of variation for torque, during submaximal contractions ranging from 5 to 50% MVC were measured. Paired electrical (PES) and transcranial magnetic stimulation (TMS) were used to assess changes in voluntary activation during MVC. Electrical stimulation and TMS were also used to assess spinal and corticospinal excitability by recording the Hoffman reflex (H reflex) and TMS-induced motor evoked potential (MEP) recruitment curves during muscle activation at 20% MVC.
RESULTS: MVC torque and torque steadiness increased (P<0.001) respectively by 9.5 and 24% (mean change for 5-50% MVC) in REB compared with PLA condition. Voluntary activation tested by TMS and PES was greater (~3%; P<0.05) in REB than PLA condition. The maximal amplitudes of H reflex and MEP and, the slope of their recruitment curves were significantly enhanced by REB (P<0.05). The ratio between TMS-induced EMG silent period and the corresponding MEP (SP/MEP) was reduced in REB condition (P<0.01).
CONCLUSION: The present findings indicate that intake of a noradrenaline reuptake inhibitor increases voluntary activation during MVC and improves the accuracy in force control. The motor performance improvements were accompanied by a greater corticospinal and spinal excitability. In conclusion, our results support a significant role for the noradrenergic system in adjusting the motor output during maximal and steady contractions.
References: 1. Berridge CW, Waterhouse BD (2003). Brain Research Reviews. 42(1):33-84.
2. Heckman CJ, Mottram C, Quinlan K, Theiss R, Schuster J (2009). Clin Neurophysiol. 120(12):2040-54.

ACETAMINOPHEN INGESTION SHORTENS THE CORTICOSPINAL SILENT PERIOD AND IMPROVES ENDURANCE PERFORMANCE OF THE KNEE EXTENSORS

PAGEAUX, B.1,3, MAUGER, A.R.2
1: UNIVERSITÉ BOURGOGNE FRANCHE-COMTÉ ; 2: UNIVERSITY OF KENT ; 3: UNIVERSITÉ DE MONTRÉAL

INTRODUCTION: Acetaminophen (ACT; paracetamol) is known to improve endurance performance, suggested to be achieved through a reduction in perceived muscle pain. However, to date, the underlying neurophysiological mechanisms responsible of the ergogenic effect of ACT on endurance performance remain unclear. The aim of this study was to test the hypothesis that the reduced muscle pain following ACT ingestion would be associated with changes in neuromuscular responses to the exercise performed.
METHODS: Nineteen subjects completed an isometric time to exhaustion test with the right knee extensors (20% maximal voluntary contraction; MVC) after ingestion of ACT or placebo (PLA). Knee extensors MVC was measured before, 45 min following ACT or PLA ingestion, and after the time to exhaustion test. In twelve subjects we measured maximal voluntary activation of the knee extensors during each MVC, as well as motor evoked potentials (MEP) during each time to exhaustion test. MEP were obtained at 53, 56 and 59 s of each minute during the time to exhaustion test. MEP area and amplitude was normalized by the amplitude and area of the muscular wave elicited at 50 s of each minute during the time to exhaustion test.
RESULTS: ACT and PLA ingestion did not induce any change in MVC and maximal muscle activation (all $P > 0.61$). Time to exhaustion was greater following ACT ingestion compared to PLA ingestion (298 ± 126 s vs 264 ± 106 s, $P = 0.02$). The improved performance in the ACT condition was associated with a lower (all $P < 0.03$) perceived effort and muscle pain at 100% of the individual isotime (i.e. relative to the shortest performance of each subject). At 50% individual isotime, ACT decreased only perceived effort ($P = 0.05$, $dz = 0.42$) and not muscle pain ($P = 0.24$, $dz = 0.28$). Following the time to exhaustion test, MVC and voluntary activation decreased to the same extent in both conditions. During the time to exhaustion test, normalised MEP area and amplitude did not change over time ($P > 0.308$) and did not differ between conditions ($P > 0.83$). A time × condition interaction ($P = 0.01$) revealed a slower increase in the MEP CSP in the ACT compared to the PLA condition. Following ACT ingestion, the MEP CSP was shorter at 50% ($P < 0.01$) and 100% ($P < 0.01$) of the individual isotime but did not differ between conditions at the onset of the exercise ($P = 0.63$).
CONCLUSION: In agreement with cycling time trials and repeated sprint cycling, ACT ingestion improves isometric endurance performance of the knee extensors. The observed decrease in perception of effort and muscle pain following ACT ingestion suggests that this is

linked with lower perceptual responses to the exercise. In addition, the lower perceptual responses were associated with a slower increase in MEP CSP duration, suggesting a slower increase in corticospinal inhibition. Future studies should investigate if the reduction in MEP CSP is due to changes in cortical and/or spinal inhibition and its relation with perceptual responses to the exercise.

TRANSCRANIAL DIRECT CURRENT STIMULATION OVER THE LEFT DORSOLATERAL PREFRONTAL CORTEX IMPROVES INHIBITORY CONTROL AND ENDURANCE PERFORMANCE

MARCORA, S.M., ANGIUS, L.

UNIVERSITY OF KENT

INTRODUCTION: The dorsolateral prefrontal cortex (DLPFC) is considered important for inhibitory control, a cognitive function essential for the self-regulation of behaviour (Diamond, 2013). Recent experiments suggested that the inhibitory control is also important for the regulation of endurance performance (Martin et al., 2016). Improvement in inhibitory control has been found when transcranial direct current stimulation (tDCS) was applied over the left DLPF (l-DLPFC) (Loftus et al., 2015). This study examined the effect tDCS over the l-DLPFC on a cognitive task involving inhibitory control and on endurance performance in healthy adults.
METHODS: In a double-blind, randomized crossover experimental study, 12 volunteers were recruited. First, volunteers practised all procedures and performed an incremental maximal cycling test to detect peak power output (PPO). In the following visits, volunteers received a placebo tDCS (SHAM) or real tDCS (EXP) over the l-DLPFC. Stimulation intensity was set at 2mA with 30 min duration on the EXP and 30 s duration in the SHAM. Volunteers performed a Stroop task before (pre-tDCS), after tDCS (post-tDCS) and after a cycling time to exhaustion (TTE, post-TTE) at 70% of PPO. Heart rate (HR), electromyographic activity in the right vastus lateralis (EMG-VL), ratings of perceived exertion (RPE), and leg muscle pain (PAIN) were monitored during the TTE while blood lactate (B[La-]) was measured at exhaustion.
RESULTS: No difference in Stroop test performance was found between conditions at pre-tDCS ($p=0.723$) while a significant improvement in Stroop performance was found in the EXP at post-tDCS ($p=0.012$). Stroop performance was impaired at post-TTE without any differences between conditions ($p=0.001$). TTE was significantly longer in the EXP compared to SHAM condition ($p=0.029$, 17±8 vs 15±8 min), with a significant lower HR ($p=0.002$) and RPE ($p=0.001$). No differences were found for PAIN ($p=0.224$) and for EMG-VL ($p=0.664$). B[La-] was significantly higher at exhaustion in the EXP condition ($P = 0.040$).
CONCLUSION: Our results provided preliminary evidences that tDCS over the l-DLPFC can improve endurance performance possibly by an improved inhibitory control.
REFERENCES:
1. Diamond A (2013). Executive Functions. Annu Rev Psychol 64, 135–168.
2. Loftus AM, Yalcin O, Baughman FD, Vanman EJ & Hagger MS (2015). The impact of transcranial direct current stimulation on inhibitory control in young adults. Brain Behav 5, e00332.
3. Martin K, Staiano W, Menaspà P, Hennessey T, Marcora S, Keegan R, Thompson KG, Martin D, Halson S & Rattray B (2016). Superior Inhibitory Control and Resistance to Mental Fatigue in Professional Road Cyclists. PloS One 11, e0159907.

METHODS: RESULTS: CONCLUSION: DYNAMICS OF NEUROPHYSIOLOGICAL ADJUSTMENTS DURING FATIGUING EXERCISE WITH CONCOMITANT WORKING MEMORY CHALLENGES

GRUET, M.1, CHATAIN, C.1, RADEL, R.2, VERCRUYSSEN, F.1, RABAHI, T.1, BERNARD, T.1

1: UNIVERSITÉ DE TOULON, LAMHESS, TOULON, FRANCE, 2: UNIVERSITÉ CÔTE D'AZUR, LAMHESS, NICE, FRANCE

INTRODUCTION: Previous studies showed that adding cognitive task to prolonged motor exercise impaired endurance performance (Yoon et al., 2009). Nevertheless, the underlying neurophysiological mechanisms remain to be elucidated. This study compared endurance performance during fatiguing quadriceps exercise in the absence or presence of concomitant memory challenges (i.e. auditory n-back tasks). We hypothesized that time to task failure would be shorter in the presence of the most demanding n-back task and associated with greater neurophysiological alterations.
METHODS: Eighteen healthy men performed intermittent isometric knee extensions at 15% of maximal voluntary contraction (block of 170 s interspaced by neuromuscular evaluations) until task failure. This motor task was performed in three different occasions in random order: i) alone (control condition); ii) with concomitant 1-back task and iii) with concomitant 2-back task. Autonomic nervous system activity, perceived effort and cognitive performance were continuously recorded. Peripheral and central mechanisms of fatigue were measured using electrical femoral nerve stimulation between each block and at task failure.
RESULTS: Time to task failure was shorter during 2-back (1273±723s ; $p<0.01$) and 1-back (1470±791s ; $p=0.04$) conditions compared to control (1704±1157s). Central voluntary activation decreased to a greater extent in 2-back (-8.7% ; $p<0.01$) and 1-back (-6.7% ; $p=0.04$) conditions compared to control (-3.7%). Pupil diameter increased to a greater extent in 2-back condition compared to control ($p=0.03$). Perceived muscle effort was higher during 2-back condition than during control ($p<0.01$). Cognitive performance decreased similarly with time during 2-back and 1-back conditions ($p<0.01$), but was systematically lower during 2-back condition.
CONCLUSION: Our results demonstrate that motor performance is reduced when adding a concomitant demanding memory task to a prolonged isometric exercise. This can be explained by the interaction of various neurophysiological mechanisms including i) higher levels of central fatigue; ii) greater perturbations of autonomic nervous system activity and iii) higher perceived muscle effort causing earlier disengagement from the task. The mechanisms underlying reduced dual cognitive-motor task performance are probably multifactorial and different from those usually reported when mental fatigue is elicited prior to the motor task (i.e. mediated mainly through higher perception of effort; Van Cutsem et al., 2017).
References :
Van Cutsem J, Marcora S, De Pauw K, Bailey S, Meeusen R, Roelands B (2017). Sports Med, 47(8):1569–88.
Yoon T, Keller ML, De-Lap BS, Harkins A, Lepers R, Hunter SK (2009). Sex differences in response to cognitive stress during a fatiguing contraction. J Appl Physiol, 107(5):1486–96.
Contact:
gruet@univ-tln.fr

Invited symposia

IS-SH01 Social inclusion through sport: analyzing effective interventions and policies to tackle social exclusion.

INCLUSION AND EXCLUSION THROUGH SPORT: TWO SIDES OF THE SAME COIN?

HAUDENHUYSE, R.

VRIJE UNIVERSITEIT BRUSSEL

Sport has been perceived as a potential rich context to include people at-risk of social exclusion. Despite its acclaimed inclusionary character, sport remains a site of multiple and diverse exclusionary processes (Spaaij et al., 2014). To better understand wider inclusionary outcomes through sport, Ekholm (2013) argued that we should problematize and critically expose the underlying assumptions, distinctions, ideologies and research positions that constitute the conceptions surrounding sport as a means for social inclusion. Furthermore, the question needs to be addressed if combatting social exclusion can effectively be tackled by promoting social inclusion? In other words: are promoting social inclusion and combatting social exclusion two sides of the same coin? Such questions are currently in the margins of sport research. As a result, it remains difficult to determine the effectiveness and impact of sport-based interventions on a broad array of societal issues (e.g. social cohesion, education, employment)

THE INCLUSION EXCLUSION CONUNDRUM: A CRITICAL ACCOUNT OF YOUTH AND GENDER ISSUES WITHIN AND BEYOND THE SPACES OF SPORT FOR DEVELOPMENT AND PEACE (SDP) PROGRAMMING

COLLISON, H., GIULIANOTTI, R., DARNELL, S., HOWE, P.D.

LOUGHBOROUGH UNIVERSITY

The Sport for Development and Peace (SDP) sector is made up of various development-focused policies and programs that seek to engage, stabilise, empower and create social and economic change on a global scale. SDP projects, most often run by Non-Governmental Organisations (NGOs), have been implemented in regions enduring physical conflicts, health pandemics, major gender divisions and other social crises that affect 'youth' in particular. In this context, sport has been accorded the difficult task of facilitating greater access for marginal, vulnerable or community groups whilst positively contributing to the attainment of diverse development objectives. While the 'where' and 'why' of SDP has been largely accounted for, the attention in this paper is on the 'who' of SDP in relation to the notion of inclusion. Drawing on extensive research conducted in Jamaica, Kosovo, Rwanda, Sri Lanka, Zambia, the idea of SDP as an inclusionary practice is critically investigated. While SDP may 'give voice' to participants, especially to individuals with athletic ability or sporting interests, the extent to which this creates social contexts that are fundamentally inclusive remains open to discussion. In this sense, while targeting populations, groups or individuals remains an attractive strategy to achieve specific goals, for example youth empowerment or gender equality, yet empirical assessments complicate the presumption that SDP programming leads to inclusion, particularly at a larger societal level. This presentation considers a matrix of inclusion criteria, potential outcomes, and the tensions arising between targeted SDP programming and the often-exclusionary dimensions of sport more broadly, with a specific focus on youth and gender issues.

PUBLIC HEALTH THROUGH COLLABORATIVE INNOVATION – SOCIAL INCLUSION IN SPORT AND PHYSICAL ACTIVITY

TJØNNDAL, A.

NORD UNIVERSITY

Introduction: Social inequality in health encompasses wicked problems that has proven challenging for public sector to effectively solve on its own (Enjolras & Wollebæk 2010; Donnelly & Coakley 2002). Hence, in order to combat social inequality and exclusion in health, collaboration across public, private and volunteer sectors is needed (Milbourne et. al. 2003). In particular, combating social exclusion in participation in sport and physical activity is a central part of the Norwegian government's public health work. This is also a main political aim of the Norwegian Olympic and Paralympic Committee and Confederation of Sports, the largest volunteer organization in Norway. On this background, the aim of this study was to investigate collaborative efforts between public sector and volunteer sport organizations aimed at increased social inclusion in participation in sport and physical activity.
Methods: 32 public sector employees were interviewed. The sample consisted of employees in the public health sector both at a county level and at municipality level. Twenty-six public health coordinators from different Norwegian municipalities were included in the sample. Additionally, eight political and administrative leaders in public health at a county level were interviewed. Central topics in the interviews included: (1) issues of social exclusion in public health locally and regionally, (2) collaborative efforts with volunteer sport organizations, (3) effects of such collaborations, and (4) challenges and advantages with such collaborative efforts.
Results: The main findings in this article indicate that public sector actors view collaboration with volunteer sport organizations as a valuable resource for public health work aimed at reducing social exclusion in physical activity. While public sector does initiate a number of collaborations with volunteer sport organizations, these collaborations mainly entail public sector agencies providing funding for local sport clubs. However, the development, implementation and sustainment of activity measures are left to the volunteers in the sport clubs.
Discussion: The results indicate that while public sector does value collaboration with volunteer sport organizations, few of these collaborative efforts can be characterised as collaborative innovation. Furthermore, there is a substantial lack of resources to evaluate the effects of such collaborations. Therefore, it stands to reason that a majority of Norwegian municipalities lack insight into the effects of their collaborative efforts with volunteer sport organizations. Changing conditions for volunteer sport organizations, such as increased commercialization and professionalization, along with a changing political climate, suggests that sport organizations and public sector agents may need to develop new ways of collaborating if the aim is to combat social exclusion in physical activity and sport participation effectively.

Oral presentations

OP-PM72 Physical activity interventions

DYADIC INTERVENTIONS TO PROMOTE PHYSICAL ACTIVITY: SYSTEMATIC REVIEW AND META-ANALYSIS

CARR, R.M., PRESTWICH, A., KWASNICKA, D., THØGERSEN-NTOUMANI, C., GUCCIARDI, D.F., QUESTED, E., HALL, L.H., NTOUMANIS, N.

CURTIN UNIVERSITY

DYADIC INTERVENTIONS TO PROMOTE PHYSICAL ACTIVITY: SYSTEMATIC REVIEW AND META-ANALYSIS
Carr, R.M.1, Prestwich, A.2, Kwasnicka, D.1, Thøgersen-Ntoumani, C.1, Gucciardi, D.F.1, Quested, E.1, Hall, L.H.2, Ntoumanis, N.1. 1: Curtin University (Perth, Australia). 2: The University of Leeds (Leeds, England)
Introduction: There are several interventions targeting the promotion of physical activity via dyads, but the available evidence has not been synthesized or meta-analysed.
Methods: Sixty-two studies were identified from MEDLINE, PsycINFO and Web of Science of which 53 were included in the main meta-analyses. Effect sizes were calculated based on random-effects models. Intervention details, type of dyadic goal, participant characteristics, and methodological quality were extracted and their impact on the overall effect size was examined through meta-regressions. Sensitivity analyses tested whether key findings were robust when (a) the effects of other statistically significant moderators were controlled; (b) outliers were removed; (c) data were included for participants who were not the main target of the intervention.
Results: Dyadic interventions had a small positive effect on physical activity g= .217, 95% CI [0.127–0.306], compared to comparison conditions. Shared target goals (which involve both dyad members holding the same goal for the main target of the intervention to increase their physical activity) and peer/friend dyads were associated with the larger effect sizes in at least some of the analyses.
Discussion: Dyadic interventions can promote physical activity and appear beneficial when dyad members share the same physical activity goal for the person who is the main target for the intervention.
Contact: rachel.carr1@postgrad.curtin.edu.au

EFFECTS OF YOGA TRAINING ON CARDIOVASCULAR REACTIVITY TO PSYCHOLOGICAL STRESS IN OFFSPRING OF HYPERTENSIVES

CHU, I.H., LAI, M.C., YU, T.C.

KAOHSIUNG MEDICAL UNIVERSITY

INTRODUCTION: Offspring of hypertensives are shown to display exaggerated cardiovascular reactivity to mental challenge, which may lead to higher risk of developing hypertension and heart disease . While studies have reported significant reductions in cardiovascular reactivity after aerobic exercise training, the effects of yoga are undetermined . Yoga was found to reduce stress and have benefits for stress-related disorders . Yet, the effect of yoga on cardiovascular reactivity to psychological stress in offspring of hypertensives remains unknown. Thus, the purpose of this study was to examine the effects of 12-week yoga training on heart rate, blood pressure, arterial stiffness, and total peripheral resistance during rest and psychological stress in offspring of hypertensives.
METHODS: A total of 30 participants with a family history of hypertension were recruited and randomly assigned to either yoga or control group. The yoga training program was 60 minutes per session, 2 times per week for 12 weeks. The control group was instructed not to participate in any yoga program and maintain their usual lifestyle. All participants performed a Stroop task and mental arithmetic task at baseline and after the intervention. Heart rate, blood pressure, pulse wave velocity , and total peripheral resistance were assessed during rest and psychological stress at baseline and post intervention.
RESULTS: Resting heart rate reduced significantly in both groups after 12 weeks, but these changes did not differ between groups. No significant changes were found for heart rate during psychological stress in both groups. Mean arterial pressure did not change during rest in both groups, but decreased significantly during psychological stress in both groups after the intervention with no significant group differences. In terms of pulse wave velocity and total peripheral resistance, both parameters showed no significant changes during rest and psychological stress in both yoga and control groups post intervention.
CONCLUSION: The results of this preliminary study suggest that a 12-week yoga program prescribed twice per week for 60 minutes per session did not appear to affect cardiovascular reactivity to psychological stress in offspring of hypertensives.

LIFESTYLE-INTEGRATED FUNCTIONAL EXERCISE (LIFE) FOR PREVENTING FUNCTIONAL DECLINE IN YOUNG OLDER ADULTS: CONCEPTUALISATION, DEVELOPMENT, AND INITIAL TESTING OF AN INTERVENTION PROGRAMME

WEBER, M., BERGQUIST, R., BOULTON, E., VAN ANCUM, J., NERZ, C., JONKMAN, N.H., TARALDSEN, K., HELBOSTAD, J.L., VEREIJKEN, B., HAWLEY-HAGUE, H., PIJNAPPELS, M., MAIER, A.B., MIKOLAIZAK, A.S.

HEIDELBERG UNIVERSITY

INTRODUCTION: With a growing population approaching retirement age (baby boomers), there is an increasing focus on how functional decline can be prevented to maintain functional capacity and independence. New avenues for increasing physical activity (PA) and achieving long-term behaviour change are emerging such as the Lifestyle-integrated Exercise (LiFE) programme, embedding balance and strength training into daily life. However, they are focused on the reduction of falls in older adults. This study aimed to 1) develop an adapted LiFE (aLiFE) programme to prevent func-tional decline in a younger age group, and 2) test the feasibility of programme deliv-ery and integration of exercises into daily life.
METHODS: Within the EU Horizon2020 project PreventIT (www.preventit.eu) and in line with the UK Medical Research Council guidance on development of complex interventions, we adapted the existing LiFE programme, originally developed for older adults aged 70+, to customize it to the needs of a younger age group (e.g. more challenging ex-ercises, different behavioural change techniques). Iterative stages of development, feasibility, and evaluation were applied and the proof of concept of the intervention was evaluated through a 4-weeks pre-post-pilot study in community-dwelling adults aged 60-70 (n=31) in Germany, the Netherlands, and Norway. Measurements in-cluded performance-based (i.e. balance and strength) and psychological self-report measures (e.g. questionnaires, documents for action planning and self-monitoring). Semi-structured interviews were applied to evaluate programme content and delivery to further improve the programme.

RESULTS: Thirty people completed the pilot study (66.6±2.4 years, 60% women). Overall ac-ceptability of the programme was high based on quantitative and qualitative measures. The majority found the intervention safe (n=29), appropriately difficult (n=23), adaptable to individual lifestyle (n=18), and helpful to improve balance (n=24), strength (n=27), and PA (n=26). They significantly improved in balance and mobility as measured by the Community Balance and Mobility Scale from pre- (66.0±12.7) to post-test assessment (70.4±13.1; p=0.001). Participants particularly choose static balance activities (e.g. tandem stance), or strength activities (e.g. stair climbing or sit to stand), that could be easily remembered and integrated. At the same time, they suggested to also include upper body exercises and limit the amount of paperwork for action-planning and self-monitoring.
CONCLUSION: The pilot study provides evidence that the original LiFE programme was successfully adapted to young-older adults. The aLiFE programme is feasible for this specific population, meeting their individual needs and preferences. Based on these results, the programme is currently being tested in a larger randomized controlled feasibility trial within the PreventIT project comparing aLiFE with and electronic version of the same programme.

RISK FACTORS FOR ATTRITION IN EXERCISE – THE GENERATION 100 STUDY

VIKEN, H., REITLO, L.S., ZISKO, N., NAUMAN, J., ASPVIK, N.P., INGEBRIGTSEN, J.E., WISLØFF, U., STENSVOLD, D.

NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

INTRODUCTION: Attrition from exercise programs both in the real world and in research is a challenge. However, data on attrition in exercise programs with older adults is scarce, and commonly from small samples and programs with short durations. More information on predictors of attrition is needed for establishing strategies on how to make older adults sustain within exercise programs. The aim of the present study was to examine total attrition rates and predictors of attrition during 3-years of exercise in older adults.
METHODS: In total 1514 men and women (age 72.4±1.9 years) were included in the present study. Participants were randomized to either a supervised exercise intervention or recommended to follow national guidelines for physical activity (PA). Self-reported demographics (e.g. education), general health, morbidity (e.g. heart disease, memory loss and psychological distress), smoking and PA were examined at baseline. Cardiorespiratory fitness (CRF) and grip strength were directly measured at baseline. Attrition was examined 1-year and 3-years into the intervention. All significant predictors from initial bivariate analyses were included in the final multivariate logistic regression analyses to identify predictors of attrition.
RESULTS: The total attrition rate was 11.0% (n=166) after 1-year and 14.9% (n=225) after 3-years. Significant predictors of attrition after 1-year were low education, low grip strength, lower CRF, low PA level and being randomized to supervised exercise. The same predictors of attrition were significant after 3-years, with reduced memory status being an additional predictor. We also analyzed predictors of attrition after 3-years in the unsupervised- and supervised exercise groups separately. In both groups, low level of education, lower CRF and reduced memory status were significant predictors of attrition. In the supervised exercise group, performing less than 30-min of PA per day at baseline was an additional predictor.
CONCLUSION: This is the largest study of predictors of attrition in a long-term exercise program with older adults. Our findings provide vital information for clinicians, healthcare professionals, researchers and politicians, for planning long-term initiatives to increase physical activity or exercise among older adults.

EFFECTS OF MODERATE AND LOW FREQUENCY RECREATIONAL FOOTBALL ON CARDIOVASCULAR RISK FACTORS: A DOSE-RESPONSE STUDY

MODENA, R.1, IMPELLIZZERI FRANCO, M.2, FORNASIERO, A.1, SCHENA, F.1

CERISM, UNIVERSITY OF VERONA <1>, UNIVERSITY OF TECHNOLOGY OF SYDNEY <2>

INTRODUCTION: Physical inactivity causes more than 5 million deaths every year,[1,2] while improvements in fitness are associated with reduced mortality riskv [3]. Among the barriers in participation to physical activity, lack of free time and low motivation are the most common. In this context an enjoyable, social and relative short duration activity such as recreational soccer (RS) might be effective to improve physical activity enrolment in sedentary people. Some studies have shown that performing RS 2 or 3 times per week has improved various parameters related with CHD, such as maximal oxygen consumption, body composition, blood pressure and blood lipid profilev[4,5]. However, RS is often performed only once a week and for a duration of one hour. The aim of the study is verified the benefit of a low and medium frequency on cardiovascular health.
METHODS: 40 sedentary and healthy men (44.62 ±1.75 years) were randomly assigned to three groups: Control (C), Low frequency (LF) and Moderate frequency (MF). Body composition, maximal oxygen consumption, blood pressure, blood lipid profile, have been evaluated before and after a 12-weeks period. Throughout this period LF and MF groups have performed, respectively, 12 and 24 sessions of RS (once and twice per week). Each participant was monitored for heart rate and time motion characteristics, and RPE was also collected. The dose effect of treatment was evaluated by one-way analysis of variance for post-test values, using pre-test values as covariate (ANCOVA); confidence intervals and magnitude based inference were used to assess the likelihood and the magnitude of effect [6].
RESULTS: Our results showed there were improvements in maximal oxygen consumption, BMI, percentage of fat mass, and waist to hip ratio between C group and the other groups: VO2max was increased of 14.4% (large likely beneficial; LF vs C) and 18.9% (large most likely beneficial; MF vs C), BMI and %FM were lowered respectively of 1.8% (moderate likely beneficial) and 7.7% (moderate most likely beneficial) (LF vs C), and 2.4% (large most likely beneficial) and 11.1% (large most likely beneficial) (MF vs C). Also, waist to hip ratio was decreased, of 1% (moderate likely beneficial; LF vs C) and 1.2% (moderate likely beneficial; MF vs C). Comparing the changes between low and moderate frequency groups, the statistical analysis has shown no differences in maximal oxygen consumption and unclear results for the other parameters.
CONCLUSION: The results of the study confirmed that a moderate volume of RS can be effective to improve some cardiovascular risk factors, as demonstrated in other studies. However, a novel finding is that a low dose of RS could improve cardiovascular health as well. Performing one hour of RS once a week can be sufficient to increase aerobic fitness and improve anthropometric parameters related to the risk of CHD.

Oral presentations

OP-PM54 Muscle damage

EFFECTS OF SEXUAL HORMONES AND ORAL CONTRACEPTIVE ON EXERCISE INDUCED-MUSCLE DAMAGE

MACKAY, K., GONZÁLEZ, C., PEÑAILILLO, L.

UNIVERSIDAD FINIS TERRAE

INTRODUCTION: It has been shown that sexual hormones have effects over exercise performance and recovery in women. When compared to men, women have shown less levels of muscle damage after eccentric exercise, being estrogen levels held responsible for these differences (Stupka et al., 2000). Results are still controversial, possibly due to differences in study design, menstrual phase and exercise protocols. The aim of this study was to determine the effects of estrogen, progesterone and testosterone concentrations over muscle damage induced by eccentric cycling in women.
METHODS: 30 sedentary healthy women participated in the study. Ten oral contraceptive users (OC), ten non-oral contraceptives users (Non-OC) were measured during their menstrual phase (days 1-3); and ten non-oral contraceptives users were measured during their ovulation phase (OV). Participants performed 30 min of eccentric cycling at 90% of their maximal concentric power output (PO). Maximal voluntary contraction (MVC), capillary creatine kinase activity (CK), muscle soreness (visual analogue scale, VAS), and pain pressure threshold (PPT) of the vastus lateralis (VL) muscle was assessed before, immediately after, 24, 48, 72, and 96 hours after cycling. Salivary estrogen (E2), progesterone (P4) and testosterone (T) concentrations were measured at same time points.
RESULTS: PO performed during eccentric cycling was similar between three groups (OC, 131.3 ± 17.7 W; Non OC 143.2 ± 35.1W; and OV, 141.6 ± 26.6 W; P=0.58). No statistical differences were found between groups for pre-exercise hormonal concentrations. OC showed 48% lower T concentration than non-OC at 96 h post-exercise (P= 0.01). P4 in OV was 35.5 times higher than OC and 11.2 times in Non OC, increasing 335% (P=0.001) at 96 hours post-exercise compared to pre. The non-OC group was the only group that showed complete recovery of MVC and VAS by 96 h post-exercise (P>0.05), with no changes in CK and PPT-VL (P>0.05). OV showed an incomplete recovery of MVC by 96 h (P=0.02), but with minimal muscle soreness (VAS and PPT-VL). OC did not recover pre-exercise values of MVC, VAS, CK, and PPT-VL.
CONCLUSION: Our results suggest that OC users take longer time to recover after eccentric cycling exercise than non-OC users. Additionally, menstrual cycle phase may affect the response to muscle recovery. However, this different response may not be related to estradiol, testosterone or progesterone levels. We suggest that female athletes should avoid OC consumption in order to maximize muscle damage recovery.

RHABDOMYOLYSIS AND MILITARY PHYSICAL EXERTION

GOMES ROLIM FILHO, N., AMARAL DOMINGUES, C., ANNUNZIATO, J., BOVOLINI, J.A., DUARTE, J.

FACULTY OF SPORTS OF UNIVERSITY OF PORTO-FADEUP

INTRODUCTION: Rhabdomyolysis is a severe injury of skeletal muscle system with abundant release of intracellular contents into the circulation and is generally defined by serum CK levels>5,000 U/L, elevations of LDH at least two times the upper limit of normal and when BUN:Creatinine ratio exceeds 20. The objective of this study was to determine the percentage of cases of Rhabdomyolysis at different times course.
METHODS: Biomarkers from 105 subjects Brazilian Commandos Course (2012) were collected at the baseline and on the remaining Commandos students during 15 moments. The Commandos course consists of 14 weeks organized in different military activities under a rigorous selection process (Preparation, Selection, Leader Test, Counter-terror, Mountain, Fights, Jungle and Caatinga phases). The Commandos students have a high dropout rate during the course and in this way, the percentages will be presented according to the number of remaining students in each phase. Serum CK, LDH, Calcium and BUN-creatinine levels were analyzed by Vitros250 and kits of dry-chemistry method. Data analyses in SPSS version 25, relation of measurements to other baseline characteristics was using Nonparametric tests(Friedman).
RESULTS: CK, LDH, Calcium and BUN:Creatinine ratio values from baseline were 177.65±146.81 U/L, 438.96±54.47 U/L, 9.78±0.28 mg.dL-1 and 36.20±6.25 respectively. The highest mean ranks were demonstrated after the fight test (CK=5.77; LDH=5.08) and at Leader Test Preparation by BUN:Creatinine ratio (5.54) and Calcium (5.88) at baseline. The presence of Rhabdomyloysis were diagnostic in 10.5% of all 105 Commandos Course volunteers. During the selection phase the incidence of Rhabdomyolysis was 11.5 % from 52 remaining students. Under the preparation of the Leader Test and Mountain activities were only 2.9% and 10% that presented Rhabdomyolysis, from 34 and 20 Commandos students respectively. Some cases of Rhabdomyolysis were found before the Fights test and caused an incidence of 10.5% at the lasting 19 students. The highest value of the 37.5% of cases of Rhabdomyolysis was found at the end of the Fight test in the last 16 Commandos survivor's students. All of those students who develops Rhabdomyolysis are classified as "low responders" (CK< 500 U/L) at the baseline. The more severe cases appear in cases with hypocalcemia (CK=10762 U/L; LDH=1274 U/L; BUN:creatinine=35.33; hypocalcemia and CK=9127 U/L; LDH=1909 U/L; BUN-creatinine=38.40; hypocalcemia).
CONCLUSION: Rhabdomyolysis at Mountain exercises probably due to vasoconstriction by climbing equipment and downhill eccentric effort. There are indications that the possible cause of Rhabdomyolysis was the preliminary physical exhaustion before the fights test and due to the large number of attack and defense impacts (crush injury) after the fight test. The increased incidence of Rhabdomyolysis is due to the cumulative effect of physiological stress and increased demand of the Commandos Course phase.

DOES WEARING COMPRESSION GARMENTS WITH HIGH-INTENSITY PRESSURE DURING DOWNHILL RUNNING REDUCE SOFT-TISSUE VIBRATIONS AND EXERCISE-INDUCED MUSCLE DAMAGE ?

VERCRUYSSEN, F.1, EHRSTROM, S.2, GRUET, M.1, GIANDOLINI, M.3, MORIN, J.B.2

1, UNIVERSITÉ DE TOULON, LAMHESS, TOULON, FRANCE; 2, UNIVERSITÉ CÔTE DAZUR, LAMHESS, NICE, FRANCE; 3, AMER SPORTS FOOTWEAR INNOVATION AND SPORT SCIENCES LAB, SALOMON SAS, ANNECY, FRANCE

INTRODUCTION: Many off-road runners are used to wearing lower-body compression garments (CGs) over different race profiles. The use of CGs is considered as a potential strategy which may reduce muscle damage from repeated eccentric muscle actions (Hill et al., 2014). The objective of this study was to investigate whether wearing CGs compared to control garments (CON) during downhill treadmill running (DHR) reduces exercise-induced muscle damage by minimizing soft-tissue vibrations and improves running economy (RE).

METHODS: Thirteen well-trained male trail runners with a mean VO2max of 64.6 ± 5.0 mL.kg−1.min−1 performed two 40-min DHR sessions (separated by one week), wearing either CGs (15-20 mmHg for quadriceps and calves) or CON (<5mmHg) at a velocity associated with ~55% of VO2max. Before and after each DHR, indirect markers of exercise-induced muscle damage were assessed from perceived muscle soreness, countermovement jumps and isometric maximal voluntary contraction (MVC) torques of knee extensors and plantar flexors. During each DHR session, RE (in J.kg-1.m-1) and soft-tissue vibrations were evaluated at both the beginning (5-10 min) and the end (35-40 min) of exercise. Soft-tissue vibrations were assessed using two tri-axial accelerometers overlying the muscle belly of the vastus lateralis and gastrocnemius (right leg). The root mean square of the resultant acceleration (i.e. RMS) was calculated for both muscles and time periods. Data were analysed for practical significance using magnitude-based inferences and the calculation of effect sizes (ES) ± 90% confidence limits.
RESULTS: Although substantial alterations in MVC were observed after CGs and CON exercises for both knee extensors and plantar flexors, meaningful differences were identified between exercises only for knee extensors, indicating a possible lower MVC decrement in favor of CGs (-4.3%; ES = 0.21 ± 0.25). DHR-induced changes in countermovement jumps and perceived muscle soreness were not influenced by the type of garment. Moreover, a lower increase in RMS over time was observed for the vastus lateralis (-5%; ES = -0.86 ± 0.71) while no clear difference in RMS was found for the gastrocnemius within- and between-exercises. Finally, RE likely increased over time either in CON (+4.7%; ES = 0.43 ± 0.31) or CGs conditions (+4.5%; ES = 0.41 ± 0.33).
CONCLUSION: These findings suggest that wearing CGs with high-pressure (>15 mmHg) may help runners to reduce quadriceps soft-tissue vibrations (i.e. lower increase in RMS for the vastus lateralis) and, in turn, minimize the effects of DHR on global muscle fatigue (i.e. lower MVC decline). However, wearing CGs during DHR had no beneficial effects on RE responses. The effectiveness of wearing CGs seems to be muscle-dependent and the decrease in muscle fatigue possibly induced by mechanically dampening soft-tissue vibrations requires further investigation.
References: Hill J, Howatson G, van Someren K, Leeder J, Pedlar C. (2014). Br J Sports Med, 48, 1340-1346.

RELATIONSHIPS BETWEEN DECREASING RATE OF RUNNING PACE AT THE END OF A MARATHON AND SERUM MUSCLE DAMAGE MARKERS

ISHIKURA, K.

SOJO UNIVERSITY

INTRODUCTION: The phenomenon of hitting the wall (HTW) is well-known among recreational marathon runners. HTW is characterized by generalized fatigue and an unintentional slowing of running pace in addition to other indicators. . Runners who reduced speed during a marathon exhibited higher values for blood muscle damage markers than runners that maintained their pace (del Coso, 2013). In generally, a muscle damage cause decline of muscle strength and muscle soreness. However, the relationship between the rate of decrease in speed at the end of a marathon and the rate of marathon-induced decline in muscle strength, muscle soreness, and muscle damage is unknown. The purpose of this study was to investigate relationships between the rate of decrease in speed at the end of a marathon and the rate of marathon-induced decline in muscle strength, muscle soreness, and muscle damage.
METHODS: Twenty seven healthy non-professional runners (16 males and 11 females) who participated in the 36th Tsukuba Full-Marathon race (Tsukuba-city Japan) were recruited as volunteers. The height of counter movement jumps, local muscle soreness, blood leukocyte profiles, and the serum activities of creatine kinase (CK), lactate dehydrogenase (LDH), aspartate aminotransferase (AST), and alanine aminotransferase (ALT) were measured before exercise, immediately after exercise and at one to four days, after exercise. The relationship between decreases in rates of running pace from an early segment of the race (from 5 km to 10 km) to the final segment (from 35 km to 40 km) and these markers were assessed.
RESULTS: The running speed of participants peaked in the third segment (10-15km) and gradually decreased thereafter. The decreasing rate of pace from the 5 km to 10 km segment to the 35 km to 40 km segment of the race and the finish time were significantly negatively correlated. The height of counter movement jumps was significantly decreased. Local muscle soreness, blood leukocyte profiles, and the serum activities of muscle damage markers were elevated immediately after the marathon. The decreasing rate of pace during the marathon was significantly correlated with the marathon time, the serum CK, and AST activity immediately after the marathon. but not correlated with the height of counter movement jumps and muscle soreness.
CONCLUSION: These results suggest that the decreasing rate of running speed at the end of the marathon is related to muscle damage rather than muscle soreness and muscle strength. It is proposed that reducing muscle damage can be maintain the speed at the end of a marathon race. It may useful to decrease muscle damage such as an experience of long distance running before the marathon or muscle strength training.

ELECTRICALLY INDUCED CRAMPING THRESHOLD RESPONSES WITH ELECTROLYTE BEVERAGE CONSUMPTION

EARP, J.E., STRANIERI, A., ZERAMBY, J.S., MATSON, T., STEARNS, R.L., WARD-RITACCO, C.L.

UNIVERSITY OF RHODE ISLAND

INTRODUCTION: Commercial electrolyte rich beverages are commonly used to prevent exercise-associated muscle cramp (EAMC) due to the belief that EAMC is related to a person's hydration and blood sodium levels. However, this theory has been challenged by a differing belief that EAMC results from an altered neurological function unrelated to hydration or electrolytes. As previous works have shown the minimal electrical stimulation frequency (MESF) at which cramp occurs is a reliable measure that relates to the frequency a person experiences EAMC, the purpose of the present study was to determine if consumption of a commercial electrolyte beverage (EB) alters MESF in euhydrated individuals compared to a placebo beverage (PB).
METHODS: This study utilized a single blinded, repeated measures crossover design. Seven subjects (5 males & 2 females, age: 23.0 ± 4.6 years, height: 1.69 ± 0.6 m, mass: 70.4 ± 10.0 kg, body fat: 16.3 ± 9.4%) took part in a familiarization session, and two experimental sessions in which MESF of the great toe was measured 15 min after consumption of 0.5 L a lemonade flavored EB (kCal: 120, Na: 840 mg, K: 320 mg, Mg: 5 mg) or PB (kCal: 5, Na: 35 mg). Prior to each session subjects refrained from exercise for 24 hr and each testing session was separated by 1-week. Additionally, and all participants were euhydrated (urine specific gravity ≤ 1.020) and performed 15, 2 s isometric contractions of the great toe immediately prior to beverage consumption. To determine MESF, a low frequency (8 hz) electrical stimulation (2 s train 80 V) of the tibial nerve was performed at increasing (+2 hz) frequencies every minute until a cramp occurred. Subject reported cramps were confirmed by 1) sustained force against a load cell, 2) sustained muscle activity measured using EMG. Additionally, cramp intensity was assessed via a validated 6 point verbal pain scale and post-stimulation EMG of the flexor hallicus brevis.

RESULTS: Urine specific gravity was similar between EB (1.014 ± 0.005) and PB (1.012 ± 0.006, p = 0.418). MESF was significantly higher after consumption of EB (14.86 ± 7.47 hz) than PB (14.00 ± 5.03 hz, p = 0.038). Additionally, cramp pain was significantly lower in PB (2.0 ± 0.6) than EB (2.7 ± 0.8, p = 0.025), but cramp intensity, as measured by post-stim EMG, was similar (p = 0.646).
CONCLUSION: n cramp prone, euhydrated subjects, EB was successful at increasing the neurological stimuli required to elicit a cramp (MESF), as well as decreasing the pain experienced during cramp, when compared to PB. As hydration and fluid consumption were similar between conditions these results suggest that electrolyte concentration rather than fluid consumption affects cramp susceptibility in euhydrated subjects. While EB did not prevent cramps from occurring in any subjects, these results support the use of EB for delaying or decreasing the intensity of EAMC.

COLD-WATER OR PARTIAL-BODY CRYOTHERAPY? COMPARISON OF PHYSIOLOGICAL RESPONSES AND RECOVERY FOLLOWING MUSCLE DAMAGE

HOHENAUER, E.1,2,3, COSTELLO, T.J.4, STOOP, R.1, KÜNG, M.U.2, CLARYS, P.3, DELIENS, T.3, CLIJSEN, R.1,2,3

1: SUPSI , 2: THIM , 3: VUB , 4: UOP

INTRODUCTION: Currently, cold-water immersion (CWI> is a widely accepted recovery modality and is believed to improve recovery. Partial-body cryotherapy (PBC> has become commercially available and is considered as an effective recovery method with similar effects as CWI. Therefore, the aim of this study was to compare i> the physiological responses following CWI and PBC and ii> the effects on recovery following a muscle-damaging protocol (5 x 20 drop jumps>.
METHODS: Nineteen healthy males were randomly allocated into either a CWI (10°C for 10 min; n = 9> or a PBC (-60°C for 30 sec, -135°C for 2 min; n = 10> group. The physiological variables (thigh muscle oxygen saturation [SmO2], cutaneous vascular conductance [CVC], mean-arterial pressure [MAP] and local skin temperature> were assessed immediately prior and up to 60 min post-treatment (10 min intervals>. The recovery variables (thigh muscle swelling, maximum voluntary contraction [MVC] of the right knee extensors, vertical-jump performance [VJP] and delayed-onset of muscle soreness [DOMS]> were measured immediately prior and up to 72 h post-treatment (24 h intervals>.
RESULTS: Compared to PBC values, CVC (at 30 min>, SmO2 (at 40 min> and lower extremity-skin temperature (thigh/shin at 60 min> were significantly reduced in the CWI group after the treatment (all $p < 0.05$). Only lower extremity skin temperature was significantly reduced in the PBC group directly post-treatment ($p < 0.05$). MAP significantly increased in both groups after the treatments (both $p < 0.05$). Thigh muscle swelling and DOMS did not differ between groups. MVC and VJP returned to baseline in both groups after 24 h ($p > 0.05$).
CONCLUSION: The primary findings in this study are that i) the physiological impact of CWI was significantly greater than PBC and ii) no differences in objective and subjective recovery variables were observed between CWI and PBC up to 72 h post-exercise. Although CWI decreased muscle oxygen saturation, CVC, mean- and local skin temperature after a muscle-damaging exercise, no differences in objective and subjective markers of recovery were observed between CWI and PBC.
References:
Costello TJ. (2015). Cochrane Database Syst Rev, 18;(9):CD010789.?
Bleakley C. (2012). Cochrane Database Syst Rev, 15(2):CD008262.?
Mawhinney C. (2017). Med Sci Sports Exerc, 49(6):1252:1260.
Contact:
erich.hohenauer@supsi.ch

Oral presentations

OP-PM59 Orthopedics

THE INFLUENCE OF APPROACH SPEED ON MUSCLE ACTIVITY DURING 90° SIDE-STEP CUTTING TASK

WANG, D.1, YUAN, P.2, XU, Y.L.2

1. NJUCM , 2. JSRISS

INTRODUCTION: Side-step cutting at 90° was considered as dangerous and frequently used in athletic events (Xie et al., 2013), which induced many anterior cruciate ligament (ACL) injuries (Vanrenterghem et al., 2012). During the deceleration phase, higher approach speeds were expected to increase the loads (Vanrenterghem et al., 2012). Sagittal-plane mechanics, such as quadriceps (Q) and hamstrings (H) contraction, have been suggested as the dominant contributors to ACL load (Hanson et al., 2008). The aim of this study was therefore to investigate the characteristics of Q and H muscle activity in 90° side-step cutting task under different approach speeds.
METHODS: Twelve female (20.6±3.1 yr, 1.83±0.07 m, 71.7±6.8 kg) and 13 male (18.4±2.7 yr, 1.96±0.06 m, 84.9±12.9 kg) athletes volunteered to participant the study. They were required to complete 3 successful 90° side-step cutting task at 3 m/s (slow), 4 m/s (medium), and 5 m/s (fast) respectively. Electromyograph (EMG) was collected from Q and H of the dominant leg by Delsys Trigno Lab EMG system (Delsys, USA). The approach speed was monitored by Smartspeed (Fusion Sport, Australia), whilst the ground reaction force measured from force plate (Kistler Instruments, Switzerland) was utilized for the decision of pre-activation phase (50 ms before touchdown) and post-activation phase (50 ms after touchdown).
RESULTS: Significant differences were noted in phase ($F=109.01$, $p<0.001$), speed ($F=4.68$, $p<0.001$), and phase*speed ($F=2.21$, $p=0.045$). Regardless of sex and speed, there were significant increases in Q activation ($F=205.15$, $p<0.001$) and H activation ($F=8.49$, $p=0.005$), and a decrease in H:Q ratio ($F=81.00$, $p<0.001$) between pre-activation and post-activation phases. Regardless of sex and phase, LSD post hoc test discovered significant differences between fast and medium speed ($p=0.001$), and fast and slow speed ($p<0.001$) in Q activation; significant differences between fast and medium speed ($p=0.009$), and fast and slow speed ($p<0.001$) in H activation; and significant difference between fast and slow speed ($p=0.044$) in H:Q ratio. There was also significant interaction between phase and speed in Q activation ($F=5.62$, $p=0.005$).
CONCLUSION: The increased muscle activation and thus the load post activation might explain the occurrence time-point of ACL injuries; the increased speed increased the muscle activation and thus knee mechanical loads; with incremental speeds, the increase in Q activation was more preferential and may increase the loads to ACL directly.
REFERENCES: Xie D, Urabe Y, Ochiai J, Kobayashi E, Maeda N. (2013). The Knee, 20, 85-89.

Vanrenterghem J, Venables E, Pataky, T, Robinson M. (2012). J Biomech, 45, 2444-2449.
Hanson AM, Padua DA, Blackburn JT, Prentice WE, Hirth CJ. (2008). J Athl Train, 43(2), 133-143.
CONTACT: danwang_dana@163.com

THE IMPACT OF LOWER EXTREMITY INJURIES ON HEALTH-RELATED QUALITY OF LIFE IN ADOLESCENT ATHLETES: A REPORT FROM THE ATHLETIC TRAINING PRACTICE-BASED RESEARCH NETWORK.

LAM, K., MARSHALL, A., VALOVICH MCLEOD, T.
A.T. STILL UNIVERSITY

INTRODUCTION: Injuries are common during adolescent sport participation, with most occurring at the ankle and knee. Current evidence suggests that sport-related injuries impact patients beyond their physical functioning. However, few studies have investigated changes in health-related quality of life (HRQOL) shortly following a sport-related injury. The purpose of this study was to describe changes in HRQOL, as measured by the Pediatric Quality of Life Inventory (PedsQL), in adolescent athletes during the first two weeks following a sport-related knee or ankle injury.
METHODS: One hundred and six patients (male=65, female=41, age=15.6±1.1 years, height=174.2±10.7 cm, mass=72.1±19.7 kg) representing fourteen sports were diagnosed with a knee or ankle injury by an athletic trainer within the Athletic Training Practice-Based Research Network. Patients received usual care from an athletic trainer and completed the PedsQL during treatment sessions at post-injury Week 1 [(W1); range=0-7 days post-intake] and Week 2 [(W2); range=10-19 days post-intake]. The PedsQL is a valid, reliable, and responsive patient-reported outcome instrument that assesses HRQOL. The PedsQL generates a total (TOT) and four subscale scores [physical functioning (PF), emotional functioning (EF), social functioning (SOF), school functioning (SCF)]. All scores range 0-100, with higher scores indicating better HRQOL. The minimal clinically important difference (MCID) for the TOT is 4.4 points. Descriptive statistics (mean±SD) were reported for each score, and Wilcoxson Signed Ranks Tests were used to identify differences between time points ($p<.05$, two-tailed).
RESULTS: Significant improvements were reported between time points for TOT ($p<0.001$; W1=77.4±16.2 [range=36-100], W2=83.8±14.1 [range=47-100]), PF ($p<0.001$; W1=61.9±28.6 [range=3-100], W2=74.4±21.5 [range=19-100]), and EF ($p<0.001$; W1=82.9±19.3 [range=15-100], W2=89.4±15.7 [range=25-100]). No significant changes were noted for SOF ($p=0.20$; W1=90.8±12.8 [40-100], W2=91.9±14.0 [range=20-100]) or SCF ($p=.11$; W1=83.1±18.1 [range=30-100], W2=85.1±17.3 [range=40-100]). When examining scores on an individual level, 50.9% (n=54) of patients reported TOT changes that exceeded the MCID value between time points. Interestingly, 28.3% (n=30) of patients reported a decrease in TOT between time points, and only 11.3% (n=12) reported a complete recovery of HRQOL (score=100) at W2.
CONCLUSION: Adolescent patients who suffer a knee or ankle injury generally report statistically significant improvements in HRQOL during the first two weeks post-injury. However, half do not experience a meaningful change in HRQOL, and a substantial majority of patients continue to experience deficits in HRQOL two weeks post-injury. Sport medicine practitioners should consider assessing HRQOL to better guide patient care decisions, particularly since current literature suggests that many patients will return to full participation within two weeks of injury.

THE EFFECT OF RUNNING SPEED ON THE INTACT LIMB LOADING EXPERIENCED BY PEOPLE WITH A TRANSTIBIAL AMPUTATION

STRIKE, S., ARCONE, D., ORENDURFF, M.
UNIVERSITY OF ROEHAMPTON

INTRODUCTION: Increasingly unilateral trans-tibial amputees are able to participate in running as a result of the advances in dynamic prosthetic limbs. However, running may result in high loads on the intact/biological limb and particularly at the knee where there is greater risk of developing osteoarthritis. Although there is some evidence that the ground reaction forces experienced during submaximal running by the intact limb are greater than those of controls (Baum et al 2016), there is no research assessing the effect at the knee. Therefore the purpose of this research was to assess the effect of speed on the load experienced at the intact knee of unilateral transtibial amputees compared to matched controls who had no disability.
METHODS: Overground running data were collected in 16 recreational runners (8 transtibial amputee using their own BladeXT prosthesis and 8 controls) using Vicon Nexus V.2.5 with Kistler force plates. Participants ran at self-selected running pace, 70% and 130% of that pace. Peak vertical ground reaction force (vGRF), and the sagittal and frontal plane peak knee forces, moments and their loading rates were analysed between limbs and speeds (ES>0.8) .
RESULTS: There was no between limb effect at any speed for the vGRF, the peak sagittal and frontal plane knee moments and the sagittal peak knee force. For the frontal knee peak force, there was a between limb difference at the self-selected and fast speeds, with the intact limb evidencing a medial force and the control limb a lateral force. For the frontal knee moment loading rate, the intact limb was greater than the control limb at all speeds. For both limbs, all variables had a lower magnitude at the slow speed than the fast speed while for the control limb, the slow speed was also lower than the self-selected speed for most variables. Large variability on the intact side may have masked some results.
CONCLUSION: The only variables that indicated an effect of limb, of those that have been previously associated with the development of osteoarthritis, were the more medial force at the knee and the increased knee abductor moment loading rate. There is limited evidence that there is an overload on the intact limb at relatively low running speeds. On the control limb, there was an effect of speed across all speeds for most variables while for the intact limb differences were evident only between slow and fast speeds, indicating that adjusting to speed was limb specific.
B.S. Baum et al, J. Appl. Biomech. 32 (2016) 287–294. doi:10.1123/jab.2014-0290.

EFFECTS OF A ONABOTULINUMTOXIN A INJECTION FOR NEUROGENIC DETRUSOR OVERACTIVITY ON UPPER BODY EXERCISE PERFORMANCE IN WHEELCHAIR ATHLETES: A CASE STUDY

PERRET, C., PANNEK, J.
SWISS PARAPLEGIC CENTRE

INTRODUCTION: Most patients with a suprasacral spinal cord injury (SCI) suffer from neurogenic detrusor overactivity (NDO), which can lead to renal damage or even death. Anticholinergic medication is the standard treatment of NDO. However, in a significant number of patients, this medication is not sufficient or leads to intolerable side effects. A therapeutic alternative is the injection of onabotulinumtoxin

A into the detrusor. Although this injection seems to be effective and safe for the treatment of NDO, it is still unclear, if there exist some systemic side effects, which might influence exercise performance. The aim of this study was to investigate, whether an onabotulinumtoxin A injection reduces exercise performance in a wheelchair basketball player.
METHODS: A wheelchair basketball player with NDO performed a Wingate test before as well as 10 days after the onabotulinumtoxin A injection. Additionally, a female handcyclist served as control and performed the same exercise testing without intervention two weeks apart.
RESULTS: The injection showed no negative effects in the wheelchair basketball player. Peak power was 4.6 W/kg (pre) vs. 4.7W/kg (post), average power 2.6 W/kg vs. 2.9 W/kg and time to peak 4.0s vs. 4.0s, whereas in the handcyclist who served as control a slight performance impairment was found. Peak power were 5.3W/kg (pre) vs. post 4.7W/kg (post), average power 3.9W/kg vs. 3.8 W/kg and time to peak 3.8s vs. 4.6s.
CONCLUSION: An onabotulinumtoxin A injection to treat NDO in a wheelchair basketball player did not lead to performance decreasing effects. However, further data to prove this single case finding are needed. Before a prove of concept can be made and to be on the safe side, we recommend to schedule onabotulinumtoxin A injections at least six weeks before important competitions.

AEROBIC FITNESS AND ATHEROSCLEROTIC CARDIOVASCULAR RISK IN PARALYMPIC ATHLETES WITH A LOCOMOTOR IMPAIRMENT

BERNARDI, M.1,2, PARISI, F.1, LANZANO, R.1, DANTE, D.1, CURATULO, P.1, SQUEO, M.R.3, ADAMI, P.E.3, SPATARO, A.3, PELLICCIA, A.3

1 SAPIENZA, UNIVERSITY OF ROME. 2 ITALIAN PARALYMPIC COMMITTEE. 3 ITALIAN OLYMPIC COMMITTEE

INTRODUCTION: Atherosclerotic cardiovascular disease (ACVD) is a leading cause of morbidity and mortality in individuals with a locomotor impairment (I-LI). ACVD occurs at earlier ages in I-LI than in ambulatory individuals because the former, in particular those with a spinal cord injury (SCI), have a higher prevalence of risk factors (RF) mainly due to their increased sedentary habit. While reduced daily energy expenditure and low aerobic fitness have been established as RF in the general population, at our knowledge, in I-LI, in spite of the fact that physical activity is encouraged, the possible role of high aerobic fitness as ACVD protective factor has not been fully evaluated. To accomplish this purpose Paralympic athletes (PA) with a locomotor impairment (LI), competing in sports with a wide range of energy expenditure and therefore having a wide range of aerobic fitness were evaluated to test the hypotheses that 1. the prevalence of atherosclerotic cardiovascular disease (ACVD) risk factors (RF) was higher in PA with SCI (PA-SCI) than in PA with other (different from SCI) LI (PA-OLI); 2. aerobic fitness (oxygen uptake peak - VO2peak) was inversely related to ACVD RF.
METHODS: Data from a total of 135 summer and winter male PA (72 PA-SCI, 28 PA with lower limb amputation, 12 PA with a cerebral palsy/brain injury, 7 PA with poliomyelitis, 9 PA with other neurological disorders and 7 PA with other orthopedic disorders), who had competed in 6 Paralympic Games (from 2004 to 2014), were retrospectively evaluated and divided in two groups (PA-SCI vs PA-OLI). They had been screened through anthropometric and blood pressure (BP) measurements, laboratory blood tests and graded cardiopulmonary maximal exercise test, to estimate both an ACVD-RF score and VO2peak. The ACVD-RF score was assessed summing 1 point for each of the following RF: obesity –OB- (BMI≥30 or waist circumference ≥102 cm), hypertension –HT- (rest systolic BP ≥ 140 mm Hg and/or diastolic BP ≥ 90 mm Hg), dyslipidemia -DL- (total Cholesterol -C- ≥200 mg/dl or LDL-C ≥130 mg/dl or HDL-C <40mg/dl), impaired fasting glucose -IG- (fasting plasma glucose ≥100 mg/dl) and subtracting 1 point when serum HDL-C was higher than 60 mg/dl.
RESULTS: Prevalence of OB, HT, DL, IG and high HDL-C were equal to 5.9% and 3.2%, 13.9% and 14.3%, 58.3% and 49%, 29.2% and 34.9%, 27.8% and 17.4%, in PA-SCI and PA-OLI, respectively. Based on the ACVD-RF score, 3 ACVD-RF groups were formed: group 1 (RF≤0, N=54), group 2 (RF=1, N=41), group 3 (RF≥2, N=40). VO2peak was statistically different in the 3 ACVD-RF groups and equal to 37.9±14.71 ml/kg/min, 30.9±9.13 ml/kg/min and 24.1±5.50 ml/kg/min in the PA of ACVD-RF group 1, 2 and 3, respectively.
CONCLUSION: Prevalence of all RF was similar in the two groups of LI. DL has a relevant and dangerous prevalence in PA regardless their LI. Being VO2peak inversely related to the 3 groups of ACDR-RF, high aerobic fitness seems to provide a protective effect on ACVD morbidity in PA with a LI.

QUANTIFYING THE CARDIORESPIRATORY RESPONSES DURING ELITE INTERNATIONAL WHEELCHAIR BASKETBALL MATCHES

FERNANDES, E.M.1,2, FROGLEY, M.3, PINOS, A.1, RUPF, R.1,3, THOMAS, S.G.1

1: UNIVERSITY OF TORONTO , 2: CANADIAN SPORT INSTITUTE ONTARIO , 3: WHEELCHAIR BASKETBALL CANADA

INTRODUCTION: Quantification of the physiological demands of competitive matches provides critical information that can impact decisions based around training design and prescription. The physiological demands during a wheelchair basketball (WCBB) match have yet to be reported. Therefore, as part of a larger project, we quantified the cardiorespiratory responses of elite athletes during WCBB matches.
METHODS: Data was collected during 5 matches between the Canadian and Japanese men's national WCBB teams. Six male WCBB athletes (Classification range 1.5 to 4.5) each wore a K4B2 Cosmed analyzer and a T31 Polar heart rate monitor during matches, where real time match data was collected. In addition to match data, each player completed a maximal treadmill (Woodway Blade) test where VO2 and heart rate (HR) data was measured. We quantified the average data for VO2, HR, %VO2peak and %HRmax over 7 minutes in the first half and 7 minutes in the second half each athlete completed.
RESULTS: For the maximal capacity tests, the average VO2peak was 34.5 ml.kg-1.min-1 and average HRmax was 184 bpm. Through 7 minutes of the first half of the match, players averaged 27.9 ml.kg-1.min-1 (73% of VO2peak) and 162 bpm (86% of HRmax). Through 7 minutes of the second half players averaged 29.7 ml.kg-1.min-1 (81% of VO2peak) and 152 bpm (80% of HRmax). The 6 athlete participants averaged 29.1 minutes play in the match with 13.8 minutes in the first half and 16.2 minutes in the second half.
CONCLUSION: We describe for the first time, the cardiorespiratory responses of athletes during a series of elite international WCBB matches. These responses indicate players work primarily in the heavy intensity domain during competition. This information could have implications for both coaches and trainers. However, given that WCBB employs a classification system and has several defined "basketball" activities, next steps will include describing the cardiorespiratory responses by classification and in response to different WCBB activities.

Oral presentations

OP-SH18 Decision making and development of exercise in team sport

ANALYSIS OF EXPERT DECISION MAKING IN ELITE COMPETITIVE SOCCER FROM AN EXPERT PLAYERS PERSPECTIVE

GLEESON, E., KELLY, S.

UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: This research analyses the decision making moment in the situated activity of elite competitive soccer from an expert player's perspective. Considering that soccer is a dynamical system of interacting performance involving multiple actors such as coaches, team mates, opposition and accepting that human activity is autonomous, experienced and situated requires research that acknowledges the summative processes affecting the decision making moment in live situated action. In this regard, this research reconstructs the expert players' autonomous course of experience during competitive international soccer games.
METHODS: The sample included 10 senior international female soccer players with experience ranging from 20 to 125 senior international appearances. A total of 20 interviews were conducted, 2 per player. Utilising video footage, stage one involved a self –confrontational interview that explored players' subjective experience of in-game decisions in competitive international games. Stage two involved a semi -structured interview with each player following her subsequent immediate competitive action post the self-confrontational process. Interviews were conducted within 24-48hours of performance. Data analysis was preformed using the methodological & theoretical 'Course of action framework' (Thereau & Jeffroy, 1994).
RESULTS: Results highlight the interlinking dependency of two symbiotic processes: (1) individual –social and (2) social –individual. Individual –Social factors relate to automated internal processes such as perception, cognition, knowledge, psychological, confidence, feelings and relational interactions i.e. dyadic relationships with teammates and opposition. Social –Individual factors relate to the coach -player relationship.
CONCLUSION: The findings have important pedagogical implications for training practice design for elite players, coach –athlete relationship, coach leadership styles, communication and the development of creative decision makers. Reconstructing the players' course of experience provides a greater insight for coaches and provides a methodology for enhancing feedback and performance analysis by facilitating the gap between first person (player) analysis and third person analysis (video).
References: Thereau, J. & Jeffroy, F. (Eds) (1994) Ergonomie des situations informatisées: la conception centréesur le coursdaction des utilisateurs. Octares, Toulouse.
Varela, F.J. (1980). Principles of biological autonomy. New York, Elseiver North Holland.
Von Cranach, M. & Harre. R. (1982). The Analysis of action: recent theoretical and empirical advances. Cambridge, Cambridge University Press.
eileen.gleeson@ucdconnect.ie

THE ROLE OF SELF-CONFRONTATIONAL INTERVIEWS IN EXPLORING FEMALE PLAYERS IN-GAME DECISION MAKING IN ELITE COMPETITIVE SOCCER.

KELLY, S., GLEESON, E.

UNIVERSITY COLLEGE DUBLIN

Introduction: Advanced decision making capabilities in elite soccer are associated with game intelligence and are considered hall marks of expert performance. Arguably, to understand the autonomous, experienced view of the decision-making moment in competitive situated activity requires a methodology that incorporates an emic, internal perspective. Consequently, this research utilised self-confrontational interviews to explore female soccer players in-game decisions during European championship qualifiers.
Methods: The sample included senior international female soccer players (n=10) with playing experience ranging from 20 to 125 senior international appearances. First, digital technology recorded player performances during a competitive international game. Second, post-performance self-confrontational tape-recorded interviews (n=10) were conducted separately with each participant to explore players subjective experience of key in-game decisions. The inclusion of video action minimized hindsight bias and enhanced recall effect through episodic memory. Third, semi-structured interviews (n=10) were conducted post subsequent-performance and post initial self-confrontation interviews. All interviews were transcribed and subjected to a process of inductive content analysis.
Results: First, the results identify that self-confrontational interviews are an efficacious method to enhance self-awareness concerning in-game decision making processes. Second, in discussing their in-game decisions players engaged in episodic future thinking (Atance & ONeill, 2001) adopting reflecting in-action and for-action (Schon, 1987). Finally, by engaging the players at a pre-reflexive level of consciousness (Thereau et al, 2003) self-confrontational interviews facilitated organic identification and subsequent exploration of the affective dimensions (Hermans & Hermans-Jansen, 1995) of athletes decision making process during competitive international games.
Conclusion
Grounded in the enactive approach this research adopts the methodological & theoretical course of action and course of interaction framework (Thereau, 2003). Within this framework, the self-confrontation method is viewed a means of self-investigation involving a narrative psychological process that requires interviewees to order and reorder events and experiences that they consider to be meaningful (Hermans & Hermans-Jansen, 1995). Despite limitations, capturing the internal expert perspective can provide a detailed insight into the complexity of decision making processes and can serve as a useful starting point in assisting practitioners develop players enhanced decision making capabilities.
References: Atance, C. M., & O Neill, D. K. (2001). Episodic future thinking. Trends in Cognitive Science, 5, 533-539.
Schön, D. A. (1987). Educating the reflective practitioner: Toward a new design for teaching and learning in the professions. San Fransisco: Jossey-Bass.
Hermans, H.J.M. & Hermans-Janses, E. (1995). Self-narratives, the construction of meaning in psychotherapy. New York: Guilford Press.
Theureau, J. (2003). Course-of-action analysis and course-of-action centred design. In E. Hollnagel (Ed.) Handbook of cognitive task design (pp.55-81). Lawrence Erlbaum: Mahwah, NJ.

BEHIND CLOSED DOORS: THE ROLE OF DEBRIEFING AND FEEDBACK IN A PROFESSIONAL NEW ZEALAND RUGBY CLUB.

MIDDLEMAS, S.G., CROFT, H.
OTAGO POLYTECHNIC

INTRODUCTION: Debriefing is a process which has been applied successfully in military, psychological and educational settings to enhance performance . In debriefing the multiple aims of performance improvement, learning and psychological recovery are achieved through a complex process . However, despite the extensive use of feedback and statistics within high performance sport environments, limited attention has been paid to the way coaches and athletes use this information to achieve these outcomes . The aim of this case study, therefore, was to gain an in-depth understanding of how a professional rugby team – playing in New Zealand's premier rugby cup competition - used the post-match and pre-match team meetings to debrief after performance and prepare for future performance.
METHODS: Multiple ethnographic techniques were employed to generate a comprehensive picture of practice, including participant observation, video recordings, formal and informal interviews, field notes, descriptive statistics and document analysis. Each meeting was transcribed separately and analysed using an inductive content analysis process and themes were identified.
RESULTS: The case study focuses on how four key factors - coach-facilitation, player engagement, leadership and the balance between reflection and preparation – impact on the debrief process. Throughout the study, the coaches were very conscious of the difficulty of measuring the success of this area of their practice. While debriefing was highly valued, the coaches struggled to find the right balance between evaluation and preparation. As the head coach states: "Sometimes I think we should have just got them on the training pitch and run more drills" After a positive start, the team's performance slumped in mid-season. In the post-study interviews, psychological recovery – a key aspect of debriefing – was identified by the coaches and players as a key reason for this. One player concluded that: "A big focus for us [as a team] was around preparation for games and I think that not talking about them meant we just ignored our problems … it had a negative effect on our performance. Like we were carrying around with us as baggage".
CONCLUSION: The findings reveal that while considerable emphasis was placed on the importance of player learning and engagement in team meetings, delivery was often ad hoc, coach-driven and results-focused. From a practical viewpoint, coaches are encouraged to place importance on effective psychological recovery from performance within the debrief process.

Oral presentations

OP-PM62 Nutrition 2

FACTORS INFLUENCING SUPPLEMENT USE IN ATHLETES COMPETING AT THE 2017 AUSTRALIAN MASTERS GAMES

GIFFORD, J.1, WU, X.2, CLIMSTEIN, M.2,3, O'CONNOR, H.1, PRVAN, T.4, STUART-SMITH, W.2
1: SYDNEY , 2: SYDNEY , 3: BOND , 4: MACQUARIE

INTRODUCTION: Supplement use among athletes is common, however, less is known about their use in masters (MA) compared to younger athletes. Knowledge on factors influencing MA supplement use would assist nutrition advice and education. We aimed to investigate the influence of demographic, health conditions, and sport type on supplement use in MA competing at the 2017 Australian Masters Games (AMG). Sources of nutrition information were also investigated.
METHODS: A total of 128 AMG participants (56.3±11.2 years, 62.5% female) completed an online survey on nutrition and health. Sports that MA entered at the AMG were categorised as aerobic, anaerobic/power or mixed sports based upon likely energy systems used, or skill sports. MA reported use of any supplements from a list of 31, which were grouped into sports food and beverages (FS, n=7), medical supplements (MS, n=13), and performance supplements (PS, n=11). Influence of demographic factors, health conditions, and sport type on type and number of supplements used was determined by fitting logistic regressions. MA also ranked sources of nutrition information 1-5 (1=most important).
RESULTS: Forty-eight (37.5%) participants reported use of supplement 1-16 supplements each. Of these 25% used SF only, 27% used MS only, 0% used PS only, and 48% used combinations; the most common were SF+MS (23%) and SF+MS+PS (15%). The most commonly reported supplements in each group were SF: sports drinks (n=16), MS: various vitamins and minerals (n=49; 6 types), and PS: caffeine (n=13; 2 types). Demographic factors (age, gender, education, nationality, body mass index, previous elite sport participation, income) and health conditions did not influence supplement use. Participation in aerobic ($p<0.0005$), anaerobic ($p=0.009$), and mixed sports ($p=0.020$) influenced SF usage. Type of sport and combinations of supplement usage ($p=0.009$) were associated. Sports dietitian/nutritionist or general dietitian/nutritionist (n=18, n=16), general practitioner (n=19), and the internet (n=17) were most often ranked number 1 as a source of nutrition information for MA.
CONCLUSION: MA that used supplements were likely to use them in combinations. Demographic factors and health conditions did not influence supplement usage in this sample of MA, however, they were most likely to use sports foods and beverages across a variety of sports. Dietitians/nutritionists and general practitioners should be prepared to provide nutrition education and advice on the effects of combinations of supplements, and potential interactions with the prescribed medications and health conditions of MA.
Contact: janelle.gifford@sydney.edu.au

NUTRITION KNOWLEDGE OF PROFESSIONAL AND SEMI-PROFESSIONAL FEMALE SOCCER PLAYERS: IMPLICATIONS FOR SPORTS NUTRITION PRACTITIONERS

HARPER, L.D.1, DATSON, N.2, EMMONDS, S.3, HICKS, S.4, HULTON, A.5, JULIAN, R.6, NAUGHTON, R.1
1: UNIVERSITY OF HUDDERSFIELD ; 2: UNIVERSITY OF CHICHESTER ; 3: LEEDS BECKETT UNIVERSITY ; 4: NORTHUMBRIA UNIVERSITY ; 5: UNIVERSITY OF SURREY ; 6: UNIVERSITÄT MÜNSTER

INTRODUCTION: Nutrition is a small but important component that contributes to successful athletic performance, recovery and health. However, due to financial and time constraints, the majority of Womens soccer teams do not employ qualified nutrition professionals. As such, female soccer players may not be receiving optimal nutritional support and advice. The purpose of this present investigation was to assess the current sport nutrition knowledge of professional and semi-professional female soccer players.
METHODS: Seventy two female soccer players completed an adapted sport nutrition knowledge questionnaire (Devlin & Belski, 2015). Players predominantly played in the United Kingdom (70/72), with one player competing in Iceland and one in the USA. Forty one players

(57%) identified international-level soccer as their highest level of competition attained in their career to date. The questionnaire contained 38 questions related to carbohydrate, protein and fat intake, hydration, vitamins, minerals and fibre, nutrient timing, training and competition-specific nutrition, and anti-doping. The questions were multiple-choice (four choices) with only one correct answer (worth one point).
RESULTS: Mean nutrition knowledge score was 57%. For questions related to protein intake and timing, only 38% of players knew how much protein should be consumed per day relative to body mass, and only 40% knew how often they should consume protein across a day. Seventy seven percent of players were aware of the negative impacts of dehydration, however; only 46% knew the correct fluid intake during exercise. Only 44% knew the importance of dietary fibre. Players were generally good at identifying the importance of carbohydrate for training and matches (75%). Players were aware of optimal timing of carbohydrate intake following exercise (75%), however; only 56% identified a mixed meal of carbohydrate and protein as superior to a carbohydrate-only meal. Only 29% of players knew the role of dietary fat, with 60% identifying which types of fat should predominate in their diet. However, 35% were aware of the optimal daily intake of Omega-3. Only 39% of players thought that vitamin and mineral supplements should only be consumed if they have been diagnosed with a clinical deficiency. Only 38% of players were aware that the World Anti-Doping Agency was responsible for the compilation of a prohibited substance list and 65% were able to identify the logo printed on products that have been tested for banned substances (Informed-Sport logo).
CONCLUSION: The data suggests that female soccer players nutrition knowledge can be improved, with a low overall knowledge score and more specifically, poor knowledge related to nutrient timing, hydration, protein intake, dietary fibre, doping and the role of fats. This data is of relevance to players, coaches and sports nutrition professionals, as well as those responsible for recruiting staff.
References: Devlin B, Belski R. (2015). Int J Sports Nutr Exerc Metab, 25, 225-232.

NUTRITIONAL STRATEGY IN SOLO SAILING, NOT ONLY CALORIES AND NUTRIENTS

GHIANI, G., MAGNANI, S., DONEDDU, A., SAINAS, G., FOIS, A., CABOI, M., CRISAFULLI, A.

UNIVERSITY OF CAGLIARI

INTRODUCTION: What would you like to eat if you were a skipper leaving for a single handed yacht race supposed to last about 130 days? In solo sailing a single man must carry out the same range of tasks in a yacht similar in design, length and rigging to that which would normally be managed by a crew of up to 12 sailors. An appropriate nutrition will be crucial to maintain energy balance and to guarantee an optimum level of performance. In this kind of challenge food feeds the body and gives comfort. Moreover there is to deal with taste, variety and hygiene. There is no fridge aboard, gas stores are limited and there are problems of weight. Most of racers eat industrial freeze-dried food but we wanted to try something different, a simple and easy to cook food. With these recommendations our group made a customized galley for the Italian sailor GM who tried to beat the worlds circumnavigation record in CLASS 40 in 2016. His race only lasted 65 days, from Gibraltar to Freemantle, because of technical problems.
METHODS: We speculated the racers needs during the race and we tried to match them with his tastes and eating habits. His daily recommended nutritional intake during the voyage, detected with a sensewear armband during preparation, was 3100 Kcal/day with carbohydrate and protein intake goals of 335 g/day and 100g/day, respectively. We planned a 10 different days menu, to avoid menu fatigue, including five meals a day, and divided it into 120 vacuum packed bags, each bag containing instruction and recipes. We trained the sailor to cook each recipe.
RESULTS: Bioelectrical impedance analysis (BIA) was used to assess body composition before and after the race, and body mass was also measured. Measurements enlightened that during the voyage the racer did not lost body mass and his body composition changes were due to changes in Fat Mass (FM pre-race 6 kg, FM post race 4,5 Kg) and Free Fat Mass (FFM pre- race 55,9 kg, FFM post-race 57,5 Kg).
CONCLUSION: The racer reported good sensations about his nutrition and the results we found in his body composition enlightened that he did not lost FFM that is very important to have a good performance.
S D Myers, S M Leamon, V R Nevola and M G L Llewellyn Energy expenditure during a single-handed
transatlantic yacht race. Br. J. Sports Med. 2008;42;285-288;
Fearnley, D., Sutton, L., O'Hara, J., Brightmore, A., King, R., & Cooke, C. (2012). Case Study of a Female Ocean Racer: Prerace Preparation and Nutritional Intake During the Vendée Globe 2008. International Journal of Sport Nutrition and Exercise Metabolism, 22, 212-219.
H.C. Lukaski, P.E. Johnson, W.W. Bolonchuk, G.I. Lykken Assessment of fat-free mass using bioelectrical impedance measurements of the human body. Am J Clin Nutr, 41 (1985), pp. 810-817

EXAMINATION OF THE TIMING OF CARBOHYDRATE AND PROTEIN INTAKE AMONG YOUNG ELITE FEMALE FOOTBALL PLAYERS

BAUHAUS, H.1,2, VON ANDRIAN, J.1,2, BRAUN, H.1,2, THEVIS, M.1,2,3

GERMAN SPORT UNIVERSITY COLOGNE, COLOGNE, GERMANY

INTRODUCTION: General recommendations for the daily intake of macronutrients in elite sports exist and vary depending on training intensity and training volume. Recently we have shown that carbohydrate (CHO) intake in young female football players is at the lower range of the recommendations (Braun et al., 2018). However, not just absolute and relative intakes should be considered, but also the timing of carbohydrate and protein intake before, during and after training. Therefore, the purpose of this evaluation is the examination of CHO and protein intake around training sessions among young female football players playing in the highest age-related division.
METHODS: Dietary data of 22 training sessions undertaken by 10 young elite female football players (15.6 ± 0.5 yrs, 105.9 ± 22.1 min daily training volume) were evaluated, using a 3-day weighed record, complemented by a diet history interview. Based on the German food database (BLS 3.01) using OptiDiet Basic Software, the intake of CHO within 4 hours prior to exercise and during exercise as well as CHO and protein intake within 1 hour after exercise was analyzed and compared to current recommendations for pre- and post-exercise nutrient recommendations for optimal sports performance (Thomas et al., 2016).
RESULTS: CHO intake was on average 0.84±0.54 g/kg bodyweight (BW) in the 4 h prior to exercise. Within the first hour after exercise CHO intake was 0.29±0.48 g/kg BW and absolute protein intake 6.57±8.03 g or 0.11±0.13 g/kg BW, respectively. There was no CHO intake during exercise.
CONCLUSION: Based on well accepted recommendations (Thomas et al., 2018) a sufficient CHO intake was not met prior, during and after exercise. Only one player had a sufficient CHO intake prior to a single training session. After exercise, the recommendation of combined absolute protein intake of 15-25 g or relative protein intake of 0.25-0.3 g/kg BW and CHO intake of 1-1.5 g/kg BW (Thomas et al., 2016) was only met once. These data show that there is a high potential to enhance timing of CHO and protein intake around training sessions and underline the importance of nutritional education in young athletes, maybe especially in team sports.

References: Braun, H., von Andrian-Werburg, J., Schänzer, W., Thevis, M. (2018). Nutrition Status of Young Elite Female German Football Players. Pediatr Exerc Sci.; 30(1):157-167.
Thomas, D. T., Erdman, K. A., & Burke, L. M. (2016). American College of Sports Medicine Joint Position Statement. Nutrition and Athletic Performance. Medicine and science in sports and exercise, 48(3), 543-568.
Contact: h.bauhaus@dshs-koeln.de

CORRELATION BETWEEN DIETARY INTAKE AND ENDOCRINE MODULATION IN ADOLESCENT ATHLETES

OLIVEIRA, T., DIAS-SILVA, C.H., FRANCA, P.A.P., MAYOR, V.C., FONTES, L.L., SANTOS, J.C., ZAGO, C.K.A., PORTO, C.P.M., VALESTE-SANTOS, L.A., FONSECA-JUNIOR, S.J., PIERUCCI, A.P.T.R.

UNIVERSIDADE FEDERAL DO RIO DE JANEIRO

INTRODUCTION: Besides the demands for training and performance adolescent athletes need adequate energy intake to maintain proper growth and maturation. Food intake is the exogenous source of energy supply, used to build endogenous macronutrient stores. Leptin and Insulin are anabolic and catabolic hormones, which have a major role in the metabolism of the subjects (ADA, 2016).
METHODS: We evaluated 46 young soccer players. Body composition was assessed through anthropometric measures (weight and height) and bioimpedance analysis. Food consumption was evaluated through a 24 hour dietary recall. Leptin and insulin blood concentrations were measured. Spearmans correlation was made between the variables of food intake and concentrations of leptin and insulin
RESULTS: The average values found were : Mean age 15.68 years (± 1.41); body mass 67.62Kg (± 7.36), height 1.73m (± 0.07), BMI 22.31kg / m2 (± 1.61), fat free mass 78.25% (± 4.98), fat mass 21.35% (± 4.97). The mean energy intake was 2982.92 Kcal (minimum 1088.14, maximum 8608.43), protein intake was 124.51 g (min 60.26, max 338.00), lipids represented 90.43 g (min 27.50, max. 328.30), and carbohydrate intake was 402.09 g (min 110.90, max 1088.60). Median insulin and leptin concentrations were 6.6 mcU / mL (min 1.6 max 60.1) and 1.42 ng / mL (min 1.13, max 3.97). Moderate correlation between protein and carbohydrate intake with insulin concentration (0.656 and 0.644), and high between caloric intake and insulin (0.871). Moderate correlation was found between lipid intake and leptin concentrations (0.642).
CONCLUSION: The athletes food intake had moderate to high correlation to leptin and insulin concentrations, specially calorie intake relative to insulin. In our findings the anthropometric profile of the athletes was higher than that found in individuals of the same age (Shirali et al, 2016). In the literature it´s been reported the correlation between total energy intake and leptin concentration (Izadi et al, 2005), however, we did not find this correlation, as conveyed by other authors (Mars et al, 2005). An association between lipid intake and leptin has also been reported in other studies (Izadi et al, 2005), as we found in our results.
References: Position of the American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and Athletic Performance. (2016) Journal of the American Dietetic Association, 109(3), 509-527.
SHIRALI, S. et al. Effect of Caffeine Co-Ingested with Carnitine on Weight, Body-Fat Percent, Serum Leptin and Lipid Profile Changes in Male Teen Soccer Players: a Randomized Clinical Trial. (2016) International Journal of Pediatrics-Mashhad, 4(10), 3685-3698.
IZADI, V. et al. Dietary intakes and leptin concentrations. (2014) ARYA atherosclerosis, 10(5), 266.
MARS, M. et al. Decreases in fasting leptin and insulin concentrations after acute energy restriction and subsequent compensation in food intake–. (2005) The American journal of clinical nutrition, 81(3), 570-577.

COMPARISON OF DIET QUALITY AMONG RUNNERS ON VEGAN AND OMNIVORE DIET

PAROL, D., ŚLIŻ, D., SOBIECKI, J., MICHNOWSKA, I., WEŁNICKI, M., DĄBROWSKA, D., PAWŁOWSKA, M., KRÓL, W., BRAKSATOR, W., MAMCARZ, A.

MEDICAL UNIVERSITY OF WARSAW

INTRODUCTION: The vegan diet is gaining popularity among the amateurs and professional athletes. American research shows that many vegetarians believe that eliminating meat from the diet can improve their physical performance. Approximately 30% of marathoners declare thir temporary adherence to vegetarian diet. The aim of the thesis is to assess the influence of vegan diet on diet quality among amateur runners population.
METHODS: Comparison of occurrence of diet quality between vegan runners (n=44) and omnivore runners (n=54). Anthropometric measurements, body composition, and blood samples were collected for analysis. Participants were also obliged to keep the diary of their current diets for 4 days to analyse their intake.
RESULTS: The study group consumed 2647 ± 618.41 kcal and the control group 2408 ± 557.8 kcal (p = 0.0505). On a weight basis, 1.11 ± 0.30 g/kg of protein was consumed by vegans, while runners on mixed diet consumed 1.44 ± 0.41 g/kg of protein (p <0.0001). Runners on the vegan diet consumed less energy from fat (25.61 ± 9.81 vs. 31.69 ± 6.61%; p = 0.0006). Both groups had insufficient intake EPA and DHA. Median in the group of vegans was 0 mg, while in the group on the mixed diet 156 mg. Both LAs average diet energy intake was statistically significantly higher in the vegan group (7.12 ± 2.67 vs 4.04 ± 1.26%, p <0.0001) as well as ALA (1.30 ± 0, 91 vs 0.83 ± 0.61%; p <0.0001).
Intake of carbohydrates converted per kilogram of body weight was in the study group increased by 1.87 g/kg (5.70 ± 1.95 vs 3.83 ± 1.05 g/kg; p <0.0001). Also dietary fibre intake was more than doubled in the study group (61 ± 14 vs 27 ± 9 g; p <0.001).
The intake of most vitamins and minerals is adequate in both groups, generally higher in the group of runners on the vegan diet. With vitamins, the exception is the intake of vitamin B12, which was 69% lower in the study group (1.67 ± 1.67 vs 5.42 ± 5.36 mcg; p <0.0001) and vitamin D, which was 81% lower in the study group (34 ± 28 vs 183 ± 136 IU, 0.85 ± 0.71 vs 4.59 ± 3.39 mcg, p <0.0001). Observations of vitamin B12 intake are corelated with lower vitamin B12 levels (329.01 ± 26.08 vs 398.75 ± 28.41 pg/ml, p = 0.075) and higher homocysteine concentrations (16.04 ± 4. 99 vs 14.46 ± 5.72 mcmol/l; p = 0.0184) in vegans.
Calcium intake was 11% lower in the study group (758.1 ± 260.2 vs 887.8 ± 293.9 mg; p = 0.0265). However, due to the bioavailability, the supply of iron and zinc may raise doubts. Lower iron nourishment was indicated in blood tests. The median of ferritin level was significantly lower in the vegan group (56.64 vs 96.70 ng/ml, p = 0.0023), same with haemoglobin level (14.57 ± 1.29 vs. 15.11 ± 0.93 g/dl; p = 0.0224). Median of selenium levels in the control group were 90.98 mcg/l, while in the study group only 73.13 mcg/l.
CONCLUSION: The vegan diet is sufficient and the composition of this diet can be defined as healthy, but vegans are more likely to experience protein, calcium, selenium, iron and vitamin D i B12 deficiency.

17:15 - 18:30

Plenary sessions

PL-PS01 Muscles in Motion: Neural Determinants of Function

NEURAL STRATEGIES OF MOVEMENT REVEALED BY IN VIVO DECODING OF THE NEURAL DRIVE TO MUSCLES

FARINA, D.

IMPERIAL COLLEGE LONDON

Discharge timings of relatively large populations of active motor neurons can now be accurately identified in vivo in humans during natural movements, even in a non-invasive way. It is thus possible to derive an accurate estimate of the neural drive sent to multiple muscles during motor tasks. This possibility has opened new perspectives in the analysis of neural strategies for movement control. For example, the neural determinants of muscle force accuracy have been identified as relative contributions of common vs independent sources of synaptic input to motor neurons. The lecture will provide an overview of the technological advances in electrodes, biosignal processing, and modelling for the study of motor unit behaviour as well as of the physiological implications of recent experiments conducted with these advanced techniques. Moreover, a recent breakthrough in techniques for motor unit identification will be presented to prove the feasibility of tracking the same motor units over weeks during longitudinal training studies. The implications of this new approach for understanding the effects of motor training on the neural control of muscles will be exemplified by presenting results on endurance and high-intensity interval training.
Overall, the lecture presents a vast overview of the progression from the use of surface EMG signal as a global indicator of muscle activity to a source of detailed neural information, and the implications of this achievement for sports sciences.

NEUROMUSCULAR DETERMINANTS OF DIFFERENCES IN MANUAL DEXTERITY

ENOKA, R.M.

UNIVERSITY OF COLORADO, BOULDER

Introduction: As one of the biomarkers for motor function across the lifespan, manual dexterity is often quantified with a pegboard test. Pegboard times are fastest in young adults and slowest in individuals with neurological disorders. Understanding the attributes that contribute to differences in pegboard times provide insight on the adaptability of the neuromuscular system.
Explaining the Variance in Pegboard Times
Time to complete the grooved pegboard test (25 keyhole-shaped pegs) is fastest for young adults (18-36 yrs), slowest for old adults (65-89 yrs), and intermediate for middle-aged adults (40-60 yrs) (Marmon et al. 2011). The variables that can explain the variance in pegboard times differ for the three age cohorts but include selected aspects of force-matching tasks involving submaximal isometric contractions with hand and arm muscles, the time it takes to complete one or two of the four phases of each peg-manipulation cycle, and performance on a test of working memory (Almuklass et al. 2016, 2017; Hamilton et al. 2017).
Force Steadiness
One of the consistent explanatory variables for the variance in pegboard times is the amplitude of the force fluctuations (force steadiness) during submaximal isometric contractions with hand and forearm muscles. Based on the strong association between force fluctuations during steady isometric contractions and variability in the common modulation of motor unit discharge times (Farina and Negro, 2015), a statistically significant proportion of the variance in the pegboard times of old adults can be explained by the variance in the common synaptic input to motor neurons (Feeney et al. in revision).
Multiple Sclerosis
MS is a demyelinating disease that impairs signal transmission and compromises both motor and sensory function. Pegboard times, which are longer for individuals with MS, are predictive of disease progression. Most of the variance (78%) in pegboard times of people with MS can be explained by the time it takes them to select each peg from the well (Almuklass et al. 2017). However, modulation of sensory feedback-such as with the application of transcutaneous electrical nerve stimulation-can immediately reduce the pegboard times of individuals with MS (effect size: 0.71).
The studies to be discussed in the presentation will describe a framework that can be applied to other aspects of sensorimotor function and used to identify potential therapeutic targets.
References: Almuklass AM, Feeney DF, Mani D, Hamilton LD, Enoka RM. (2017). Exp Brain Res, 235, 3487-3493.
Almuklass AM, Price RC, Gould JR, Enoka RM. (2016). J Appl Physiol, 120, 1410-1417.
Farina D, Negro F. (2015). Exerc Sport Sci Rev, 43, 23-33.
Feeney DF, Mani D, Enoka RM. (2018). J Physiol, in revision.
Hamilton LD, Thomas E, Almuklass AM, Enoka RM. (2017). Exp Gerontol, 97, 9-16.
Marmon AM, Pascoe MA, Schwartz RS, Enoka RM. (2011). Med Sci Sport Exerc, 43, 560-567.
enoka@colorado.edu

Thursday, July 5th, 2018

08:00 - 09:30

Invited symposia

IS-PM06 Oxidative Stress, Redox Biology and Antioxidants in Exercise: What's New?

EXERCISE-INDUCED OXIDATIVE STRESS: HISTORY, CAUSE, AND CONSEQUENCES

POWERS, S.

UNIVERSITY OF FLORIDA

The observation that living cells produce free radicals was first reported in 1954 and this important discovery launched the field of free radical biology. The detection that contracting skeletal muscles produce reactive species followed in the 1980's and many studies have now confirmed that prolonged exercise is associated with an accumulation of oxidation products in the active muscles. This presentation will provide an overview of the history of research in exercise-induced oxidative stress and will highlight the potential causes and consequences of exercise-induced oxidant production. In particular, the sources of radical production in contracting muscles will be debated followed by a discussion of the role that radicals play in the regulation of skeletal muscle force production. Moreover, evidence that reactive species play a key role as signal transduction messengers in exercise-induced muscle adaptation will also be highlighted. Finally, the possibility that exercise-induced production of reactive oxygen species is an important player in epigenetic events in skeletal muscle will be introduced in hopes of stimulating future research.

NEW INSIGHTS INTO THE REDOX REGULATION OF MUSCLE ADAPTATION TO CONTRACTILE ACTIVITY

JACKSON M.

UNIVERSITY OF LIVERPOOL

Skeletal muscle responds to exercise by modifying the expression of genes involved in regulation of muscle structure, mass and energy metabolism. During ageing many of these responses are attenuated leading to poor adaptations to exercise. It is clear that exercising muscle generates superoxide and nitric oxide, and the reactive species derived from them, act as signalling agents that stimulate some adaptive responses to muscle contractions, but the extent of their involvement is unclear because the mechanisms by which these highly reactive molecules can target specific responses are not understood. Most studies in this area have assumed that reactive oxygen species directly activate adaptive signalling pathways. Hydrogen peroxide generated from superoxide dismutation appears to be the most important of these redox signalling molecules, but recent data have shown that only a small number of proteins, specifically the peroxidases, peroxiredoxins (Prx) and thioredoxins (Trx), can react with hydrogen peroxide at the concentrations found in cells. In some cell types these proteins have also been shown to have the capacity to transmit oxidising equivalents to other less reactive proteins by disulphide exchange, but this has not yet been shown for skeletal muscle. The potential of disulphide signalling to play a role in the responses of muscle to contractile activity, the role that Prxs and Trxs play in these processes and how they are disrupted during ageing will be discussed.

AN UPDATE ON ANTIOXIDANTS IN MUSCLE ADAPTATION TO EXERCISE TRAINING

GOMEZ-CABRERA, M.

UNIVERSITY OF VALENCIA

Physical exercise increases the cellular production of reactive oxygen species (ROS) in muscle, liver, and other organs. Originally, ROS were considered as detrimental and thus as a likely cause of cell damage associated with exhaustion. In the last decade, evidence showing that ROS act as signals has been gathered and thus the idea that antioxidant supplementation in exercise is always recommendable has proved incorrect (1). In fact, we proposed that exercise itself can be considered as an antioxidant because training increases the expression of classical antioxidant enzymes such as superoxide dismutase and glutathione peroxidase and, in general, lowering the endogenous antioxidant enzymes by administration of antioxidant supplements may not be a good strategy when training (2).

Antioxidant enzymes are not the only ones to be activated by training. Mitochondriogenesis is an important process activated in exercise (3). Many redox-sensitive enzymes are involved in this process. Important signaling molecules like MAP Kinases, NF-•B, PGC-1α, p53, Heat Shock Factor, and others modulate muscle adaptation to exercise. Interventions aimed at modifying the production of ROS in exercise must be performed with care as they may be detrimental in that they may lower useful adaptations to exercise (4).

References:

1. M. C. Gomez-Cabrera et al., J Physiol, (Jun 2, 2005).
2. M. C. Gomez-Cabrera, E. Domenech, J. Vina, Free Radic Biol Med 44, 126 (Jan 15, 2008).
3. M. C. Gomez-Cabrera et al., Am J Clin Nutr 87, 142 (Jan, 2008).
4. M. C. Gomez-Cabrera, A. Salvador-Pascual, H. Cabo, B. Ferrando, J. Vina, Free Radic Biol Med 86, 37 (Sep, 2015).

Oral presentations

OP-PM09 HEAT - THERMOREGULATION

FAKING THE HEAT: SUBJECTIVE THERMAL STRAIN IMPAIRS ENDURANCE PERFORMANCE IN A TEMPERATE ENVIRONMENT

VAN CUTSEM, J., ROELANDS, B., DE PAUW, K., MEEUSEN, R., MARCORA, S.

VRIJE UNIVERSITEIT BRUSSEL

INTRODUCTION: In addition to physiological strain, performing endurance exercise in the heat is associated with significant subjective thermal strain [1]. This strain is indicated by ratings of heat sensation, thermal discomfort and higher perceived exertion. Its possible role in the impairment of endurance exercise in the heat is however often ignored. The aim of this study was to dissociate subjective thermal strain from the physiological strain normally experienced during endurance exercise in the heat, and test the hypothesis that subjective thermal strain, by itself, impairs endurance performance in a temperate environment.
METHODS: In 20°C and 44% relative humidity, 12 endurance-trained athletes (1F 11M; mean ± SD; age:27 ± 6 y; VO2-max:61 ± 6 ml/kg/min; Wpeak:399 ± 54 W) performed a time to exhaustion (TTE) test in two different experimental conditions: with an electric heat pad applied to the subjects' upper back (HP) and control (CON: without heat pad). In both conditions, subjects cycled to volitional exhaustion at 70% of their VO2-max established in a preliminary incremental exercise test. Cardiorespiratory, metabolic, thermoregulatory and perceptual responses were measured throughout the TTE test and compared at 0%, 50% and 100% isotime and at exhaustion. Normality was checked, repeated measures ANOVAs were employed to observe interaction and/or main effects of condition and time during the TTE test. Follow up tests were performed where necessary. Paired t-tests assessed whether there was any effect of condition at exhaustion ($p<0.05$).
RESULTS: TTE was impaired by 9% in HP (2092 ± 305s) compared to CON (2292 ± 344s; $p=0.023$). At isotime, subjects rated thermal discomfort consistently higher in HP (-3.6 ± 0.3) compared to CON (-2.4 ± 0.4; $p=0.002$). Rating of perceived exertion showed an interaction between condition and time ($p=0.036$). None of the measured cardiorespiratory, metabolic and thermoregulatory variables differed between conditions.
CONCLUSION: HP was successful in inducing significant subjective thermal strain during endurance exercise in a temperate environment. Despite the absence of the physiological strain normally associated with heat stress, HP significantly impaired endurance performance (-9%). The most likely explanation for the shorter TTE in the HP condition is the higher perception of effort induced by the heat pad. These results provide additional evidence that subjective thermal strain is an important determinant of endurance performance rather than an epiphenomenon.
REFERENCES:
1. Nybo L, et al. Compr Physiol, 2014.
CONTACT:
jeroen.van.cutsem@vub.be

HEAT ACCLIMATION WITH CONTROLLED HEART RATE: EFFECTS OF HYDRATION ON ADAPTATIONS AND SELF-PACED EXERCISE IN A HOT HUMID ENVIRONMENT

TRAVERS, G.1,2, NICHOLS, D.2, RIDING, N.2, GONZÁLEZ-ALONSO, J.1, PÉRIARD, J.2,3

1. BRUNEL UNIVERISTY LONDON , 2. AHP , 3. UCRISE

INTRODUCTION: During heat acclimation (HA) with controlled hyperthermia dehydration may enhance adaptations to HA independently of heat stress via a fluid regulatory response, resulting in a protracted expansion of the vascular compartment (1). However, recent findings comparing the additional dehydration stimulus to euhydrated HA on haematological, thermoregulatory and cardiovascular adaptations are equivocal (2, 3). We therefore sought to characterise the adaptations to HA with and without dehydration and their effects on self-paced exercise performance.
METHODS: Seven males underwent two 10-day HA interventions (40°C, 40% RH) separated by ~six weeks in a randomised order. Each 90-min exposure consisted of 15-min cycling at 65% VO2max (174±22 W) followed by automated alterations in work-rate to maintain heart rate at the value associated with this intensity (145±7 bpm). Fluid intake was prescribed to either maintain body mass (-0.6±0.3%; HA-EUH) or elicit similar levels of dehydration (-2.9±0.5%; HA-DEH) each day. Changes in blood (BV), plasma (PV) and red cell (RCV) volumes were determined via CO rebreathing prior to each HA intervention and measured on days 1, 5 and 10 via venepuncture. A VO2max test (~20°C) and 30-min cycling time trial (35°C, 60% RH) were completed to determine the effects on exercise capacity and performance.
RESULTS: Resting BV, PV and RCV did not change across either HA intervention ($p>0.05$), but BV and PV were acutely reduced after DEH-HA exposures ($p<0.05$). 15-min heart rate and 90-min average skin temperature decreased ($p<0.05$), while mean heart rate and core temperature (38.4±0.2°C) were similar during the final 75-min of each day, regardless of hydration. Sweat lost increased with HA and power output during fixed heart rate exercise was lower in HA-DEH than HA-EUH ($p<0.05$). HA significantly increased VO2max (+3.2±0.4%, $p<0.05$), while 30-min time trial power output increased significantly in HA-EUH (+16±11 W, $p<0.05$), but not HA-DEH (+18±28 W, $p=0.18$). Heart rate, core and skin temperature responses and rating of perceived exertion were similar across all time trials, while sweat lost increased following both HA interventions.
CONCLUSION: The present findings demonstrate that moderate, transient dehydration with exercising heat stress do not enhance HA adaptations. Improvements in exercise performance may be due to the ability to maintain a similar relative intensity and evaporative heat loss for a greater level of metabolic heat production during self-paced exercise in the heat.
REFERENCES:
1. Patterson et al (2004). J Physiol 559, 327-334.
2. Garrett et al (2014). Am J Human Biol 26, 311-320.
3. Neal et al (2016). Front. Physiol 7, 564.

PASSIVE HYPERTHERMIA REDUCES MAXIMAL BUT NOT EXPLOSIVE TORQUE PRODUCTION

GORDON, R.J.F.H., TYLER, C.J., TILLIN, N.A.

UNIVERSITY OF ROEHAMPTON, LONDON

INTRODUCTION: Hyperthermia can reduce maximal voluntary force/torque (MVT) of skeletal muscle due to reduced neural activation (Todd et al., 2005). Rate of force/torque development (RTD) may be a more functionally relevant measure of neuromuscular performance than MVT; however, the effect of hyperthermia on RTD has received little attention. Primary determinants of RTD include neural activation and electrically evoked involuntary RTD (Maffiuletti et al., 2016), and whilst neural activation may decrease with hyperthermia, increased muscle temperature improves involuntary RTD, so it is unclear how voluntary RTD will be affected by hyperthermia. This study aimed to investigate the effects of progressive passive whole-body hyperthermia on MVT and voluntary RTD, as well as the neural and contractile factors contributing to any effects.
METHODS: Nine male participants completed two trials; one involving passive heating to a rectal temperature (Tre) of 39.5˚C (HOT) and the other (CON) where Tre was maintained at ~37˚C. The same neuromuscular measurements of the knee extensors were completed when participants first entered the chamber (Tre ~37˚C; Base), and at Tre=38.5˚C (ModHyp) and Tre=39.5˚C (SevHyp), in the HOT trial, and at equivalent time points into the CON trial. MVT, voluntary activation (VA) determined via interpolated twitch, and EMG at MVT normalised to maximal M-wave (EMGMVT) were measured during MVCs. Explosive voluntary RTD and normalised EMG were measured over 0-50 (RTD50; EMG50) and 0-100 (RTD100; EMG100) from torque/EMG onsets during explosive contractions. Involuntary RTD50 was measured during evoked octets at 300Hz.
RESULTS: In the HOT trial, MVT declined throughout and was 15% lower at SevHyp than Base (P=0.016), which coincided with declines in EMGMVT (-44%; P<0.005) and VA (-16%; P<0.005) from Base to SevHyp. In contrast, voluntary RTD50 and RTD100 remained unaffected in the HOT trial (P>0.05), despite 23-31% decreases in EMG50 and EMG100 from Base to SevHyp (P<0.001). Involuntary RTD50 however, increased from Base to ModHyp (10%; P<0.001) and from ModHyp to SevHyp (4%; P<0.001). There were no changes in any dependent variables throughout the CON trial.
CONCLUSION: As expected MVT declined as a result of passive hyperthermia which was largely due to reduced neural activation (i.e., EMGMVT and VA). In contrast, this study provides novel evidence that voluntary RTD was largely unaffected by passive hyperthermia, despite considerable reductions in explosive neural activation, which likely occurred due to the increased involuntary RTD, and thus cancelling out of neural and contractile effects.
References: Todd et al. (2005). J Physiol. 563.621-631.
Maffiuletti , et al. (2016). Eur J Appl Physiol. 116(6),1091-1116.
Contact: gordonr@roehampton.ac.uk

EFFECTS OF VARIATIONS IN AIR VELOCITY ON THERMOREGULATION AND ENDURANCE EXERCISE CAPACITY IN THE HEAT

OTANI, H.1, KAYA, M.2, TAMAKI, A.2, WATSON, P.3, MAUGHAN, R.J.4

1: HIMEJI DOKKYO UNIVERSITY , 2: HYOGO UNIVERSITY OF HEALTH SCIENCES , 3: VRIJE UNIVERSITEIT BRUSSEL , 4: UNIVERSITY OF ST ANDREWS

INTRODUCTION: Only one published study (Saunders et al. 2005) has systematically examined the effects of gradual variations in air velocity (0.2, 9.9, 33 and 50 km/h) on thermoregulatory responses during exercise in a hot environment (33°C, 59% relative humidity). However, this study measured heat storage, body temperature and sweat rate but did not assess exercise performance. The current study therefore investigated the effects of variations in air velocity on time to exhaustion and thermoregulatory and perceptual responses to exercise in a hot environment.
METHODS: Eight male volunteers completed an initial maximal exercise test, and, after a familiarization trial, four stationary cycle exercise trials at 70% peak oxygen uptake until exhaustion in an environmental chamber maintained at 30°C and 50% relative humidity. Four air velocity conditions, 30, 20, 10 and 0 km/h, were tested, and the headwind was directed at the frontal aspect of the subject by two industrial fans, with blade diameters of 1-m and 0.5-m, set in series and positioned 3-m from the subject's chest. Rectal temperature, skin temperature (chest, upper arm, thigh and calf), heart rate, skin blood flow, blood pressure, perceived thermal sensation and perceived exertion were recorded during exercise.
RESULTS: Mean±SD time to exhaustion was 90±17, 73±16, 58±13 and 41±10 min in the 30, 20, 10 and 0 km/h trials, respectively, and was different between all trials (P<0.05). There were progressive elevations in the rate of core temperature rise, mean skin temperature and perceived thermal sensation as airflow decreased (P<0.05). Core temperature, heart rate, cutaneous vascular conductance and perceived exertion were higher and evaporative heat loss was lower without airflow than at any given airflow (P<0.05). Dry heat loss and the change in plasma volume were similar between trials (P>0.05).
CONCLUSION: The present study demonstrates a progressive reduction in time to exhaustion in the heat as air velocity decreases. This response is associated with a faster rate of core temperature rise and a higher skin temperature and perceived thermal stress with decreasing airflow. Moreover, airflow greater than 10 km/h (2.8 m/s) might contribute to enhancing endurance exercise capacity and reducing thermoregulatory, cardiovascular and perceptual strain during exercise in a hot environment.
References: Saunders AG, Dugas JP, Tucker R, Lambert MI, Noakes TD. (2005). Acta Physiol Scand, 183: 241-255.
Contact: hotani@himeji-du.ac.jp

THERMOREGULATORY BURDEN IN ELITE SAILING ATHLETES DURING EXERCISE IN THE HEAT: A CROSS-OVER STUDY

VAN DELDEN, M.1, BONGERS, C.1, BROEKENS, D.2, DAANEN, H.3, EIJSVOGELS, T.1

1. RADBOUD UNIVERSITY MEDICAL CENTER 2. SAILING INNOVATION CENTRE 3. VRIJE UNIVERSITEIT AMSTERDAM

INTRODUCTION: Exercising in a hot and humid environment increases core body temperature, which may limit exercise performance. The risk of exercise-induced hyperthermia and associated performance decrement in Olympic sailing athletes is largely unknown. Therefore, this study aimed to compare thermoregulatory responses and performance indicators of elite sailors in a cool versus hot environment.
METHODS: A cross-over study was performed in which seven elite athletes from four different Olympic sailing classes (Laser, RS:X, Finn, 470) performed simulated sailing exercise in a cool (18.4±2.1°C) and hot (32.8±0.9°C) environment. Core body temperature (Tc), skin temperature (Tsk), exercise performance (covered distance), and rating of perceived exertion (RPE) were measured, and differences in maximal Tc and increase in Tc were calculated between the cool and hot environment.

RESULTS: The increase in Tc was significantly higher in the hot environment (37.6±0.2°C to 39.2±0.2°C) compared to the cool environment (37.5±0.1°C to 38.5±0.1°C; p=0.002), and the increase in Tc between the conditions differed substantially between individuals (range: 0.3°C – 0.9°C). Exercise performance decreased with 6.2±2.9% in the hot compared to the cold environment (p=0.013), and ranged from 2.3% to 9.5% across individuals. The decrease in exercise performance was significantly correlated with the increase in Tc in the hot environment (r=-0.76; p=0.047) and maximal Tc in the hot environment (r=-0.78; p=0.039). RPE (cool: 14.2±0.6; hot: 13.9±1.2) and increase in Tsk (cool: 0.5±1.0°C; hot: 0.9±0.3°C) did not differ between conditions (p=0.59 and p=0.36, respectively).
CONCLUSION: As expected, a larger increase in Tc and a substantial exercise performance decrement were observed in the hot versus cool environment. More importantly, large inter-individual differences were observed across athletes, which stresses the importance of appropriate and personalized interventions to reduce thermoregulatory burden in elite sailors during exercise in the heat.

HEAT ACCLIMATION AUGMENTS PEAK POWER OUTPUT AND THERMOREGULATORY RESPONSES IN THERMONEUTRAL BUT NOT HYPOXIC CONDITIONS

SOTIRIDIS, A.1,2, DEBEVEC, T.1,3, CIUHA, U.1, EIKEN, O.4, MEKJAVIC, I.B.1

1: JOZEF STEFAN INSTITUTE , 2: JOZEF STEFAN IPS , 3: UNIVERSITY OF LJUBLJANA , 4: ROYAL INSTITUTE OF TECHNOLOGY

INTRODUCTION: Heat acclimation (HA) mediates numerous cardiovascular, thermoregulatory and cellular adaptations (Corbett et al. 2014). While HA is known to enhance exercise performance in the heat, it remains unresolved whether this beneficial effect of HA is reflected in the performance in thermoneutral normoxic and/or hypoxic conditions. Accordingly, we explored the effects of HA on exercise cardiorespiratory and thermoregulatory responses in thermoneutral normoxic, hypoxic, and hot conditions.
METHODS: Twelve trained males participated in a 10-day HA protocol comprising daily 90-min controlled-hyperthermia (target rectal temperature, Tre = 38.5°C) exercise sessions. Before and after HA, the subjects conducted a cycle-ergometry test in normoxic (23°C, 50% RH, 20.9% FiO2; NOR), hypoxic (23°C, 50% RH, 13.5% FiO2; HYP) and hot (35°C, 50% RH, 20.9% FiO2; HE) conditions in a randomized and counterbalanced order. The tests comprised two stages: a 30-min steady-state exercise followed by incremental-load exercise to exhaustion. The steady-state exercise was performed at 40% NOR peak power output (Wpeak) to evaluate submaximal responses.
RESULTS: HA attenuated the submaximal exercise Tre and HR response. However, HA did not affect VO2max or maximal cardiac output in either condition. Wpeak was increased in NOR and HE by 41±21 and 26±22 W, respectively but not in HYP (pre: 282±28, post: 294±26 W). HA increased the ventilatory threshold in NOR only. Exercise economy was higher whereas resting Tre and sweating thresholds were lower in all environments. The gain of the sweating response was attenuated in the HYP condition.
CONCLUSION: HA improved Wpeak and thermoregulatory responses in HE and NOR, but not in HYP. Given that VO2max remained unaltered, the increase in Wpeak in both NOR and HE could be related to the improved exercise economy and ventilatory threshold (only in NOR) (Jones & Carter 2000) as well as to the lower resting Tre (Hessemer et al. 1984).
REFERENCES:
Corbett J, Neal RA, Lunt HC, Tipton MJ (2014) Adaptation to heat and exercise performance under cooler conditions: a new hot topic. Sports Med 44 (10):1323-1331.
Hessemer V, Langusch D, Bruck LK, Bodeker RH, Breidenbach T (1984) Effect of slightly lowered body temperatures on endurance performance in humans. J Appl Physiol Respir Environ Exerc Physiol 57 (6):1731-1737.
Jones AM, Carter H (2000) The effect of endurance training on parameters of aerobic fitness. Sports Med 29 (6):373-386

Oral presentations

OP-PM10 CEREBRAL FLOW / HEMODYNAMICS

A DECREASE IN CEREBRAL BLOOD FLOW IS NOT RESPONSIBLE FOR DECREMENTS IN COGNITIVE FUNCTION DURING INTENSE EXERCISE

ANDO, S., KOMIYAMA, T., TANOUE, Y., SUDO, M., COSTELLO, J., UEHARA, Y., TANAKA, H., HIGAKI, Y.

UNIVERSITY OF ELECTRO-COMMUNICATIONS

INTRODUCTION: During mild to moderate exercise, cerebral blood flow (CBF) increases in response to neuronal activity and metabolism. However, during intense exercise, hyperventilation-induced hypocania constricts blood vessels and restricts CBF (Ogoh & Ainslie 2009). This implies that reduction in CBF may compromise cerebral metabolism, thereby compromising cognitive function. Carbon dioxide (CO2) is a potent cerebral, but not muscle, vasodilator (Subduhi et al. 2011) and CO2 inhalation selectively increases CBF without altering other physiological variables (Subudhi et al. 2011). Therefore, the purpose of this study was to examine the role of CBF in cognitive impairment during intense exercise. We hypothesized that maintaining CBF during intense exercise, through inhalation of hypercapnic gas, would prevent any reductions in cognitive function.
METHODS: Seventeen healthy male participants (22.1 ± 1.7 years) took part a within participant, balanced cross-over design. Cognitive function was assessed using an executive function task that incorporated a combination of a spatial delayed-response task and a Go/No-Go task (Komiyama et al. 2017). Middle cerebral artery mean velocity (MCAv) was measured continuously. Cognitive function was assessed at rest and during moderate (50% peak oxygen uptake) and intense (80% peak oxygen uptake) cycling with or without hypercapnic gas inhalation. In the hypercapnic gas condition, the participants breathed hypercapnic gas (2% CO2) during intense exercise. As a control, we assessed cognitive function in the same time course while sitting on the cycle ergometer.
RESULTS: MCAv increased during moderate exercise (67.6 ± 10.0 cm/s, $P < 0.01$) as compared with rest (57.7 ± 11.6 cm/s) and decreased during intense exercise (57.2 ± 7.7 cm/s, $P = 0.85$, vs. rest). In contrast, MCAv did not decrease during intense exercise with hypercapnic gas (69.4 ± 10.6 cm/s, $P < 0.001$, vs. without hypercapnic gas). Accuracy of the cognitive task was impaired during intense exercise (84.1 ± 13.3 %) as compared with rest (95.1 ± 5.3 %, $P < 0.01$). The impairment was not altered when MCAv increased during intense exercise with hypercapnic gas (85.7 ± 11.6 %, $P = 0.68$, vs. without hypercapnic gas). These results indicate that cognitive function was impaired during intense exercise even when CO2 inhalation restored CBF.
CONCLUSION: Restoration of CBF, using hypercapnic gas inhalation, did not restore cognitive function during intense exercise. These novel findings suggests that the reduction in CBF per se is not responsible for impaired cognitive during high intensity exercise.

HEMODYNAMICS DURING THE MUSCLE METABOREFLEX FOLLOWING A SINGLE SESSION OF EXERCISE UNDER NORMOBARIC HYPOXIA

CRISAFULLI, A., SAINAS, G., MAGNANI, S., ROBERTO, S., MANNONI, M., TOCCO, F., GHIANI, G., PINNA, V., DONEDDU, A., MULLIRI, G.

UNIVERSITY OF CAGLIARI

INTRODUCTION: Available normobaric hypoxic ventilatory circuits has provided useful tools to induce arterial hypoxemia during exercise. These devices expose the athletes to bouts of hypoxemia suddenly followed by normoxia when the hypoxic stimuli is removed. The body homeostasis is then continuously perturbed. We conducted this investigation to assess hemodynamic response to the metaboreflex (MM) activated during normoxia immediately after a bout of exercise under acute hypoxia (EAH). We hypothesised that a session of EAH would lead to a reduction in systemic vascular resistance (SVR) response and dampen the increment in mean blood pressure (MBP) during the MM recruited following EAH.
METHODS: Ten trained subjects (4 females, age 22-45 yrs) were recruited. They underwent randomly assigned one session (10 min) of training in normoxia (TN) and two sessions of EHA with FiO2 at 15.5% and at 13.5% respectively. After training sessions, they underwent randomly assigned the following protocol: MM activation test, consisting in a post-exercise (cycling) muscle ischemia protocol (PEMI)(1), or a control exercise-recovery (CER) session. Hemodynamics were evaluated with of impedance cardiography. The hemodynamic response due to MM activation was assessed by calculating the difference PEMI minus CER in each cardiovascular variable.
RESULTS: The main results were that the two sessions of EAH significantly reduced the stroke volume (SV) response during the MM activation (+5.0±5.7 vs. –10.6±8.7 and –9.1±3.2 ml for TN and EAH with FiO2 15.5% and 13.5% respectively), while the SVR was increased (-8.1±206.6 vs. +323.5±264.7 and +318.6±229.1 dynes·s-1·cm-5). Moreover, ventricular filling rate (VFR) response, a measure of diastolic flux, was reduced during the MM activation following EHA. Finally, the MBP response during the MM activation was unchanged following EHA.
CONCLUSION: Contrary to our initial hypothesis, this investigation provides evidence that the capacity to regulate MBP by modulating SVR is not affected during the MM activation after EHA. Rather, the capacity to centralise blood volume by increasing venous return is impaired following EAH. This occurrence can explain the reduced SV response found after EAH. These findings support the concept that diastolic functions are important to sustain circulation during the MM recruitment(2).
References: 1. Crisafulli et al. Med Sci Sport Exerc 2003; 35:221-228.
2. Roberto et al. J Appl Physiol 2017; 122:376-385.
Contact: crisafulli@tiscali.it

CEREBROVASCULAR RESPONSES TO RESISTANCE AND ENDURANCE TRAINING IN MONO-ZYGOTIC TWINS

THOMAS, H.J., SMITH, K.J., MARSH, C.E., HAYNES, A., CORRERIA, M.A., SHKREDOVA, D., NAYLOR, L.H., GREEN, D.G.

THE UNIVERSITY OF WESTERN AUSTRALIA

INTRODUCTION: Cerebral blood flow and pressure regulation are critical determinants of brain health. We compared the impacts of endurance and resistance training on cerebrovascular function in mono-zygotic (MZ) twins to determine the heritability of cerebrovascular adaptation to distinct modes of exercise. We hypothesized that cerebrovascular responses to a standardized change in perfusion pressure would be highly correlated in MZ twin pairs, regardless of training intervention.
METHODS: Healthy female MZ twin pairs (n=18) underwent 3-months of both progressive overload resistance and endurance training (3x per week 70-90% 1RM and 60-90% VO2max respectively) separated by a 3-month washout. Middle cerebral artery velocity (MCA) was assessed using transcranial Doppler ultrasound, with arterial blood pressure measured using photo-plethosmography, during a 3-min squat (hypertensive): stand (hypotensive) manoeuvre at fast (0.33 Hz) and slow (0.16 Hz) oscillatory frequencies. Comparisons of hypertensive and hypotensive perfusion pressure ranges (squat-minus-stand) were performed. Vascular duplex ultrasound in the internal carotid artery (ICA) was also performed pre- and post-training to quantify volumetric changes in cerebral perfusion in response to each training modality.
RESULTS: Resting ICA flow (233 ± 8.8 ml.min-1 vs 251 ± 14 ml.min-1) and MCA velocity (79 ± 2.2 cm.s-1 vs 79 ± 0.2 cm.s-1) did not differ pre vs post endurance training. Similarly, ICA flow (232 ± 0.5 ml.min-1 vs 241 ± 9.6 ml.min-1) and MCA velocity (85 ± 9.4 cm.s-1 vs 76 ± 17 cm.s-1) did not differ pre vs post resistance training. Resistance training reduced the MCA response during the 0.33 Hz squat manoeuvre (2.1 ± 0.74 cm.s-1; $p < 0.05$), whilst both resistance (2.1 ± 0.99 cm.s-1) and endurance (2.09 ± 0.99 cm.s-1) training reduced the MCA response over the 0.16 Hz squat-stand range ($p < 0.05$). Correlation between twin pair responses to squat-stand in the MCA were significant following endurance ($r2 = 0.62$, $p = 0.001$), but not resistance, training.
CONCLUSION: Exercise training, regardless of mode, improved cerebral perfusion in response to imposed pressure oscillations by nearly 20%. Our concordant twin pair analysis in individuals who share 100% of their DNA indicates that endurance training adaptations are more heritable than the adaptations induced by resistance training. Our novel approach to studying cerebrovascular adaptation to exercise training can be used to reveal genetic versus environmental contributions to the regulation of cerebral blood flow in humans.

HEMODYNAMICS MONITORING IN CROSS COUNTRY SKIERS OF DIFFERENT AGES FOR INDIVIDUAL TRAINING PLANNING DESIGN

ZAKHAROVA, A., TARBEEVA, N.

URALS FEDERAL UNIVERSITY

INTRODUCTION: In modern cross country skiing the distances' shortening and hereto related performance intensity increase are seemed to downgrade the endurance demand in skiers. At the same time we must realize that in modern conditions of hypodynamia and everyday well-being natural motor activity of children and adolescents does not provide the sufficient development of the cardiovascular system. The lack of outdoor games, agricultural and house work, hiking and walks in the forest causes low endurance not only in athletes during initial training but in teenagers and young adults. So skiers' hemodynamics must be under monitoring to avoid overreaching and benefit the endurance training process.
METHODS: Cross country skiers (n=120, age from 11 to 20) underwent hemodynamics monitoring with MARG 10-01 (Microlux, Russia) based on impedance cardiography. Hemodynamics data were automatically registered by beat-to-beat record during an active orthoclinostatic test. Following hemodynamics parameters were under consideration: HR at supine and standing, stroke volume (SV, ml), end-diastolic volume (EDV, ml) and their indices (SI, ml/m2 and EDI, ml/m2), ejection fraction (EF, %) (all of them at supine and standing) as well

as volemia, inotropy (heart contractility) and vascular tone. The monitoring procedure was the same for all objects but different sets of indicators were considered in different age athletes groups.
RESULTS: Firstly, we determined the hemodynamics age norms. Secondly, in young cross country skiers 12-14 years old analysis of HR, SV, EDV and inotropy allowed to divide them into 3 groups with different training focus: (1) low aerobic fitness: SV< 70 ml, EDV<110 ml; (2) normal fitness with high inotropy: HR< 65 bpm, SV>70 ml, EDV >110, inotropy > 45; (3) normal fitness with inotropy less than 40%. Different training design were suggested to every group. Regular hemodynamic monitoring (once per 3 months) assisted to individualize training, transferring athletes from one group to another according obtained monitoring results, thus avoiding inadequate cardiac adaptation. Ideally all the athletes should train in group 3.
During growth spurt in teenagers HR in 3 positions of orthoclinostatic test are under analysis while all the hemodynamic parameters are used for the individualization of endurance-building training in application to 15-17 years old skiers and elder considering the age norms. Special attention should be paid to the hemodynamics indices in standing position.
CONCLUSION: The hemodynamic monitoring data in cross country skiers allow to rate the individual limitations in athletes of different ages and efficiently achieve the relevant corrective training effects.

Invited symposia

IS-PM08 Joint Injury and the Development of Post-traumatic Osteoarthritis

CARTILAGE RESPONSES TO ACUTE JOINT INJURY

BRAMA, P.
UNIVERISITY COLLEGE DUBLIN

Articular cartilage responds differently to injury than other tissues. Unlike other tissues, cartilage has no direct blood supply, lymphatic drainage, or innervation. Cartilage has an extremely slow regeneration rate, and although matrix flow is described as an intrinsic cartilage repair process for small defects, chondrocytes cant really migrate within the matrix to the site of injury over any significant distance. Thus, in partial-thickness cartilage injury the repair response remains limited or non-existent. However, the more recent discovery of progenitor cells in the surface layers of articular cartilage holds great promise and challenges the traditional concept of intrinsic and extrinsic cartilage repair.
In articular cartilage defects that penetrate the subchondral bone, a reparative response is generated. Initial granulation tissue is converted into fibrocartilage or a mixture of hyaline cartilage and fibrocartilage at best. However, fibrocartilage has weaker mechanical properties, cannot distribute forces as well, and, over time, is prone to fibrillation and breakdown. Therefore, damage to articular cartilage, with or without damage to the underlying subchondral bone, has long-lasting consequences and contributes to the development of post-traumatic osteoarthritis. Thus, it is of critical importance that clinicians have a complete and contemporaneous understanding of the inflammatory and repair responses of articular cartilage resulting from acute joint injury.
Animal models are useful in obtaining a better understanding of acute cartilage injury but translational capacity into human athletes and the human sports medicine discipline is very limited in most animal models of acute joint injury. The horse however is an exemption since it performs at levels of athleticism very similar to human athletes, engages with similar biomechanical challenges and has a fast developing research active discipline of equine sports medicine. Therefore it is essential to look across species towards the equine sports medicine discipline when working with human athletes. In this presentation an overview is presented what we have learned from acute articular cartilage injury models in the horse over the years. Additionally, some recent results and advanced diagnostic technologies from the authors research group using repeated bilateral low dose LPS induced joint inflammation models and acute articular cartilage defect models in the horse will be presented.
Finally, results will be discussed in the light of current treatment regimens and an algorithim of treatment options in the horse athlete in comparison with the human athlete. What have equine sports medicine vets learned from human sports medicine medics and vice versa. Importantly, how can the horse athlete as a model and end user provide solutions for the critical problem of athletes longevity in humans regarding articular cartilage injury and the ultimate goal of prevention of prevention of development of post-traumatic osteoarthritis.

TO STABILIZE OR NOT - HEALTH AND STRUCTURAL CONSEQUENCES OF ANTERIOR CRUCIATE LIGAMENT INJURY

FROBELL, R.
LUND UNIVERSITY

This talk will cover health and structural consequences of knee injury, with specific emphasis on ACL injury, from an evidence based perspective. The burden of knee injury in terms of general incidence, prevalence and health economy will be discussed as well as the current evidence on treatment. Should all active individuals with an acute ACL tear consider ACL reconstruction as their primary treatment option or are results after a "wait and see" treatment algorithm comparative? Is there a difference in treatment strategies between professional and recreational high level athletes and, if so why? Patient expectations and wishes will be related to what actually could be expected, again from a scientific perspective.
The long term structural consequence of knee injury is osteoarthritis (OA) but this talk will highlight changes that occur within the first years after injury and that may, or may not, be related to OA development. Findings from imaging- and biochemical reports, especially regarding inflammation and the development of bone shape of the knee, will be highlighted

STRATEGIES TO FORESTALL THE DEVELOPMENT OF SPORTS-RELATED POST-TRAUMATIC OSTEOARTHRITIS

VAN MIDDELKOOP, M.
ERASMUS MC - UNIVERSITY MEDICAL CENTER ROTTERDAM

INTRODUCTION: Certain types of sports injuries are known to have a high association with the development of osteoarthritis. Post-traumatic osteoarthritis is especially disabling because of its early onset in life affecting a young and active population. The aim of this talk is to present an overview on the current evidence of risk factors for post-traumatic osteoarthritis and to give direction to future prevention of sports-related post-traumatic osteoarthritis.

METHODS: This lecture will discuss factors involved in the development and progression of post-traumatic osteoarthritis. The identification of these factors is especially important since early detection may improve the prognosis and minimize the costs due to unnecessary diagnostics and later functional loss. Studies investigating risk factors for post-traumatic knee and ankle osteoarthritis will be presented and identified factors will be evaluated in the light of treatment and prevention strategies to be applied in clinical practice.
RESULTS: Most research has been done in the knee in athletes with ACL injuries. It was for example recently shown that progression of cartilage defects does occur in up to 27% of patients two years after an anterior cruciate ligament injury. Perhaps more striking is that signs of early stage osteoarthritis are seen in almost half of the patients with a lateral ankle sprain after 6 to 12 months. Some factors have been associated with the development and progression of post-traumatic osteoarthritis in the different joints. The identification of these factors is especially important in order to be able to identify those individuals at higher risk for the development of osteoarthritis.
CONCLUSION: Recent literature has given us some direction on who is at risk to develop post-traumatic osteoarthritis, especially of the knee and ankle. Though, future studies are needed to investigate effective preventive strategies in athletes with traumatic injuries.

Oral presentations

OP-BN03 NEUROMUSCULAR

NEURAL MODULATION DURING SUBMAXIMAL DORSIFLEXION OF DIFFERENT CONTRACTION TYPES IN YOUNGER AND OLDER ADULTS

ŠKARABOT, J., ANSDELL, P., BROWNSTEIN, C., HOWATSON, G., GOODALL, S., DURBABA, R.

NORTHUMBRIA UNIVERSITY

INTRODUCTION: Lower electromyographic (EMG) activity, reduced motor evoked potentials (MEPs) and depressed H-reflexes are typically observed with eccentric (ECC) contractions in comparison with isometric (ISO) and concentric (CON) contractions, suggesting a unique modulation strategy is adopted by the central nervous system (CNS) [1]. Aging is associated with several alterations within CNS, including changes in cortical neurons and reductions in response from afferent sensory receptors to spinal motor neurons [2], which may account for greater declines in motor performance during ECC [3]. Accordingly, this study aimed to assess whether neural modulation of different contraction types is preserved in older age.
METHODS: Fifteen younger (26 ± 4 yrs, 7 females) and 14 older (64 ± 3 yrs, 5 females) adults performed ISO, CON and ECC dorsiflexions at 25 and 50% of contraction type specific maximums. Percutaneous nerve and transcranial magnetic stimulations were delivered at anatomical zero. H-reflex and MEP amplitudes, normalised to maximal muscle response (H/M and MEP/M, respectively), and cortical silent period (CSP) duration were assessed in tibialis anterior (TA).
RESULTS: Maximal dorsiflexor force was greater during ECC compared to CON or ISO ($p < 0.001$), but was not age dependent ($p > 0.05$). Mean EMG was greater in older compared to younger individuals at the same relative intensity and contraction type ($p < 0.05$), and greater during CON compared to ISO or ECC contractions in both groups ($p < 0.001$). H/M was greater during CON compared to ISO or ECC at 25 and 50% MVC ($p = 0.02$), and younger adults exhibited greater H/M during ISO and CON at 50% MVC compared to older adults ($p = 0.02$). MEP/M was greater during CON compared to ISO or ECC during 25% ($p < 0.005$) and compared to ISO during 50% ($p = 0.026$), with no age group differences. Older adults exhibited longer MEP and H-reflex latencies compared to younger ($p < 0.05$). No differences in CSP were observed ($p > 0.05$).
CONCLUSION: The findings show that in TA, CON was differently modulated compared to ECC and ISO, which may be specific to the task or muscle studied [4]. This trend was not age-related, suggesting that neural modulation of different contraction types is preserved with aging. However, the older CNS may be associated with compensatory changes as evidenced by greater EMG activity, but lower spinal excitability, and prolonged conduction velocity and/or transmission efficacy compared to younger.
References: 1. Duchateau, J. & Enoka, R. 2016. J Exp Biol 219, 197-204.
2. Hunter, S.K. et al. 2016. J Appl Physiol 121, 982-995.
3. Enoka, R. et al. 2003. J Electromyogr Kinesiol 13, 1-12.
4. Abbruzzese, G. et al. 1994. J Physiol, 481 499-507.

NEUROMUSCULAR RESPONSES AFTER FREQUENT BLOOD FLOW RESTRICTED RESISTANCE EXERCISE PERFORMED TO VOLUNTARY FAILURE VS SUBMAXIMALLY

VÅRVIK, F.T.1, GERBI, S.2, LINDBERG, K.2, MANGSETH, H.2, SØRLI, T.2, WERNBOM, M.3, BERNTSEN, S.2, FIMLAND, M.S.1, PAULSEN, G.4, RAASTAD, T.5, BJØRNSEN, T.2

1 NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY, 2 UNIVERSITY OF AGDER, NORWAY, 3 UNIVERSITY OF GOTHENBURG, SWEDEN, 4 NORWEGIAN OLYMPIC FEDERATION, 5 NORWEGIAN SCHOOL OF SPORT SCIENCE

INTRODUCTION: High-frequent blood flow restricted resistance exercise (BFRRE) performed to failure has been shown to increase muscle size with loads as low as 20% of 1 repetition maximum (1RM) (1). However, voluntary muscle activation and rate of muscle activation (RMA) was reduced during the BFRRE intervention and did not return to baseline levels before 12 days of detraining. Thus, the purpose of the present study was to compare the neuromuscular responses after a failure protocol versus a less strenuous submaximal protocol during high-frequency BFRRE.
METHODS: Nineteen untrained men and women (23.5±6.1 years old) performed BFRRE with four sets to voluntary failure with one leg, and a submaximal protocol with 20, 10, 10 and 10 repetitions with the other leg, using unilateral knee extensions (20% of 1RM). A 145mm wide pressure cuff was used to restrict blood flow (100 mmHg pressure). The intervention consisted of 14 BFRRE sessions distributed over two blocks of seven sessions (5 days), separated by 10 days of rest. Peak muscle activation and RMA (0-30, -50, -100, -150, -200 and -250ms) were assessed by surface electromyography in m. rectus femoris (RF) and m. vastus lateralis (VL) during maximal voluntary isometric contraction at baseline, in the rest period and at 3 (Post 3), 10 (Post 10), 17 (Post 17) and 24 (Post 24) days after the last BFRRE bout.
RESULTS: No group differences were detected in changes of peak muscle activation. However, both protocols increased peak muscle activation of VL from baseline to Post 10 (failure: 18.4%, submaximal: 18.4%), and Post 24 (failure: 17.7%, submaximal: 22.5%) ($p <0.05$). Only the submaximal protocol increased in peak muscle activation to Post 3 (15.7%), while the failure protocol increased 15.3% to Post 17 ($p <0.05$). No significant increases were observed in peak muscle activation of RF. Over the time course of the study, RMA in VL at 0-30, -

50, and -100ms decreased in the submaximal group compared to the failure group ($p < 0.05$). Furthermore, RMA 50ms in RF decreased to Post 24 in the submaximal group compared to the failure group (34.5%, $p < 0.05$).
CONCLUSION: We did not observe any differences between the protocols in the increases of peak muscle activation. RMA was reduced in the submaximal protocol after 17 to 24 days of detraining. Increases in strength after high-frequent low-load BFRRE could be partly explained by neurological factors, however, the increases in peak muscle activation did not peak before 10 (failure) and 24 (submaximal) days of detraining in the present study, which could indicate an overreaching effect. Future research should investigate if a less strenuous BFRRE protocol could be more potent to increase peak muscle activation during high-frequency BFRRE.
References: 1. Nielsen et al., (2017) MEDICINE & SCIENCE IN SPORTS & EXERCISE 49(6):1157-1167
Contact: ftvaarvik@gmail.com

NEUROMUSCULAR ADAPTATIONS TO LONG TERM MUSCLE DISUSE IN UNILATERAL TRANSTIBIAL AMPUTEES

SIBLEY, A., STRIKE, S., MOUDY, S., TILLIN, N.

UNIVERSITY OF ROEHAMPTON

INTRODUCTION: Current understanding of the effects of muscle disuse on neuromuscular function is based on short-term (<120 days) intervention studies (Narici & de Boer, 2011). Unilateral transtibial amputees (TTAs) habitually load the quadriceps muscles of their amputated limb considerably less than their intact limb during ambulation (Fey & Neptune, 2012); thus, TTAs provide a useful model for investigating the long-term (>120 days) effects of muscle disuse. This study aimed to compare neuromuscular function and architecture in the quadriceps muscles of the amputated (AMP) vs. intact limb (INT) of TTAs, and in both limbs compared to aged matched-controls (CON).
METHODS: Participants (5 TTAs and 6 aged-matched controls) were recreationally active males. Voluntary maximal and explosive isometric contractions of the knee extensors were performed on an isokinetic dynamometer, to measure maximum voluntary torque (MVT; measures maximum strength) and peak rate of torque development (RTD; measures explosive strength). Electrically evoked involuntary (300 Hz octet) contractions assessed intrinsic contractile properties. Neural activation at MVT was assessed by the interpolated twitch technique (VA), and by EMG amplitude normalised to maximal M-wave (EMG-MVT). Explosive neural activation was also measured by normalised EMG over the first 100 ms of explosive contractions (EMG0-100). Static ultrasound images of the vastus lateralis muscle were captured to measure muscle thickness (MT), pennation angle (θ) and fascicle length (Lf).
RESULTS: AMP had lower MVT (-52%; p=0.034) and RTD (-66%; p=0.047) than INT, whilst INT had lower MVT (-37%; p=0.070) and RTD (-52%; p=0.031) than CON. VA and EMG-MVT were lower (-39%, VA; -44%, EMG-MVT; $p<0.05$), but EMG0-100 similar (p=0.534), in AMP vs. INT, whilst VA, EMG-MVT, and EMG0-100 were all similar for INT vs. CON. AMP showed lower octet peak torque (-64%, p=0.019); absolute (-64%, p=0.002) and relative octet RTD (-26%, p=0.002); Lf (-40%, p=0.022); and MT (-48%, p=0.005) than INT. Peak octet torque was lower in INT vs. CON (-42%; p=0.040), but there were no differences in absolute or relative octet RTD, MT or Lf between these two limbs. All limbs were similar for θ.
CONCLUSION: The declines in strength in the AMP vs. INT limb of TTAs (-52%, MVT; -66% RTD) due to long-term habitual disuse, are considerably greater than typically observed in short-term disuse intervention studies (-23%; Narici & de Boer, 2011); and were coupled with considerable reductions in neural activation, MT, Lf, and a shift towards slower intrinsic contractile properties. Further study with a larger sample size is required to fully understand the mechanisms of the lower strength in the INT vs. CON limbs.
REFERENCES:
Fey NP, Neptune RR (2012) Clin Biomech 27, 409-414
Narici MV, de Boer MD (2011) Eur J Appl Physiol 111, 403-420

ACUTE EFFECTS OF DIFFERENT EXERCISE MODALITIES ON ANKLE FORCE AND MOTION SENSE

SMAJLA, D., TOMAŽIN, K., STROJNIK, V.

UNIVERSITY OF LJUBLJANA

INTRODUCTION: Different exercise modalities are often performed at the same exercise unit where former activity may influence later one. This information is important for proper planning a sequence of exercise modalities. The purpose of the present study was to determine acute effects of different exercise modalities on ankle force and movement sense.
METHODS: Seventeen participants (23,5±1,9 years, 67,6±11,6 kg, 174±6,8 cm) volunteered the study. Each participant performed familiarization protocol before measurements. After that, each of them visited the laboratory 4 times. Each visit contained measurements before and after intervention protocol. Between measurements, subjects performed randomly selected intervention protocols (static stretching, balance task, strength exercise, no intervention). Intervention protocols were designed to target the ankle joint. In static stretching they performed 6 static stretches for 40 s (each muscle). Balance task contained one leg stance on Airex mat (4x4x20 s), while in strength exercise subject performed plantarflexion and dorsiflexion (30% RM, 25-30 rep.).
Sense of movement was measured in sitting positon on device driven by electromotor in plantarflexion-dorsiflexion direction with velocity of 0,5°/s. Participants pressed hand-held switch when they felt ankle movement. In force sense test, participants were asked to perform isometric contractions (5 s) equivalent to 10% and 30% of the maximal isometric voluntary contraction (plant. and dors. direction). First repetition of each force was performed with visual information, while second was performed without visual information (result: abs. error).
Arithmetic mean and standard deviation were calculated for sense movement angles and absolute errors of force sense test. Samples involved in this study represented abnormal distribution (K-S test), so we used nonparametric methods for examination of stat. differences (Wilc. ranks test). Cronbach alpha was used to determine the reliability of tests.
RESULTS: The results of measurements without intervention indicated good reliability (Cronbach alpha: 0,8-0,96). Acute effects on ankle movement sense were shown after strength exercise (improved sensibility for plantarflexion and dorsiflexion, $p<0,05$) and after static stretching (reduced sensibility for dorsiflexion, $p<0,05$). Balance task did not have influence on ankle movement sense in this case. In force sense tests, there were no statistical significant differences, but there was a tendency for greater absolute errors after static stretching.
CONCLUSION: The main outcomes of the study revealed greater influence of different exercise modalities on ankle movement sense than on force sense. Among exercise modalities representing different neuromuscular activation strategy, strength intervention (activation strategy) improved motion sense while static stretching (damping strategy) reduced it. This should be considered when different consecutive exercise modalities are performed at the same exercise unit.

POPULATIONS OF LONGITUDINALLY TRACKED MOTOR NEURONS INCREASE THEIR DISCHARGE RATE FOLLOWING FOUR WEEKS OF ISOMETRIC STRENGTH TRAINING

DEL VECCHIO, A., CASOLO, A., NEGRO, F., BAZZUCCHI, I., CONTI, A., FELICI, F., FARINA, D.
IMPERIAL COLLEGE LONDON

INTRODUCTION: It has been argued that strength training results in an increase in the neural drive to the muscle (1). However, the specific motor unit adaptations following training remain unknown. In this study we tracked the behavior of large populations of motor units with recent developed techniques (2) following four weeks of isometric strength training by using high-density surface EMG decomposition.
METHODS: Twelve male subjects performed four weeks of isometric ankle-dorsiflexion strength training. Moreover, eleven subjects were recruited as controls. Training involved 30 ballistic contractions (as fast as possible) and 30 gradually increasing contractions up to 75% of maximal voluntary force (MVC) with a plateau of 3 s. The main trial measurements consisted of linearly increasing ramp contractions up to 70% MVC and isometric ballistic force contractions. The steady state phase of the ramp contractions lasted ten seconds. The myoelectrical activity of the tibialis anterior muscle was recorded with one high-density surface EMG grid of 64 electrodes. The EMG signals were decomposed into individual motor unit action potentials. Additionally, the motor unit action potentials were tracked pre- and post-strength training and associated to voluntary force.
RESULTS: The results from the training are from a preliminary cohort of 8 subjects and for the ramp contractions only. The total number of tracked motor units was 312, with an average of 38 ± 16 per subject. The maximal voluntary strength increased significantly following training [pre: 306.4 ± 35.2 to post: 349.2 ± 32.6 (N), $P<0.001$]. The training intervention did not change the absolute force value at which individual motor units were recruited ($P>0.05$), although the recruitment thresholds normalized with respect to MVC decreased (by 7.8 ± 4.2 %MVC on average, $P<0.001$). The motor unit discharge rate at recruitment and de-recruitment did not change ($P<0.05$). On the other hand, the average motor unit discharge rate during the plateau of the ramp contractions increased after training [17.2 ± 1.34 vs 19.9 ± 1.2 (pps), $P<0.001$].
CONCLUSION: Four weeks of isometric ankle-dorsiflexion strength training decreased the recruitment thresholds and increased the discharge rate of motor neurons innervating the tibialis anterior muscle. The present results may be interpreted as an increase in the synaptic input to the motor neuron pool following training.
1) Aagaard et. al., J Appl Physiol, 2002.
2) Martinez-Valdes et. al., J Physiol, 2016.

THE EFFECT OF SHANK ADDITIONAL MASS ON THE MUSCLE RECRUIT CHARACTERISTIC OF LOWER LIMB DURING MAXIMAL SPEED IN SPRINTING

ZHUANG, W., YU, J., LIU, Y.
SPORT PERFORMANCE RESEARCH CENTER

INTRODUCTION: Studies have found that muscle activities, pre-activation and co-contraction may reflect the adjustments made by the nervous system with the changes of conditions (e.g. load). Based on our previous researches, with the increment of running speed, the leading joint at stance phase is distal joint (ankle joint), and change to proximal joint (hip joint) at swing phase. Therefor, adding mass on athlete's shank may train different joint at different phases, which is more targeted than traditional methods. This study aims to investigate the recruit characters of lower limb muscles with this training method.
METHODS: Three-dimension motion capture system (200Hz) and force plate (1000Hz) were used to record the kinematics and kinetics data of 13 elite sprint athletes at their maximum speed in track field. Electromyography of Rectus Femoris, Vastus Medialis, Vastus Lateralis, Biceps Femoris were recorded (4000Hz). Additional mass was 10% and 15% of shank mass. A stride was divided into four phases: braking, propulsion, swing ahead, swing backward. Pre-contact phase was defined as 50ms before contact the ground. One way repeated ANOVA was used to examine the effect of different mass($p<0.05$).
RESULTS: (1) In the pre-contact phase, the Root Mean Square EMG of Rectus Femoris increased which is contrary to the other three muscles. Besides, the co-contraction of hip and knee muscles enhanced during this phase. (2) The activity contribution ratio of Rectus Femoris decreased significantly ($p<0.05$) in the swing ahead phase between without and 10% additional mass conditions. To Biceps Femoris, the activity contribution ratio of propulsion phase increased both in two additional mass conditions ($p<0.05$, $p<0.05$).
CONCLUSION: Nervous system makes corresponding adjustments to the additional mass on shank. It presented as the increment of muscle pre-activity and co-contraction level, the muscle activity contribution under different phase also changes. This resisted-training method may exercise the contraction ability of special muscles for sprint effectively, which turns out will advance athletic performances.

Oral presentations

OP-MI02 SOCCER

RELIABILITY, VALIDITY, AND SENSITIVITY OF COMMONLY USED FIELD-BASED FITNESS TESTS IN YOUTH SOCCER PLAYERS

DUGDALE, J.H., ARTHUR, C.A., HUNTER, A.M.
UNIVERSITY OF STIRLING

INTRODUCTION: Identification and development of talented youth athletes is a crucial process in maximising chances for future competitive success (Hulse et al., 2013; Paul and Nassis, 2015). Whilst evaluation of physical capacities through field-based fitness tests in senior players is well established, the effectiveness of this method of testing to evaluate and discriminate within a youth population remains inconclusive (Paul and Nassis, 2015). We aimed to establish test-retest reliability, validity, and sensitivity of commonly used field-based fitness tests in youth soccer players.
METHODS: Three-hundred-and-seventy-three Scottish youth soccer players (U11–U17) from 3 different playing standards (amateur, development, performance) completed a battery of commonly used field-based fitness tests (grip dynamometry, standing broad jump, countermovement vertical jump, 505/T-test change of direction (COD), and 10/20m sprint tests) on two separate occasions within 6–14 days.

RESULTS: The field-based fitness tests selected within this study proved to be reliable measures of physical performance (ICC=.912-.968; p<0.01). However, sprint and COD tests showed weaker reliability in younger participants (ICC=.567-.787; p<0.01) compared to other measures. Moreover, discriminant function analysis revealed that, when controlling for age, the selected testing battery successfully discriminated between 'amateur' (unidentified) and combined-'development' and 'performance' (identified) playing levels; Chi-square (7) = 101.646, p<0.01. Inspection of the canonical correlation coefficients revealed that standing broad jump (r=.754) and 505 COD (r=.541) performance were the strongest contributors to the discriminant function, with the canonical correlations from the other tests all being <.4. All tests were sensitive to performance improvements resultant of chronological age progression, except from between U11/U12 and U15-U17 age groups.
CONCLUSION: Results from this study promote the use of field-based fitness tests as reliable measures of physical performance in youth soccer players. However, COD tests may be less suitable for younger players, potentially due to the lack of familiarity of the movements required and the limited training age established by these players. Whilst the testing battery selected in this study was able to discriminate between 'identified' and 'unidentified' players, the strongest and therefore best tests for discriminating were the standing broad jump and 505 COD tests, with the other tests being less influential. Future research should further investigate jump and COD components of field-based fitness testing batteries as a means of more explicitly differentiating between competitive playing standards.

STRENGTH DEVELOPMENT OF HAMSTRING AND QUADRICEPS MUSCLES IN HIGH LEVEL YOUTH SOCCER PLAYERS

ROTH, R.
UNIVERSITÄT BASEL

INTRODUCTION: Appropriately developed lower leg strength is a relevant prerequisite for high level soccer players, both from a performance as well as from an injury prevention perspective. Particularly the thigh muscles are considered most relevant in this regard. Isokinetic assessment of leg flexor (hamstrings) and extensor (quadriceps) muscles is frequently applied in order to identify imbalances between agonists and antagonists as well as between limbs (standing vs. kicking leg) (Kyritsis et al., 2016). A deeper understanding of the development of thigh strength and asymmetries from late puberty to full maturation may support fitness staff in soccer academies to prepare their talented players for the upcoming demands. Therefore, the aim of this cross-sectional study was to analyze the isometric and isokinetic strength of hamstring and quadriceps muscles in elite-level youth soccer players.
METHODS: 102 male soccer players of the same professional club (under-15: N=18; age=14.7 (SD 0.3) years; body mass=54.7 (9.1) kg; under-16: N=23; age=15.5 (SD 0.7) years; body mass=63.6 (6.6) kg; under-17: N=19; age=16.6 (SD 0.3) years; body mass=67.7 (7.3) kg; under-18: N=22; age=18.0 (1.12) y; body mass=71.7 (7.3) kg; under-21: N=21; age=18.7 (0.8) y; body mass=68.7 (6.6) kg;) agreed to take part in a cross sectional study. Strength of hamstrings (H) and quadriceps (Q) were measured on an isokinetic device (IsoMed 2000) at a speed of 60°/s, 240°/s (concentric) and -30°/s (eccentric) (Croisier et al., 2003) and in an isometric condition at 60° knee angle. H:Q-ratios were calculated for both dominant (kicking leg) and non-dominant (standing leg) at 60°, 240° and the functional ratio (-30°/240°). Magnitude-based inferences were calculated for differences between the dominant and the non-dominant leg.
RESULTS: Isokinetic and isometric hamstring and quadriceps strength increased with the age of players. No relevant differences occurred between the kicking and the standing leg for quadriceps strength at all team levels and in all testing conditions (most likely trivial, -0.18
CONCLUSION: Our results show that an unequal development in physical strength values over age categories can occur in young high-level soccer players with older players showing smaller differences H:Q-ratios between legs. Regular assessment and corresponding strength training regimes may contribute to decrease strength asymmetries and, thereby, to prevent injuries and to prepare the players regarding muscular loads associated with elite soccer.

LET THE KIDS #PLAYMORE: EVALUATION OF A NEW MATCH FORMAT IN U-11 SOCCER TO INCREASE THE INDIVIDUAL PLAYING TIME AND GAME INVOLVEMENT

HINTERMANN M.
SWISS FEDERAL INSTITUTE OF SPORT, MAGGLINGEN

INTRODUCTION: To improve soccer specific skill acquisition the match play in children's soccer should be designed to maximize the individual playing time and game involvement. Small-sided games showed an increased individual playing time, individual game involvement, number of ball contacts, variability and frequency of game situations, and positional changes (Buszard et al., 2016, J Sports Med). Playing on a larger pitch however showed increased position specific demands, movement patterns in width and depth and number of long passes (Katis & Kellis, 2009, J Sports Sci Med; Silva et al., 2014, J Hum Kin). Therefore, the aim of the study was to evaluate a new match format combining games with a smaller number of players and pitch size (COMBINED 4 vs. 4 and 7 vs. 7) with the traditional 7 vs. 7 match format on the regular pitch size for U-11 soccer players (TRAD).
METHODS: Four teams with a total of 45 young male soccer players (age: 9.9±0.5) completed both match formats on two separated days. The pitch size was adapted according to the number of players involved. The TRAD match play was performed for 3 x 20min on the regular pitch size. The COMBINED match play involved 4 x 8min with 4 vs. 4 players (pitch size: 20m x 30m) followed by 3 x 15min with 7 vs. 7 players with regular pitch size (44.5m x 30m). Local positioning data were collected for the total distance covered, high-intensity distance, and acceleration. To examine technical actions the matches were video captured and subsequently analyzed for the number of ball contacts, passes, goals, shots on goal, and duels. All data were analyzed with a pairwise comparison using SPSS.
RESULTS: The number of ball contacts were significantly higher in COMBINED compared to the TRAD (3.05 ±1.58 vs. 1.89±0.63 per player/min, respectively; P<0.001). There were similar results regarding duels (0.29±0.18 vs. 0.17±0.11 per player/min; P<0.001) and passes (0.89±0.42 vs. 0.65±0.20 per player/min). From significantly more shots on the goal (0.15±0.11 vs. 0.06±0.06 per player/min), followed a four times higher chance to score in COMBINED compared to TRAD (0.04±0.05 vs. 0.01±0.01 per player/min; P<0.001). The high-intensity distance covered was significantly reduced with the COMBINED compared to TRAD (7.43±3.79 vs. 12.34±4.71 m, respectively; P<0.001). Also the total distance covered was lower with the new COMBINED match format (83.84±13.86 vs. 90.99±19.09 m; P<0.01).
CONCLUSION: The new match format combining matches with 4 vs. 4 and 7 vs. 7 players improved the variability, frequency of game situations and individual playing time by increasing the number of ball contacts, duels, and shots on the goal per player. However, high-intensity distance and total distance covered were reduced. The new COMBINED game format might be beneficial for the players' technical skill development. However future research needs to investigate the long term effects and the impact of the new match format on the training practice.

EFFECTS OF TABATA TRAINING MODEL ON SPRINT PERFORMANCE OF ADOLESCENT SOCCER PLAYERS

BAYRAM, I., AKDOGAN, E., CERRAH, A.O.

ANADOLU UNIVERSITY

INTRODUCTION: High Intensity Interval Training (HIT) has been widely used by the coaches for many years. Remarkable well-documented data is available related the physiological adaptations responsible for both aerobic and anaerobic performance. In contrast, little is known concerning the effects of HIT on field tests, especially sprint performance. In this regard, the aim of this study was to investigate the effects of HIT on 10m, 20m, 30m and repeated sprint performance of adolescent soccer players.
METHODS: 20 healthy soccer players participated in the study and randomly assigned as Training Group [TG (age:16.90±0.74 years, weight:61.80±8.97 kg height: 1.71±0.06 cm)] and Control Group [CG (age:17.10±0.74 years, weight:60.88±8.39 kg height: 1.73±0.06 cm)]. While CG (n=10) followed the regular soccer training (3 days a week), the TG (n=10) performed a gradually increasing Tabata training program after the regular training. Electronic timing gates (Smart Speed; Fusion Sport Pty, Ltd, Brisbane, Queensland, Australia) were used to evaluate 10m, 20m, 30m and repeated sprint performance of adolescent soccer players before and after the training period.
RESULTS: The data showed a normal distribution for all the parameters of pre and posttest. Independent Sample T Test results for pretest between TG and CG showed that there were no statistical differences for 10m (p=.927), 20m (p=.706), 30m (p=.763) and repeated sprint tests (p=.770) which means groups were distributed equally. There were also no statistical differences for 10m (p=.961), 20m (p=.427), 30m (p=.946) and repeated sprint tests (p=.473) for post test results. Applying a Paired Sample T Test, pre and post test results have been calculated within groups. Comparison of pre and post test results of CG showed that there were no statistical differences for 10m (p=.332), 20m (p=.309), 30m (p=.231) and repeated sprint tests (p=.462). Unlikely, comparison of pre and post test results of TG showed statistical differences for 10m (p=.044) and 30m (p=.007), but not for 20m (p=.775) and repeated sprint tests (p=.672). Statistical significance was taken as $p<0.05$ in all test.
CONCLUSION: Both TG and CG improved their 10m, 20m and 30m sprint performances with different amounts. It seems only 10m (p=.044) and 30m (p=.007) performance of the TG was statistically significant. Therefore, we conclude that Tabata training-induced positive outcomes are effective on 10m and 30m sprint performance. Interestingly, we observed that repeated sprint performance of both TG and CG groups were worse at the posttests. The reason for that might be the existing stress on the players because of the ongoing competition period. For better results, Tabata exercises should be applied for longer periods (i.e. 8 weeks, 12 weeks) and maybe out of season, also tested by using other field performance tests such as vertical jump, agility and/or Yo-Yo IR1 test.

REPRODUCIBILITY OF EXTERNAL LOAD OF UNDER-19 SOCCER PLAYERS IN A MEDIUM-SIDED GAME

CLEMENTE, F.M.1,2, RABBANI, A.3, KARGARFARD, M.3, PINTO, N.4

1IPVC, ESDL , 2INSTITUTO DE TELECOMUNICAÇÕES , 3FSS, UI , 4CDN

INTRODUCTION: Variability of physical stimulation should be a concern during sided-games. The purpose of this study was to examine the reproducibility of the performance variables during 5vs.5 with small goal, when completed within the same session and between two different sessions
METHODS: Ten field under-19 male soccer players (18.27±0.47 yo; 71.42±6.89 kg; 177.78±5.63 cm) participated in this study. The 5x5 was played twice with a 3-day interval in the same week. The 5x5 was played in a pitch of 30x30 m with a small goal in the middle of the ending line. The regimen of the sided-game was 3x5 minutes/2 minutes of rest. The games were played in the same natural turf, with temperatures of 14-16 C° and relative humidity of 60-70%. The variables of total distance (TD), running distance (RD; 14.0-20.0 km/h), and player load (PL) were monitored with GPS units (10 Hz, JOHAN Sports).
RESULTS: Moderate between-session variations were observed for TD (range, Coefficient of variation CV, 6.9; 8.3%, Confidence interval CI, [5.0; 14.0], standardized typical error, STE, 0.68; 1.06, [0.64; 1.75]) and RD (range CV, 53.3; 145.7%, [36.6; 338.9], STE, 0.83; 1.09, [0.60; 1.76]) for all three sets and their accumulated values. However, PL showed small variations (range CV, 4.9; 6.0%, [3.6; 10.1], STE, 0.37; 0.43, [0.27; 0.71]) in all sets and accumulated values as the most reliable measure. In within-session analyses for examining differences between sets, a small decrease was observed in RD in set 3 versus set 2 (-14.8%, 90%CI [-32.1; 6.9%]; standardized difference ES: -0.39[-0.95; 0.16]). TD decreased with moderate (-3.5%, [-6.8; -0.1%]; ES: -0.65[-1.30; -0.01]) and large (-8.2%, [-11.4; -4.9%]; ES: -1.58[-2.24; -0.92]) effects in set 2 and 3 versus set 1, respectively. A moderate decrease was also observed in set 3 versus set 2 for TD (-4.9%, [-8.1; -1.5%]; ES: -0.93[-1.58; -0.29]). PL decreased with small (-3.5%, [-5.2; -1.8%]; ES: -0.24[-0.36; -0.12]) and moderate (-10.6%, [-14.3; -6.6%]; ES: -0.76[-1.06; -0.47]) effects in set 2 and 3 versus set 1, respectively. A small decrease was also observed in set 3 versus set 2 for PL (-7.3%, [-10.9; -3.6%]; ES: -0.52[-0.79; -0.25]).
CONCLUSION: PL is the more reproducible variable. Coaches can be confident in to use 5x5 to apply a consistent training load. However, must be aware of greater noise that may occur in specific variables associated with running intensity, thus some conditions should be used in sided-games to ensure a more stable demanding. Regarding the variation of performance variables between sets it was verified a progressive decreasing tendency on the results. Coaches must consider to rethinking the recovery strategies or the training regimen to ensure a more stable performance across the sets.
Acknowledgements
We would like to thank to JOHAN Sports. This work is funded by FCT/MEC through national funds and when applicable co-funded by FEDER - PT2020 partnership agreement under the project UID/EEA/50008/2013.
Contact: Filipe.clemente5@gmail.com

Oral presentations

OP-MI05 Wearables and new technology

ASSESSMENT OF FOURTEEN PLAYER TRACKING SYSTEMS FOR CONCURRENT VALIDITY AGAINST A COMPUTER VISION SYSTEM IN ECOLOGICALLY VALID MATCHES IN A LARGE STADIUM (FIFA EPTS).

AUGHEY, R.J., BALL, K.A., DUTHIE, G.D., ELLENS, S., SERPIELLO, F.R., VARLEY, M.C., ROBERTSON, S.J., EVANS, N.

VICTORIA UNIVERSITY

INTRODUCTION: We were contracted by FIFA to establish the concurrent validity of fourteen commercially available athlete tracking systems consisting of global, local and optical tracking systems, during friendly matches played at an international stadium. The tracking systems were compared to a bespoke computer vision system, itself previously validated by us against VICON at the same stadium used here.
METHODS: Following ethical approval, 28 teams competed in a total of 17 matches over a 10-d period. In each of fourteen matches, player position and movement data was simultaneously obtained from one athlete tracking system and compared to computer vision. Validity was established via the root mean square error (RMSE) and mean bias for instantaneous velocity, velocity in selected velocity bands, and derived mean acceleration.
RESULTS: A small number of manufacturers achieved satisfactory concurrent validity against computer vision for instantaneous velocity (RMSE <0.5 m.s-1), six systems were marginal (RMSE >0.5 but <1.5 m.s-1) and four had poor validity (RMSE > 1.5 m.s-1). As player velocity increased, concurrent validity decreased as expected. No systems obtained satisfactory concurrent validity against computer vision for mean acceleration.
CONCLUSION: The data presented here is unique as an ecologically valid comparison of many manufacturers against a validated system during matchplay in a challenging but controlled stadium environment. Local and global positioning systems performed best, but no system was able to be concurrently validated across all parameters tested.

USING A HEART RATE MONITORS IN THE WATER, IS IT RELIABLE?

THIEL, D.1, SYKORA, K.2, NEMECEK, V.2

1, 2 FACULTY OF PHYSICAL EDUCATION, CHARLES UNIVERSITY, PRAGUE

INTRODUCTION: Heart rate monitors (HRM) are commonly used tool for monitoring physiological response to exercise also in the swimming. HRM are used to estimate exercise intensity based on a percentage of the individual maximum heart rate (HRmax). Correct estimation of HRmax is crucial for the assessment of the proper training zone. Heart rate (HR) can be influenced by environment temperature, humidity, daytime and also body surrounding environment including water. Previous studies (Kruel, 1994; Onodera, 2010; Fujishima et al., 2001) have shown different HR response related to water condition. HRM companies do not provide information about the readjustment of HR in the water. Purpose of this study is to examine the influence of the water environment on the resting heart rate.
METHODS: This is a quantitative study conducted by comparing the values of heart on the land and in the water of 34 athletes with experiences from water sports and swimming (age 23.7 ± 1.8 years). Heart rate was measured for five minutes in the static position on the back (water = 26 cm, water temperature 30.4 ± 0.2° C, air temperature 23.4 ± 0.4° C). Parametric unpaired Student t-test has been used for calculation of statistical significance have (p = .05). The threshold for estimation of the practical significance of heart rate variance has been established at ±3 beats per minute.
RESULTS: Results of parametric unpaired Student t-test did not indicate a statistically significant difference of resting heart rate in the water and on the land (p = .080-.925). Heart rate decreased at least 3 beats per minute in ten people, increased at least 3 beats per minute in seven people, or stayed in the range of ±3 beats per minute in 13 people.
CONCLUSION: Estimation of HR training zone is influenced by the accuracy of HRmax estimation. Both HR and HRmax can be affected by exercise environment. Our study has shown that the body water immersion has not influenced resting HR. It is necessary to realize that HR dynamic can be changed by the exercise intensity in the water. Providing information about adjustment of HR in the water could be used for accuracy using.
References:
Kruel, L. F. M. (1994). Hydrostatic weight and heart rate in subjects immersed at different water depths. Unpublished master dissertation. Santa Maria. Federal University of Santa Maria, Brazil (In Portuguese).
ONODERA, S. Relationship between heart rate and water depth in the standing position. Biomechanics and Medicine in Swimming?, 2010, 11: 213-214.
Fujishima, K., Shimizu, T., Ogaki, T., Hotta, N., Kanaya, S., Shono, T., & Ueda, T. (2001). Thermoregulatory responses to low-intensity prolonged swimming in water at various temperatures and treadmill walking on land. Journal of physiological anthropology and applied human science, 20(3), 199-206.

A VIRTUAL REALITY BASED PITCHSIDE BALANCE ASSESSMENT FOR CONCUSSION

GREY, M.J., WILKINSON, M.R.

UNIVERSITY OF EAST ANGLIA

INTRODUCTION: Current guidelines require athletes to be removed from competition or practice on suspicion of concussion. Standard concussion assessments rely primarily on self-reporting of symptoms in combination with neurocognitive evaluation. Balance dysfunction has been recognised as one of the few non-cognitive markers of concussion. However, current balance procedures are expensive and laboratory-constrained or inexpensive, but subjective. We have recently developed an inexpensive tool to assess balance using the Oculus Rift Virtual Reality (VR) headset to induce a visual perturbation and a Wii Balance Board (WBB) to measure the balance response. The objective of the study was to quantify the balance response as a function of speed and axis of rotation of the visual perturbation.
METHODS: Sixty participants were recruited to the study (37F, 23M, age: 19.5 ± 1.3y). Participants were exposed to a virtual environment resembling an office with a large white board central to their field of view. To focus their attention, participants were asked to complete a stroop test using the names of colours displayed on the white board. After a few seconds, the virtual environment was rotated by 22.5 deg about the roll or pitch axes, at one of four speeds between 4.5-11.25 deg/s). The visual perturbation produced a balance response

that was quantified by analysis of the centre of pressure (CoP) comparing the path length of the response before and after the perturbation.
RESULTS: The visual perturbation produced an effective balance perturbation that could be adequately quantified by the CoP data recorded with the WBB, with balance affected up to 12s after the perturbation. Two-way repeated measures ANOVA revealed a significant effect of perturbation speed ($p<0.001$, $F2.8, 80.3= 17.453$, $\eta p2 =.376$), and rotation axis ($p< 0.001$, $F2.87 = 17.605$, $\eta p2 =.288$) with post-hoc analysis revealing a much greater effect for perturbations about the roll axis compared with the pitch axis ($p<0.001$).
CONCLUSION: Manipulating axis and speed of perturbation significantly affected the CoP response. This study confirms that the VR-WBB prototype is an effective system to induce a perturbation and obtain quantifiable balance responses. With further refinement, this tool will be a useful addition to the pitchside assessment of concussion.

RELIABILITY OF BODY SHAPE CHANGES IN MULTIPLE TEST SESSIONS BY A SIMPLIFIED THREE-DIMENSIONAL SCANNING SYSTEM

CHIU, C.Y., SANDERS, R.H.2

1: SHEFFIELD HALLAM UNIVERSITY, 2: THE UNIVERSITY OF SYDNEY

INTRODUCTION: Monitoring anthropometric changes of athletes enables assessment of the effect of training (Kerr, Ackland, & Schreiner, 1995). Recently, many companies have produced simplified 3D scanning systems which enable measurement of anthropometric data rapidly and automatically. The repeated reliability and accuracy of the simplified 3D scanning system has been determined by comparing with traditional manual measurement (Bourgeois et al., 2017). The previous research has been limited to determining the reliability by conducting the 3D scanning repeatedly in only one test session. However, the participants' postures and protocols relating to breathing may vary across test sessions. The purpose of this study was to examine the inter-session reliability of measuring changes in waist girth measurements using a simplified 3D scanning system.
METHODS: Traditional manual measurement and 3D scanning techniques were used to obtained anthropometric data from 58 Year 7 male participants in two test sessions. The time between the first test session and second test session was around 12 weeks. The differences of waist girths between the first and second test sessions acquired from the traditional manual measurement were compared to the differences obtained from the 3D scanning system by using pair sample t-Test, intra-class correlation coefficient and root mean square error.
RESULTS: There is no significant difference between the changes of waist girths acquired from the traditional manual measurement and the changes obtained from the simplified 3D scanning system (p-value > 0.05). Therefore, the simplified 3D scanning system could be used to understand the body shape change for a group of athletes. The intra-class coefficient showed 'fair' agreement (0.48) and the root mean square error between the changes of traditional manual measurement and the ones of the simplified 3D scanning system was considerably large (2.51 cm).
CONCLUSION: The results showed that further development is required to minimize the effect of participants' postures and breathing conditions in multiple test sessions before tracking individual body shape changes by this kind of 3D scanning system.
REFERENCE:
Bourgeois, B., Ng, B. K., Latimer, D., Stannard, C. R., Romeo, L., Li, X., . . . Heymsfield, S. B. (2017). Clinically applicable optical imaging technology for body size and shape analysis: comparison of systems differing in design. European Journal of Clinical Nutrition. doi:10.1038/ejcn.2017.142
Kerr, D., Ackland, T., & Schreiner, A. (1995). The elite athlete-assessing body shape, size, proportion and composition. Asia Pacific Journal Clinical Nutrition, 4(1), 25-30.

ROW YOUR BEAT: THE DEVELOPMENT OF AN INNOVATIVE AUDITORY FEEDBACK PLATFORM FOR ROWING PERFORMANCE

LINTMEIJER, L.L., HUIBERTS, S.C., HOFMIJSTER, M.J., BEEK, P.J.

VRIJE UNIVERSITEIT AMSTERDAM IN COLLABORATION WITH THE HKU UNIVERSITY OF THE ARTS UTRECHT - MUSIC AND TECHNOLOGY

INTRODUCTION: Rowing performance (i.e. the average shell velocity) can be analysed in terms of a power equation describing what part of a rower's mechanical power output contributes to shell velocity and what is lost to other factors [1] . To optimize performance, valid quantitative feedback can now be provided on parameters related to this equation [2,3]. However, this digital feedback is less effective to alter time-dependent coordinated movement patterns such as crew synchronization and rhythm of the boat, both of which are considered important determinants of rowing performance [4].
Auditory feedback improves performance and acquisition of temporal aspects more effectively than visual feedback and may therefore preferred when seeking to enhance synchronisation and rhythm in rowing. Previous studies have transformed the boat acceleration signal into sonified form in order to improve the rowing rhythm [5,6], but the resulting audible sine wave was often experienced by rowers as annoying and distracting. In this project we aimed to develop auditory feedback on boat motion and rythm in a manner that is experienced as comfortable and motivational to listen at and act upon.
METHODS: We developed an Android platform that connects rowing data to Audiokinetic Wwise SoundBanks. Via a machine learning algorithm the boat acceleration signal is used to detect the start of the stroke cycles. During the drive phase the acceleration signal triggers a transparent yet forceful sound to indicate boat movement. The drive-recovery rhythm is indicated via drum patterns in the rhythm of the current stroke being based on the average rhythm of the three previous strokes. In other words, an integrated feedback and feedforward loop simultaneously prescribes the rhythm of the boat while being dependent on the movements of the rowers. After the app was found to be stable and functional, we examined the experiential feel of training with this auditory feedback in a pilot study involving 4 first year rowers.
RESULTS: The rowers experienced the feedback as motivational and helpful. They indicated that the feedback aided them in keeping a constant rhythm and that is was easier to synchronize rowing movements.
CONCLUSION: In this project we developed auditory feedback that was found pleasant and motivating to use in a small sample of relatively inexperienced rowers. Although we did not yet formally test the effect of the feedback on rowing performance and crew synchronization, both the qualitative results as well as some preliminary obtained data indicated that the feedback altered crew synchronization. Experiments are planned to test these promising initial findings.
References: [1] Hofmijster, MJ (2010). VU Amsterdam.
[2] Lintmeijer, LL, et al (in press). J. Sports Science.

[3] Lintmeijer LL, et al (submitted). Int. J Phys Performance.
[4] Cuijpers, LJ, et al (2016). Scand J Med Sci Sports,1-8.
[5] Schaffert et al (2011). J Hum Sports Exc, 2 (6)
[6] Lintmeijer, LL, et al (2015). BMC Sports Sc, Med Reh, 7 (1).

PROCESSING ACCELEROMETER DATA OF CHILDREN AND ADOLESCENTS - INFLUENCE OF WEAR TIME ALGORITHM, EPOCH LENGTH AND CUT-OFF POINTS ON AGE SPECIFIC SUBGROUPS

ANEDDA, B., ALBRECHT, C., BURCHARTZ, A., ORIWOL, D., SCHMIDT, S., WOLL, A.

KARLSRUHE INSTITUTE OF TECHNOLOGY

INTRODUCTION: In order to determine physical activity (PA) in free-living conditions the most common used objective method is accelerometry. Large-scale epidemiologic studies frequently use "counts" derived from the ActiGraph device to classify PA. The PA outcome is influenced by different parameters set during data collection and data processing. The aim of this study was to analyse the effect of epoch length (EL), wear time (WT) algorithm and cut-off points (CP) on PA outcome for age specific subgroups within the sample of the Motorik-Modul-Study (MoMo) (Woll et al., 2017).
METHODS: 1,848 children and adolescents between the age of 6 and 17 (N(male) = 901, N(female)=947) wore either ActiGraph GT3x+ or ActiGraph wGT3X-BT as part of the examination throughout the nationwide MoMo survey "Wave 2" (2014-2017). The participants wore the device during all waking hours on 8 consecutive days. The device was placed laterally at the hip and data was sampled with a frequency of 30Hz. Afterwards data was downloaded and converted into one second epochs using ActiLife. Further data processing was done in MATLAB. Data was reintegrated into 5, 15 and 60 second epochs and Troiano (Troiano et al., 2008) and Choi (Choi et al., 2011) WT algorithms were applied. PA outcome was determined using different CPs commonly used for the specific age groups (Evenson et al., 2008, Freedson et al., 2005, Hänggi et al., 2013, Romanzini et al., 2014).
RESULTS: In contrast to the results found in existing literature the MoMo data shows no effect of EL on activity count outcome. Data shows that EL does affect total WT when using the Troiano algorithm but does not affect total WT when using the Choi algorithm. Applying 8h-WT-criterion leads to 13% more valid data sets than 10h-WT-criterion. EL and CP have a significant effect on PA classification leading to differences in the prevalence of adherence to the PA recommendations by the WHO of up to 50% for certain age groups.
CONCLUSION: The discrepancy between results from this study and existing literature (Logan et al., 2016) on the effect of EL on activity count outcome could be due to the calculation of the Vector Magnitude (VM) when integrating data. Choi WT algorithm should be preferably used over Troiano algorithm when data is reintegrated and compared to different ELs. The choice of EL, WT and CP influences PA outcome significantly and have to be carefully investigated before reporting population-based results.
References: Choi, L., et al. (2011). Med Sci Sports Exerc, 43(2), 357–364.
Evenson, K. R. e al. (2008). J Sports Sci, 26(14), 1557–1565.
Freedson, P. et al. (2005). Med Sci Sports Exerc, 37(Supplement), S523-S530.
Hänggi, J. M. et al. (2013). J Sci Med Sport, 16(1), 40–44.
Logan, G. R. M et al. (2016). J Sports Sci 34 (21), 2047–2053.
Romanzini, M. et al. (2014). European J Sport Sci, 14(1), 91–99.
Troiano, R. P. et al. (2008). Med Sci Sports Exerc 40 (1), S. 181–188.
Woll, A. et al. (2017). Journal of Health, 2(S3), 66–73.

Oral presentations

OP-BN24 Low back pain

WHOLE-BODY ELECTROMYOSTIMULATION (WB-EMS) TRAINING IN PATIENTS WITH CHRONIC UNSPECIFIC BACK PAIN

KONRAD, K., BAEYENS, J.P., RANKER, A., WIDMANN, J., JANSSON, V., WEGENER, B.

VRIJE UNIVERSITEIT BRUSSEL ; LUDWIG-MAIXIMILIANS-UNIVERSITÄT MÜNCHEN

INTRODUCTION: The preferred intervention for treating patients with chronic nonspecific back pain, according to the German National Care Guideline, is active exercise and to establish regular exercise in daily life. The lifestyle of patients with chronic nonspecific back pain mostly does not include any sports. They also often suffer from limitations of their mobility due to degenerative diseases of further joints. Therefore, there is an urgent need to help physical passive people to enable them to exercise easier. The use of Electromyostimulation (EMS) in order to train specific muscles has been established in physiotherapy for decades. Within fitness industry, supported training by WB-EMS is becoming increasingly popular. Therefore, applying this kind of training seems logical in patients with chronic unspecific back pain.
METHODS: In an ongoing prospective clinical trial, 49 patients with chronic nonspecific back pain have been enrolled for WB-EMS training. The average age is 53.7 years (27-85 years). The first evaluation takes place after 3 months. The training is carried out according to the usual recommendations in fitness training once a week for 20 minutes under the guidance of a trained physiotherapist. The core muscles are trained, upper and lower limbs.
RESULTS: The pain sensation averages on the Numeric Rating Scale (NRS; 1-10) improved significantly by 1.198 (from 4.66 to 3.46, $p < 0.05$). The Ostwestry Disability Index (ODI) improved significantly, resulting in a significant 3.37% reduction in disability ($p < 0.05$). The NASS also achieved a significant improvement of 0.51 points ($p < 0.05$). The pain value of the SF 36 questionnaire improved by 8.88 ($p < 0.05$). The other SF-36 parameters also tended to improve without reaching significance levels. In the point "limitations due to emotional problems", no improvement could be achieved. In the HADS score, improvements could be found for depression and anxiety, but these changes were also not significant.
CONCLUSION: By training with WB-EMS, all the back and pain parameters in the examined scores could be improved. It is thus an efficient training tool for people with chronic nonspecific back pain. In the further course of the study, the long-term effect will be evaluated by extending the training period. A comparison group with a traditional physiotherapy program will show the efficiency compared to a physiotherapeutic therapy concept.

LOW BACK PAIN IN ROWERS: PAIN INTENSITY, DISABILITY AND RISK FACTORS

TROMPETER, K., FETT, D., PLATEN, P.
RUHR-UNIVERSITY BOCHUM

INTRODUCTION: Back pain (BP) is one of the most often occuring complaints among athletes. Many studies have shown that in some sports athletes seem to have a higher risk for developing BP as compared to athletes from other sports. One of the highest BP prevalence among all sports was identified to be in rowers in a systematic review by Trompeter et al. [1]. Currently, there is no information of the prevalence of BP in German rowers. Therefore we aimed to establish the prevalence of BP in German rowers compared with a non-rowing control group, and to determine pain intensity and disability. Additionally to evaluated different risk factors that might be responsible for BP.
METHODS: A standardized and validated online BP questionnaire (Nordic questionnaire [2] and the questionnaire for grading the severity of chronic pain [3]) was sent to 351 elite rowers, 150 non-elite rowers, and to a control group of 253 physically active but non-elite sports students. Additionally a self-developed questionnaire focusing different aspects of training and competition was used to evaluate the athletic workloads.
RESULTS: Responses from 156 rowers (104 elite and 52 non-elite) and 166 controls were received. BP prevalence and severity were significantly higher among rowers compared with controls ($p<0.05$). The lower back was the main location of BP in rowers and in controls. Age, sex, and training volume influenced the prevalence of BP. Rowing kinematics, strength, and ergometer training were the main associated risk factors for BP in rowers. Elite and non-elite rowers did not significantly differ in BP prevalence.
CONCLUSION: Our findings indicate that BP is a common complaint in German rowers. Rowing kinematics, strength, and ergometer training were the main associated risk factors for developing BP in rowers. Thus, the spinal load due to rowing kinematics and different types of training should be investigated in future studies. Additionally, training should be monitored by experienced coaches to prevent BP due to technical mistakes or too-heavy loads. The results of this investigation underline the necessity of BP prevention and intervention programs in addition to the discipline specific training units.
Acknowledgement
This article was conducted within the MiSpEx (National Research Network for Medicine in Spine Exercise) research consortium. The authors are thankful to the German Olympic Sports Confederation (DOSB) for their help in the collection of data. The study was supported by the Federal Institute for Sport Science, Germany (ZMVI1-080102A/11-18).
References: [1] Trompeter, K. et al (2017). Sports Med. 47(6), 1183–207.
[2] Kourinka, I. et al. (1987). Appl Ergon. 18, 233-37.
[3] von Korff M. et al (1992). Pain. 50(2), 133-48.

MUSCLE ACTIVATION, PAIN AND EXERTION IN PEOPLE WITH AND WITHOUT LOW BACK PAIN DURING AQUATIC AND LAND EXERCISES

PSYCHARAKIS, S., COLEMAN, S., LINTON, L., KALIARNTAS, K., VALENTIN, S.
THE UNIVERSITY OF EDINBURGH

INTRODUCTION: Chronic low back pain (CLBP) is the most prevalent musculoskeletal disorder. Exercise has been shown to be beneficial in reducing pain and improving quality of life, and aquatic exercise is often used for the treatment and management of CLBP. Nevertheless, information on the appropriateness of aquatic exercises targeting trunk supporting muscles is lacking, in particular for people with CLBP. Thus, exercise selection is often arbitrary or based on anecdotal evidence. The aim of this study was to quantify the activation of the main trunk supporting muscles for people with and without CLBP when performing aquatic and land exercises commonly used in rehabilitation programmes.
METHODS: A wireless and waterproof electromyography system was used to measure muscle activation for 20 people with CLBP and 20 healthy participants. The participants performed 15 exercises in the water that focus on trunk stabilisation with upper or lower limb loading and are commonly used for LBP rehabilitation. A set of similar exercises was used on land. Mean and peak muscle activation was measured for seven trunk supporting muscles on each side of the body (14 in total). Other outcome measures included, pain (VAS), perceived exertion (RPE) and intensity (heart rate).
RESULTS: There were almost no differences in muscle activation, exercise intensity and perceived exertion between the CLBP and control groups. Between-environment differences were found in heart rate (always higher on land). Muscle activation and perceived exertion in the water were at least equal to that on land in about two thirds of the cases. Pain level had a non-significant trend for lower values in the water, while pain occurrence more than doubled when exercising on land (3.7% Vs 7.8%).
CONCLUSION: Aquatic exercise provided sufficient muscle activation and exertion, and had considerably lower occurrence of pain. This suggests that exercise in the water may be beneficial and more appropriate than exercise on land for CLBP, especially for people at early stages of rehabilitation or with higher levels of disability.

Oral presentations

OP-PM41 Nitrate

EFFECTS OF BEETROOT JUICE SUPPLEMENTATION ON OXYGEN UPTAKES SLOW COMPONENT AND EFFICIENCY/ECONOMY

PALAU-SALVÁ, G.1, DOMÍNGUEZ, R.2, SERRA-PAYÁ, N.1, GOMIS, M.1, SAMATIER, B.1, GUIRAO, L.1, PLEGUEZUELOS, Z.1, VILCHES-SÁEZ, S.1, MATÉ-MUÑOZ, J.L.2. GARNACHO-CASTAÑO, M.V.1
TECNOCAMPUS

INTRODUCTION: Beetroot juice (BJ) is classified as a high-level supplement for improving sports performance (AIS, 2016). However, there is some controversy over the benefits of BJ supplementation for endurance exercise performance, especially when referring to highly-trained athletes. The objective of the present study was to assess the effects of BJ on oxygen uptakes slow component (VO2sc), gross mechanical efficiency (GME), and metabolic variables (lactate, energy consumption, carbohydrate and fat oxidation) in a test executed at a constant work intensity in watts (W) corresponding to first ventilator threshold (VT1) and second ventilator threshold (VT2).

METHODS: 10 well-trained, male triathletes (aged 38.5 ± 8.5 years) were assigned in a randomized, double-blind, crossover design to receive 70 ml of BJ (6.5 mmol NO3-) or placebo (PL). Three hours after taking the supplement (BJ or PL), participants completed a 50 min test on a cycle ergometer first at a constant work rate corresponding to VT1 (30 min) and then (without rest) at a constant work rate set at VT2 (20 min). A two-way ANOVA with repeated measures, supplement * intensity, was used to compare the effects of BJ vs. PL.
RESULTS: No significant interaction effect (supplement*intensity) was observed on VO2sc, GME, lactate, energy expenditure, or carbohydrate and fat oxidation ($p > 0.05$). Although no significant differences emerged between BJ and PL in time to completion of VT2 and VT1+VT2, BJ supplementation did lead to a longer time to VT2 completion (approximately 1 min).
CONCLUSION: This study was designed to test the efficacy of BJ at improving performance during aerobic energy metabolism (VT1) and during the transition from aerobic to anaerobic metabolism (VT2). As in previous findings, acute BJ supplementation was not observed to improve GME (Bescos et al., 2011), use of energy substrates or performance in triathletes. Changes in exercise intensity from VT1 to VT2 involve variations in VO2, leading to the use of different substrates. GME calculations include possible respiratory exchange ratio (RER) changes and, therefore, take into account substrate use. Neither did BJ seem to induce more efficient substrate use as reflected by our data for GME and energy expended. Furthermore, GME calculations were targeted at assessing the effects of blood alkalization on gradual losses in muscle efficiency as the best indicator of the so-called VO2sc phenomenon (Gasser and Poole, 1996). BJ supplementation did not improve the behavior of VO2 kinetics.
In conclusion, the slight changes detected in performance variables such as test duration in several studies prompts numerous questions as the mechanical and physiological mechanisms analyzed so far do not support these improvements and remain poorly understood.
REFERENCES: Australian Institute of Sport. (2016).
Bescós R, Rodríguez FA, Iglesias X, Ferrer MD, Iborra E, Pons A. (2011). Med Sci Sports Exerc 43, 1979-86.
Gaesser GA, Poole DC. (1996). Exerc Sport Sci Rev, 24, 35-70.

THE INFLUENCE OF EQUIMOLAR NITRATE DOSES FROM BEETROOT JUICE AND SODIUM NITRATE ON UPPER AND LOWER BODY EXERCISE

FLUECK, J.L., GALLO, A., BRACHER, P., PERRET, C.

SWISS PARAPLEGIC CENTRE

INTRODUCTION: Beetroot juice (BR) and sodium nitrate (NIT) have been shown to enhance performance in recreationally trained men (Hoon et al. 2013). In addition, it was found, that nitrate reduces oxygen consumption (VO2) during exercise. A recent study revealed, that BR might be more beneficial compared to NIT in terms of VO2 during severe exercise intensity (Flueck et al. 2016). However, it is unclear, whether such benefit might be present as well when it comes to time trial (TT) performance. Therefore, the aim of this study was to investigate, whether BR or NIT enhance performance in upper and lower body exercise and whether one of these supplements is more beneficial than the other one.
METHODS: In total, 29 recreationally active men participated in this study. Fourteen upper body trained men (mean ± SD; age: 28 ± 7y, height: 183 ± 5cm, body weight: 82 ± 9kg, VO2peak: 33.9 ± 4.2ml/min/kg) performed a 10km handcycling (HC) TT and 15 leg trained men (age: 31 ± 8y, height: 182 ± 7cm, body weight: 76 ± 7kg, VO2peak: 59.1 ± 5.2ml/min/kg) performed a 16km TT on their bicycle (CYC). Each subject visited the laboratory on four different occasions. On the first day, they performed a maximal performance test to determine VO2peak and a familiarization TT. On the other 3 occasions, they ingested either 6mmol BR, 6mmol NIT or water as a placebo (PLC). Three hours after the ingestion the TT was performed. Blood samples were taken before and 3h post-ingestion for [NO3-] and [NO2-] analysis.
RESULTS: No significant difference in time-to-complete the TT between the 3 interventions BR, NIT and PLC in either HC ($p=0.61$) nor CYC ($p=0.11$) was found. Both exercise types showed a significantly higher power output to VO2 ratio in the BR trial compared to NIT and PLC (HC: $p=0.041$; CYC: $p=0.034$). No significant differences were seen between the 3 interventions in both exercise types for heart rate, end lactate concentration, VO2 and rated perceived exertion during exercise ($p>0.05$>. Plasma [NO3-] and [NO2-] concentrations significantly increased in NIT and BR from pre to post ingestion in all subjects ($p>0.05$) with no difference between BR and NIT 3h after ingestion ($p>0.05$).
CONCLUSION: This study showed no significant improvement in HC and CYC TT performance in recreationally active men after BR or NIT ingestion. In terms of performance, BR seems not to excel NIT but the power output to VO2 ratio seems to be higher for BR compared to PLC and NIT. The influence of dietary nitrate on upper body exercise needs to be further investigated.
References: Flueck et al. (2016). Appl Physiol Nutr Metab 41(4): 421-429.
Hoon et al. (2013). Int J Sport Nutr Exerc Metab 23(5): 522-532.
Contact: joelle.flueck@paraplegie.ch

DIETARY NITRATE SUPPLEMENTATION DOES NOT IMPROVE TOLERANCE TO SUPRAMAXIMAL INTENSITY INTERMITTENT EXERCISE IN ELITE ENDURANCE ATHLETES

PAWLAK-CHAOUCH, M.1, BOISSIÈRE, J.1, MUNYANEZA, D.1, GAMELIN, F.X.1, CUVELIER, G.2, BERTHOIN, S.1, AUCOUTURIER, J.1

1: LILLE UNIVERSITY, FRANCE, 2: CONDORCET, TOURNAI, BELGIUM

INTRODUCTION: Dietary nitrate (NO3-) supplementation is recognized as a means to improve tolerance to submaximal to maximal intensity exercise (Bailey et al. 2010; Lansley et al. 2011). Regarding supramaximal intensity exercise, we previously reported an improved tolerance to supramaximal intensity intermittent exercise in moderately fit subjects (VO2max between 40 and 55 mL.kg-1.min-1) (Aucouturier et al. 2015). Although 15% of the total race duration in cycling or triathlon can be performed at intensities beyond VO2max, little is known about the effectiveness of dietary NO3- supplementation on tolerance to supramaximal intensity intermittent exercise in endurance athletes. Our aim was therefore to determine whether dietary NO3- supplementation enhances the tolerance to supramaximal intensity intermittent exercise in elite endurance-trained athletes.
METHODS: Using a randomized, single-blind, cross-over design, 9 elite endurance athletes (21.7±3.7 years, maximal oxygen uptake (VO2max): 71.1±5.2 mL.kg-1.min-1) performed a supramaximal intensity intermittent exercise test following either a 3-day beetroot juice supplementation (BJ, NO3- content of 680 mg.L-1), or a placebo supplementation (PL, NO3- content<5 mg.L-1). The exercise test consisted of 15-s cycling exercise bouts at 170% of the maximal aerobic power interspersed with 30-s passive recovery periods performed until volitional exhaustion. Gas exchange measurements (indirect calorimetry), changes in local muscle oxygenation, and microvascular THb concentration were measured by Near Infrared Spectroscopy (NIRS).

RESULTS: Dietary NO3- supplementation did not increase the tolerance to supramaximal intensity intermittent exercise (BJ: 13.9±4.0 reps, PL: 14.2±4.5 reps, NS). Dietary NO3- supplementation did not affect oxygen uptake (VO2) during supramaximal intensity intermittent exercise tests (BJ: 3378.5±681.8 mL.min-1, PL: 3466.1±505.3 mL.min-1, NS). In contrast to our previous findings in subjects with lower aerobic fitness level (Aucouturier et al. 2015), the area under the curve for microvascular total hemoglobin (AUC-THb) was not different between the two conditions (BJ: 6816.9±1463.1 arbitrary units (a.u.), PL: 6771.5±3004.5 a.u., NS).
CONCLUSION: A short-term dietary NO3- supplementation did not increase the tolerance to supramaximal intensity intermittent exercise in elite endurance athletes contrary to recreationally trained subjects. This finding provides additional support to the hypothesis that dietary NO3- supplementation with beetroot juice is ineffective to improve performance in subjects with high VO2max (>60 mL.kg-1.min-1), regardless of exercise intensity domains.
REFERENCES: Bailey SJ et al. (2010). J Appl Physiol, 109, 135–148.
Lansley KE et al. (2011). Med Sci Sports Exerc, 43, 1125–1131.
Aucouturier J et al. (2015). Nitric Oxide, 49, 16–25.
CONTACT: mehdi.pawlak-chaouch@etu.univ-lille2.fr

DIETARY NITRATE INGESTION AND BLOOD PRESSURE LEVELS IN VEGETARIANS COMPARED TO OMNIVORES

BESCOS, R., ASHWORTH, A., EASTON, C., LIDDLE, L.
PLYMOUTH UNIVERSITY, UNIVERSITY OF WEST SCOTLAND

INTRODUCTION: Dietary consumption of inorganic nitrate (NO3) in vegetarians has been suggested to be higher than in omnivores as the main dietary sources of this anion are vegetables. Given the potential role of NO3 in lowering blood pressure, it has been suggested that this can explain, at least partially, the lower levels of blood pressure of vegetarians compared to omnivores. However, no previous study has investigated this question. Thus, the main aim of this study was to estimate dietary NO3 consumption in vegetarians and omnivores, to analyse plasma and salivary levels of NO3 and nitrite (NO2), and to investigate whether NO3 and NO2 bioavailability in vegetarians was associated with lower blood pressure compared to omnivores.
METHODS: 22 healthy subjects following a vegetarian diet (V) for at least a year (16 F + 6 M) and 19 omnivores (O) (11 F + 8 M) of similar age (V= 26 ± 6; O= 26 ± 6 y/o), BMI (V= 22.9 ± 3.8; O= 22.1 ± 2.9), gender and physical activity levels (V= 315 ± 221; O= 334 ± 208 min/week) completed this study. Following a single-blind and non-randomized protocol participants were given a mouthwash placebo (water) for one week. Additionally, they recorded all their food consumption during that week using food diaries. Dietary NO3 was estimated using the European Food Safety Authority database (European Food Safety Authority, 2008). They visited the laboratory on the seventh day in order to provide a saliva and blood sample under fasting conditions and for measurement of blood pressure in triplicate using an automated sphygmanometer. Then, participants were given antibacterial mouthwash (Corsodyl, UK) for seven more days in order to inhibit the oral NO3/NO2 pathway. They were also encouraged to replicate their food intake from the previous week. The same measurements were taken under fasting conditions on the fourteenth day.
RESULTS: Results are expressed as mean ± SD. Dietary NO3 intake by vegetarians (97 ± 79 mg/day) was 19 mg/day higher than in omnivores (78 ± 47 mg/day), but this was not statistically different (P>0.05). Plasma NO3 (V= 43 ± 33 µM; O= 40 ± 18 µM) and NO2 (V= 84 ± 41 nM; O=74 ± 21 nM) and salivary NO3 (V= 525 ± 698 µM; O= 542 ± 571 µM) and NO2 (V= 329 ± 340 nM; O= 319 ± 283 nM) were also similar between both groups after using placebo. Blood pressure was also not different (P> 0.05) between both groups (V SBP= 104 ± 8 mmHg, DBP 64 ± 6 mmHg; O SBP= 103 ± 6 mmHg, DBP 61 ± 7 mmHg). A significant reduction (P<0.05) of plasma NO2 (V= 65 ± 15 nM; O= 61 ± 16 nM) and salivary NO2 (V= 155 ± 171 nM; O= 133 ± 214 nM) was observed in both groups after using antibacterial mouthwash, but, this was not associated with any change in blood pressure.
CONCLUSION: A vegetarian diet was not associated with higher dietary NO3 intake or increased NO3/NO2 bioavailability compared to a healthy omnivore diet. This study also challenges previous literature as blood pressure was not lower in vegetarians compared to omnivores in healthy and young adults.

THE IMPACT OF BEETROOT JUICE SUPPLEMENTATION ON MUSCLE STRENGTH AND ENDURANCE

HILKENS, L., JONVIK, K.L., PEELEN, H., HOOGERVORST, D., DE NIET, M., VERDIJK, L.B., VAN LOON, L.J.C., VAN DIJK, J.W.
HAN UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Dietary nitrate supplementation has been shown to improve high-intensity exercise performance and has been linked to enhanced muscle contractility. These observations suggest that dietary nitrate supplementation may also improve muscular strength and endurance. In the present study we investigated the effects of nitrate supplementation on muscular strength and endurance.
METHODS: Fifteen recreationally active males (25±4 y, BMI 24±3 kg/m2) participated in a randomized cross-over study comprising two 6-d supplementation periods with daily supplementation of nitrate-rich (BR; 985 mg/d) or nitrate-depleted (PLA; 0.37 mg/d) beetroot juice. On day 6 of each experimental period, 3 h after ingesting the last supplemental dose, muscular strength and endurance were assessed by an isokinetic dynamometer. Maximal strength was assessed by maximal voluntary isometric and isokinetic contractions of the upper leg muscles. Isometric knee extensions were conducted at a knee angle of 30° and 60°, whereas isokinetic extensions and flexions of the knee were conducted at an angular velocity of 60, 120, 180 and 300°·s-1. Muscular endurance was assessed as the total work conducted during 30 reciprocal isokinetic contractions at an angular velocity of 180°·s-1. Differences between plasma nitrate, plasma nitrite, and exercise tests were analysed by paired-samples t-tests. Data are presented as mean±SD.
RESULTS: Plasma nitrate and nitrite concentrations assessed at 2h45min following the last supplemental dose were higher following BR vs PLA (respectively 870±239 vs 33±13 µmol/L and 463±217 vs 176±50 nmol/L, both P<0.001). Maximal voluntary isometric contraction at 30° and 60° did not differ between BR and PLA (204±39 vs 200±37, and 286±43 vs 285±47, respectively; both P>0.50). Maximal voluntary isokinetic contraction for the knee extensors did not differ between BR and PLA for any of the velocities (60°/s: 220±45 vs 218±40 W, 120°/s: 392±74 vs 387±62 W, 180°/s: 500±86 vs 487±67, 300°/s: 554±102 vs 544±81 W, P>0.33 for all velocities). However, maximal voluntary isokinetic contraction of the knee flexors was significantly improved by BR at 60°/s (157±22 vs 150±23 W, P<0.001) and tended to be improved at 180°/s (500±86 vs 487±67 W, P=0.066), whereas no effect was observed at an angular velocity of 120°/s (392±74 vs 387±62 W, P=0.24) and 300°/s (493±73 vs 485±81 W, P=0.36). Muscular endurance did not differ between BR and PLA (3950±690 vs 3926±661 kJ, P=0.73).
CONCLUSION: Supplementation of beetroot juice generally does not improve muscular strength and endurance. Nevertheless, beetroot juice supplementation improved some markers of knee flexor strength. It remains to be established whether this finding holds practical implications for exercise performance where hamstring strength is important, such as sprinting and jumping.

ASSESSING THE BIOLOGICAL VARIATION OF NITRATE AND NITRITE CONCENTRATION IN HUMAN PLASMA AND SALIVA FOLLOWING INGESTION OF NITRATE-RICH BEETROOT JUICE

EASTON, C.1, LIDDLE, L.1, BURLEIGH, M.1, MONAGHAN, C.1, MUGGERIDGE, D.J.2

1UNIVERSITY OF THE WEST OF SCOTLAND, 2UNIVERSITY OF THE HIGHLANDS AND ISLANDS

INTRODUCTION: Dietary nitrate (NO_3^-) supplementation increases circulating nitric oxide (NO) metabolites and has been shown to improve exercise performance in some, but not all, studies To date, the intra-individual biological variation in NO metabolite pharmacokinetics have not been quantified, despite these data being important to determine the thresholds that are sufficient to improve performance. The aim of this study was to determine the biological variation and critical difference (CD) in salivary and plasma nitrite ($[NO_2^-]$) and ($[NO_3^-]$) before and after ingestion of NO_3^- rich beetroot juice (BR).

METHODS: Ten healthy male participants (age 25 ± 5 years and body mass 81 ± 11 kg) completed three identical trials ~7 days apart. Following a 30 min period lying supine, blood and saliva were collected before (PRE) and 2.5 h after (POST) ingestion of 140 ml of BR (~12.4 mmol NO_3^-). Samples were analysed for ($[NO_2^-]$) and ($[NO_3^-]$) using gas-phase chemiluminescence. The analytical coefficient of variation (CVa) for these measures was ≤4.1%. The within-subject variation (CVi) of measurements for the three visits was calculated and coupled with the CVa to determine the CD. The between-subject variation (CVg) was also calculated for each measurement time point.

RESULTS: Across the three trials, plasma ($[NO_2^-]$) increased ($P<0.01$) from PRE (124 ± 49 nM, CVi 9%, CD 19%, CVg 40%) to POST (279 ± 94 nM, CVi 19%, CD 45%, CVg 32%) ingestion of BR. Likewise, plasma ($[NO_3^-]$) increased ($P<0.01$) from PRE (34 ± 10 µM, CVi 5%, CD 10%, CVg 32%) to POST (415 ± 92 µM, CVi 12 %, CD 24%, CVg 23%). Both salivary ($[NO_2^-]$) and ($[NO_3^-]$) also increased from PRE to POST ($P<0.01$) although the variation in salivary ($[NO_2^-]$) was substantially greater than ($[NO_3^-]$). Salivary ($[NO_2^-]$) values were 136 ± 100 µM at PRE (CVi 33%, CD 87%, CVg 79%) and 904 ± 268 µM at POST (CVi 24%, CD 58%, CVg 38%). Salivary ($[NO_3^-]$) values were 0.5 ± 0.2 mM at PRE (CVi 15%, CD 37%, CVg 25%) and 8.5 ± 2.1 mM at POST (CVi 12%, CD 30%, CVg 37%).

CONCLUSION: There is profound biological variation in the measurements of NO metabolites in human saliva and plasma suggesting that a large change in these parameters is required before a biologically relevant mean change can be suggested. Nevertheless, the increases in salivary and plasma ($[NO_3^-]$) and ($[NO_2^-]$) following ingestion of BR consistently exceeds the CD range. Studies measuring ($[NO_3^-]$) and ($[NO_2^-]$) should carefully consider the CD of these measures when interpreting experimental outcomes.

Invited symposia

IS-SH06 Sport and International Development

STATE-CIVIL SOCIETY RELATIONS FOR SPORT AND THE SUSTAINABLE DEVELOPMENT GOALS: A NORMATIVE-ANALYTIC FRAMEWORK

LINDSEY, I.

DURHAM UNIVERSITY

Common calls for greater governmental involvement in sport-for-development have been prominently made by multiple stakeholders and academics in the field alike. However, such calls lack clarity as to governments' prospective role, especially in relation to the burgeoning involvement of civil society organisations in sport-for-development. Academic contributions are weakened by a lack of both theorisation and empirical investigation. These limitations are increasingly problematic given the implications for sport that come from the 2030 Agenda for Sustainable Development, its establishment of an expansive set of Goals and prioritisation of the 'Means of Implementation' for these Goals. Therefore, drawing on development studies literature, this paper proposes a framework for state-civil society relations in sport-for-development that provides a normative basis for future policy and supports further empirical analysis. A fourfold continuum is suggested whereby sport-for-development interventions may vary from being state-led, enacted through structured partnerships or complementary relationships, to being undertaken autonomously by civil society organisations. Each component of this continuum brings specific implications in terms of the potential for scaled impact, capacity requirements and risks. These issues will be considered in respect of the framework's potential to inform policy approaches to enhancing the contribution of sport to various Sustainable Development Goals.

THE DONOR-RECIPIENT RELATIONSHIP IN SPORT FOR DEVELOPMENT AND PEACE

STRAUME, S.

MOLDE UNIVERSITY COLLEGE

In recent years, SDP policy scholars have highlighted the strong dominance of Global North ideologies, agendas and input within many Sport for Development and Peace (SDP) interventions. This criticism relates to the development of donor-led policies, top-down programming and control over the flow of SDP funding, enabling and sustaining an un-equal relationship. Simultaneously, the SDP sector has experienced a remarkable growth, and consequently its stakeholders are multiple and complex, ranging from governments and government agencies to local NGOs and independent individuals.

Through a study of the interface between policy and practice in an SDP project in Zimbabwe, this presentation reflects on the donor-recipient relationship in SDP. The study showed that different worldviews were negotiated within the project, as official discourses and policy-driven ideas were translated and given meaning by recipient organization or local project staff in the social contexts where it was implemented.

With the exponential growth of various SDP stakeholders in mind, it is argued that future research should continue to strive for more understanding of the way policies influence SDP relationships. This is particularly important in driving the sector towards policies that are increasingly based on development cooperation and equal partnership.

SHIFTING GEARS: EXPLORING THE 'BICYCLES FOR DEVELOPMENT' MOVEMENT

MCSWEENEY, M., HAYHURST, L., WILSON, B.
YORK UNIVERSITY

In countries throughout the global South, and in disadvantaged communities across the global North, bicycles are being hailed by NGOs, corporations, international institutions, and local communities as tools for reducing poverty and achieving environmental sustainability. Despite this surging interest in what can be termed the 'bicycles for development' (BFD) 'movement', little is known about BFD in relation to the wider sport for development and peace (SDP) movement. Indeed, having identified concerns associated with development efforts driven by institutions of the global North, researchers have advocated for more 'on the ground', contextual research on SDP informed by the wealth of research and theoretical work that: 1) is sensitive to sport and non-sport related postcolonial legacies; and 2) considers the use of non-human objects and technologies in SDP, such as the bicycle, as possible catalysts for development. In this paper, framed by a postcolonial lens, we offer an analysis and discussion of interviews with global BFD 'executives' involved in the transnational movement of bicycles. Specifically, we explore how individual BFD executives engage in practices of social entrepreneurship, and further, identify and examine BFD organizational models that rely on social entrepreneurial processes. Overall, our goal is to consider how, based on the perspectives of BFD executives, bicycles may offer an innovative form of development and unique social entrepreneurship opportunities, while being influenced by and influencing the contextual and neoliberal structures of the international movement of bicycles.

Oral presentations

OP-PM74 High intensity training 2

VOLUME-MATCHED, SINGLE AND ACCUMULATED BOUTS OF IN-SCHOOL HIGH-INTENSITY INTERVAL RUNNING REDUCE POSTPRANDIAL LIPAEMIA IN ADOLESCENT BOYS

TOLFREY, K., SMALLCOMBE, J.W., BARRETT, L.A.
LOUGHBOROUGH UNIVERSITY

INTRODUCTION: The current study aimed to examine the efficacy of high-intensity interval running (HIIR), accumulated during the natural breaks in the school day, to modulate postprandial metabolism in adolescent boys. A secondary aim was to compare the effects of accumulated HIIR with those of the same volume HIIR performed in a single after-school exercise session.
METHODS: Nineteen healthy adolescent boys (12.6 <0.5) years) completed the study. A within-measures, counter-balanced research design was employed whereby all participants completed three, 2-day experimental conditions; a resting control condition (CON); an accumulated, high-intensity exercise condition (ACC); and a single, high-intensity exercise condition (SIN), separated by fourteen days. On Day 1, after a standardised overnight fast, participants arrived at school at 07:30. A fasting capillary blood sample was taken at 07:35 and three subsequent blood samples in the postprandial state at 10:30, 12:35 and 15:10. In all conditions, standardised mixed meals were consumed at 08:10 & 13:00 on Day 1. During CON, no exercise was prescribed. During ACC, participants performed four sets of 10 × 30 m maximal-intensity sprint runs (40 sprints in total) accumulated in four bouts across the school day (07:50, 10:35, 12:40 and 15:30). During SIN, participants performed the same number of sprints (40) in a single exercise session performed at 16:00. On the morning of Day 2 participants reported to school, where fasting and postprandial blood samples were taken as described above. High fat meals, standardised to body mass, were consumed at 08:10 and 12:40, respectively.
RESULTS: No differences in TAUC-TAG were observed across conditions on Day 1 (P = 0.359), however, differences were observed on Day 2 (P = 0.007). On Day 2, The TAUC-TAG was 12% lower after ACC (ES = 0.49; P = 0.002) and 10% lower after SIN (ES = 0.37; P = 0.019) compared with CON. The difference between SIN and ACC for TAUC-TAG was trivial and non-significant (3%, ES = 0.12, P = 0.418). No differences in TAUC-glucose were observed across conditions on Day 1 or Day 2 (P =0.738). During exercise, affective ratings on the One Item Feeling Scale differed significantly across conditions (P = 0.011) and between sprint sets (P = 0.024). The condition by sprint set interaction was also significant (P = 0.002) with higher affective ratings reported following the third (+1 fairly good vs. 0 neutral) and fourth (+1, fairly good vs. -1 fairly bad) exercise sets during ACC compared with SIN.
CONCLUSION: High-intensity interval running, accumulated in four separate bouts during the school day, was efficacious in reducing postprandial triacylglycerol concentrations in adolescent boys. The exercise-induced reductions observed after accumulated HIIR were similar in magnitude to those observed after the same of volume exercise was performed in a single, after-school bout and match findings from laboratory-based studies with adolescent boys and girls; the ecological validity may differ.

A MULTI-DISCIPLINARY EVALUATION OF A HOME-BASED HIGH-INTENSITY INTERVAL TRAINING INTERVENTION IN PEOPLE WITH TYPE 1 DIABETES

SCOTT, S.N.1, SHEPHERD, S.O.1, ATKINSON, S.1, ANDREWS, R.C.2, NARENDRAN, P.3, PUREWAL, T.S.4, COCKS, M.1
1 LIVERPOOL JOHN MOORES UNIVERSITY, 2 UNIVERSITY OF EXETER, 3 UNIVERSITY OF BIRMINGHAM, 4 ROYAL LIVERPOOL & BROADGREEN UNIVERSITY HOSPITAL

INTRODUCTION: High-intensity interval training (HIT) may be particularly effective in people with type 1 diabetes (T1D), as HIT addresses the two major barriers to exercise identified by people with T1D, fear of hypoglycaemia and lack of time. However, HIT protocols investigated in people with T1D require specialised equipment introducing additional barriers to exercise, which are relevant as people with T1D also identify access to facilities and embarrassment as key barriers. In addition, studies investigating HIT in people with T1D have only been conducted under optimal lab conditions with high levels of supervision, bringing into question how the work translates into practise. As such, using guidance from the RE-AIM framework, we used a multi-disciplinary approach to evaluate a new home-based HIT (Home-HIT) intervention in people with T1D, investigating physiological responses and qualitatively evaluating participant experiences of the new intervention.
METHODS: Eight previously sedentary people with T1D (age 31±4yrs; BMI 27.1±1.5kg·m; VO2peak 33.5±2.7ml·kg·min; duration of T1D 9±3yrs) completed 6wk of Home-HIT (repeated 1min intervals of simple bodyweight exercises). Participants trained unsupervised in a place of their choosing, and were advised to train 3x/wk completing between 6-10 intervals at a heart rate (HR) of ≥80% HRmax. Adherence and compliance to the prescribed exercise intensity were remotely monitored using a HR monitor and mobile app. Aerobic capacity (VO2peak) and blood pressure were assessed pre and post-training. Blood glucose was monitored before, immediately and 1h after all

exercise sessions. Perceptions of the program along with attitudes towards exercise, barriers to exercise and previous experiences of exercise were evaluated using an online interview.
RESULTS: Training session adherence was 93±2%, with participants achieving their target HR in 99±1% of sessions. Blood glucose was not different from baseline immediately or 1h post HIT exercise. Training increased VO2peak by 1.7±0.5ml/kg/min (P=0.015), but blood pressure was unchanged (P=0.445). The interview revealed that the Home-HIT programme was positively received with a lot of benefits. Participants identified that it reduced many of the barriers to exercise, including those related to T1D. All 8 participants said they would continue with Home-HIT following the intervention.
CONCLUSION: This is the first study to combine physiological evidence with qualitative evaluation of a training intervention in people with T1D. Using this approach home-based HIT appears to be a highly effective intervention for people with T1D, resulting in high adherence and inducing clinically relevant increases in aerobic capacity. Importantly, home-based HIT not only reduced traditional barriers to exercise, but also the key barrier in people with T1D, fear of hypoglycaemia. As such, home-based HIT may represent an effective strategy to improve health in people with T1D by increasing exercise participation.

EFFECTS OF COMBINED UPPER- AND LOWER-BODY HIGH-INTENSITY INTERVAL TRAINING ON MUSCULAR AND CARDIORESPIRATORY FITNESS IN OLDER ADULTS

HURST, C.1, WESTON, K.L.2, BATTERHAM, A.M.2, WESTON, M.2

1 DURHAM UNIVERSITY 2 TEESSIDE UNIVERSITY

INTRODUCTION: Age-related declines in cardiorespiratory and muscular fitness can have considerable functional implications in older adults with the ability to perform the tasks of daily living dependent on upper- and lower-body fitness. High-intensity interval training (HIT) improves both cardiorespiratory and muscular fitness (Sculthorpe et al., 2017; Weston et al., 2014), thereby offering an attractive strategy for the training of older adults. However, previous studies have typically used a predominantly lower-body training stimulus. As such, we aimed to assess the effects of 12-weeks of combined upper- and lower-body HIT on measures of fitness in adults aged >50 years.
METHODS: Following baseline assessment of leg extensor muscle power, handgrip strength and aerobic fitness (predicted VO2max), 36 adults (21 male; 62 ± 7y [mean ± standard deviation, SD]) were assigned to HIT (n=18) or no-exercise control (CON, n=18) via minimisation (age, gender, and baseline fitness). The HIT programme comprised two training sessions per week for 12-weeks using a double-concentric hydraulic resistance machine. Participants were encouraged to work at a high-intensity performing a combination of upper-, lower- and full-body exercises including squats, power clean and press, lat-pull to squat and step-and-press. HIT sessions consisted of four sets of four exercise bouts interspersed with a 15-s transition period allowing movement to the next exercise. Initial HIT bout duration was 45 s, progressing every third week by 10 s. Each set was followed by 3-minutes passive rest. Data were analysed via ANCOVA with baseline values, age and sex as covariates, with magnitude based inferences subsequently applied.
RESULTS: All participants in the HIT group completed the intervention with mean (82 ± 6%[maximal heart rate, HRmax]) and peak (89 ± 6%HRmax) exercise heart rates confirming a high-intensity training stimulus. Compared to CON, HIT showed possibly small beneficial effects for dominant leg power (10.5; ±90% confidence limits ±8.5%), non-dominant leg power (9.4; ±6.3%) and non-dominant handgrip strength (6.3; ±5.2%), with a likely small beneficial effect for VO2max (8.4; ±6.8%). The effect for dominant handgrip strength (5.9; ±5.5%) was likely trivial.
CONCLUSION: Twelve weeks of combined upper- and lower-body HIT induces clear improvements in muscular and cardiorespiratory fitness measures relevant to functional performance in older adults. Our findings highlight potential for innovative approaches to training delivery and should encourage researchers to move beyond exercise modes traditionally associated with HIT.
REFERENCES:
Sculthorpe et al. (2017). Medicine 96(6), e6040
Weston et al. (2014). Sports Med 44(7), 1005-1017
CONTACT:
christopher.d.hurst@durham.ac.uk

THE EFFECTS OF DIFFERENT HIGH-INTENSITY INTERVAL TRAINING MODALITIES ON BODY COMPOSITION IN NON-OBESE YOUNG ADULT FEMALES

BROWN, E.C., ORR, S.C., TYLER, R.T., RENGERS, T.A., ELSESSER, M.A., HEW-BUTLER, T., MARKS, C.R.C., CHOI, M.D., BUTCHER, S.J.

OAKLAND UNIVERSITY

INTRODUCTION: Long-term (≥ 12 weeks) high-intensity interval training (HIIT) is an effective way to improve body composition in overweight/obese populations, but few studies have examined these effects in normal weight populations. Additionally, most HIIT protocols include aerobic-type and not resistance training exercises. Therefore, the aim of this study was to compare the effects of rowing HIIT (R-HIIT) and multi-modal HIIT (MM-HIIT) using resistance and conditioning modalities on body composition in non-obese females.
METHODS: 19 non-obese women aged 22.8±5.3 years were randomized into either a MM-HIIT or R-HIIT group. Participants completed a 12-week HIIT intervention consisting of 1-hour sessions 3 days a week. All participants had measures of height, weight, waist circumference and dual-energy X-ray absorptiometry (DEXA) measures of body fat percentage (BF%), visceral adipose tissue (VAT), bone mineral content (BMC), bone mineral density, fat mass, and lean body mass (LBM) assessed pre- and post-intervention. An independent samples t-test was computed to determine differences between groups at baseline, and a general linear model with repeated measures was used to determine changes in variables across time and between groups. P-value was set a priori at 0.05.
RESULTS: 14 participants (R-HIIT: n=6; MM-HIIT: n=8) completed the intervention and no differences between groups were found at baseline. A significant main effect for time pre- to post-intervention was found for some DEXA variables such that both groups increased BMC (MM-HIIT: effect size (ES)=1.00, confidence interval (CI)=6.16–67.61, P=0.03; R-HIIT: ES=2.43, CI=17.48–44.05, P=0.002) and LBM (MM-HIIT: ES=2.71, CI=1732.77-3279.26, P<0.001; R-HIIT: ES=3.79, CI=1551.03–2740.04, P<0.001). No between group differences nor changes in anthropometric variables were found.
CONCLUSION: R-HIIT and MM-HIIT groups improved similarly for BMC and LBM. Improvements in LBM was similar to the findings of Cervantes-Sanabria and Hernández-Elizondo (2017) who noted an increase in muscle mass and decrease in fat mass and BF% in overweight women after 16 weeks of HIIT using body weight exercises. The lack of body fat improvement in the present study was likely due to the participants having healthy levels of waist circumference, body mass index, and VAT at baseline with little room for improvement. The increases in BMC in the present study are contrary to the findings of Nybo et al. (2010) that demonstrated no improvement in BMC

after 12 weeks of running HIIT in men. As both HIIT protocols resulted in positive changes, either may be chosen by coaches or health professionals who wish to improve their clients' LBM and/or BMC.
References: Cervantes-Sanabria, J., Hernández-Elizondo, J. (2017). Arch Sports Med, 1(2):65-74
Nybo, L., Sundstrup, E., Jakobsen, M., Mohr, M. Hornstrup, T., Simonsen, L., Bulow, J., Randers, M., Nielsen, J., Aagaard, P., Krustrup, P. (2010). Med. Sci. Sports Exerc, 42(10):1951-8.

EXPLORING ADOLESCENT PERCEPTIONS OF A HIGH-INTENSITY INTERVAL TRAINING INTERVENTION: EVALUATING THE EXERCISE FOR ASTHMA WITH COMMANDO JOE'S (X4ACJ) TRIAL

EDDOLLS, W.T.B., MCNARRY, M.A., WINN, C.O.N., MACKINTOSH, K.A.
SWANSEA UNIVERSITY

INTRODUCTION: The prevalence of poor health in children and adolescents has reached unprecedented levels (Lobstein et al., 2015). While conventional methods for treating such poor health are often expensive, exercise has been identified as an alternative cost-effective tool. Traditional strategies have principally utilised moderate-intensity continuous exercise, however, more recently, high-intensity interval training (HIIT) has been proposed as a means of improving adolescent health (Weston et al., 2016). However, despite the importance of capturing participants' post-intervention attitudes, there remains a dearth of evaluative research. Therefore, the aim of this study was to evaluate the eXercise for Asthma with Commando Joe's (X4ACJ) HIIT intervention.
METHODS: Eighty adolescents (13.3 ± 1.0 years; 45 boys) from X4ACJ, participated in this study. The intervention involved 6 months of 3 x 30-minute HIIT sessions per week delivered by Commando Joe's®. Participants, stratified into groups based on attendance (attendees and non-attendees) each completed one of eighteen semi-structured focus-group interviews. Questions were structured around participants' perceptions of X4ACJ and HIIT. Data was transcribed verbatim and thematically analysed deductively. Key emergent themes were represented using pen profiles.
RESULTS: Psychological, physiological and social benefits of participating in the HIIT intervention emerged as the primary facilitators to exercise. Aspects of the exercise sessions, such as games and competition, as well as the instructor were highlighted as facilitators. Poor peer behaviour, the challenging nature of HIIT, the timings of the sessions and competing interests were the predominant barriers to participating in the HIIT intervention.
CONCLUSION: Future research should carefully consider HIIT implementation strategies. Indeed, HIIT interventions should embed a fun and varied games-based intervention into physical education lessons led by a well-qualified and approachable instructor. Sessions should account for the variation in ability between participants, avoiding intra- and inter-session repetition, to enhance long-term adherence.
Lobstein, T., Jackson-Leach, R., Moodie, M. L., Hall, K. D., Gortmaker, S. L., Swinburn, B. A., … McPherson, K. (2015). Child and adolescent obesity: part of a bigger picture. The Lancet, 385(9986), 2510–2520.
Weston, K. L., Azevedo, L. B., Bock, S., Weston, M., George, K. P., & Batterham, A. M. (2016). Effect of novel, school-based high-intensity interval training (HIT) on cardiometabolic health in adolescents: Project FFAB (Fun Fast Activity Blasts) - an exploratory controlled before-and-after trial. PLoS ONE, 11(8), e0159116.

CHANGES IN THE POWER-CADENCE RELATIONSHIP FOLLOWING HIGH-RESISTANCE AND HIGH-CADENCE SPRINT TRAINING INTERVENTIONS

RUDSITS, B.L., TAYLOR, S.B., HOPKINS, W.G., ROUFFET, D.M.
VICTORIA UNIVERSITY

INTRODUCTION: Ballistic training interventions targeting different portions of the power-velocity relationships have been shown to elicit different neuromuscular adaptations. This study investigated how two sprint training interventions performed on a stationary cycle ergometer against high resistances or at high cadences affected the power-cadence relationship and the motor command (i.e. kinetics, lower limb kinematics and intermuscular coordination).
METHODS: Two groups of physically active males completed either a training program exclusively made of sprints performed against high resistances (4-8 N·m·kg-1; 0 to 122 ± 15 rpm; mean ± SD; n= 9) or sprints performed at high cadences (0.1 ± 0.5 N·m·kg-1; 131 ± 5 to 211 ± 10 rpm; n= 8). For both training interventions, participants trained bi-weekly for four weeks. Alterations in power-cadence relationships were quantified from changes in power produced at training-specific cadences (60-90 rpm and 160-190 rpm), estimated maximal torque, maximal power, optimal cadence, maximal cadence. Changes in peak crank torque, average muscle co-activation, and joint angles at the training-specific cadences were also analysed. Magnitudes of effects and their uncertainty were assessed using standardisation.
RESULTS: The effects of training were greatest in the cadence range of training: small-moderate increases in power (7 ± 6%) at 60-90 rpm for high-resistance and trivial-small increases (11 ± 20 %) at 160-190 rpm for high-cadence. The improvement for high-resistance was associated with small-moderate increases in maximal torque (25 ± 19 %), trivial-small reductions in optimal cadence (3 ± 5 rpm), small-moderate reductions in ankle joint range of motion (6 ± 4°) and trivial-moderate increases in co-activation of the gastrocnemius and tibialis anterior muscles. High-cadence training was associated with a more plantar-flexed ankle joint of a trivial-moderate magnitude (4 ± 8°), trivial-small increases in optimal cadence (3 ± 5 rpm), and increased co-activation of the gastrocnemius and tibialis anterior muscles.
CONCLUSION: High-resistance and high-cadence training led to different improvements in the power-cadence relationship. High-resistance training was linked to a modification in ankle joint kinematics and greater co-activation of surrounding musculature, while the responses to high-cadence training were more variable. These findings indicate that upon assessment of an individual's power-cadence profile, training over specific sections of the power-cadence relationship could be used to optimise their profile to match the requirements for their given sporting event.

Oral presentations

OP-PM53 Injury prevention

IS SPORTOMICS A USEFUL APPROACH TO EVALUATE METABOLIC RESPONSES AND TO PREVENT INJURIES IN PROFESSIONAL SOCCER PLAYERS? PRELIMINARY RESULTS.

BONGIOVANNI, T., PINTUS, R., MARINCOLA, F.C., FRANCAVILLA, V.C., CORBU, S., DESSÌ, A., NOTO, A., CORSELLO, G., FANOS, V.

NUTRITION, HYDRATION & BODY COMPOSITION DEPARTMENT, PARMA CALCIO 1913, PARMA, ITALY.

INTRODUCTION: Sportomics is non-hypothesis-driven research on an individual's metabolite changes during sports and exercise. It is the application of metabolomics, one of the omics sciences that provide a snapshot of the metabolome of an individual in both physiological and pathological conditions such as sport practice and musculoskeletal diseases or injuries through the analysis of biological fluids such as blood, urine or saliva.
METHODS: In this study we performed an 1H-NMR analysis of urine metabolome of 21 professional soccer players, playing in Italian Serie-A league, at 3 different times: the first day (T1), after five days (T2) and at the end (T3) of the pre-season period 2016-17. We used this approach to investigate cellular and metabolic responses due to chronic physical exercise and to study the usefulness of sportomics to prevent injuries.
RESULTS: A clear separation was obtained between samples collected at time T1, T2 and T3. The metabolites responsible for the separation were: TMAO, DMA, N-methylhistidine, 3 OH-butyric acid and hippuric acid which levels were increased. Some of these compounds may be related both to the diet or the training since, for instance, N-methylhistidine is an indicator of proteins turnover that could correlate to the assumption of proteins or to muscular stress, while the influence of microbiota is highlighted by hippuric acid.
CONCLUSION: To the author's knowledge this was the first sportomics study in professional soccer players; preliminary results show significant changes in urine metabolites such as TMAO, DMA, N-Methylhistine, 3 OH-butyric acid and hippuric acid, attesting sportomics as an interesting approach to advance in the understanding of global response to a programmed exercise and diet. Since it is the first study ever made on professional soccer players it has several limitations and the experimental setting could be improved in order to have clearer results. Further research is needed to determine whether sportomics could be employed to prevent, diagnose and manage injuries induced by exercise.

WHAT IS THE EFFECT OF INJURY DEFINITION ON THE INCIDENCE OF INJURY IN A JUNIOR INTERNATIONAL FIELD HOCKEY SQUAD?

REES, H.1,2, DELAHUNT, E.1,2, BOREHAM, C.1,2, MCCARTHY-PERSSON, U.1,2, SHRIER, I.3, MURPHY, J.4, BLAKE, C.1,2

1 INSTITUTE OF SPORT AND HEALTH, UCD 2 SCHOOL OF PUBLIC HEALTH, PHYSIOTHERAPY AND SPORTS SCIENCE, UCD 3 CENTRE FOR CLINICAL EPIDEMIOLOGY, LADY DAVID INSTITUTE, MCGILL UNIVERSITY 4 MEDFIT, DUBLIN

INTRODUCTION: Consensus statements highlight that a range of injury definitions can be used in epidemiological studies of sports injuries. To date, injury surveillance in field hockey has primarily reported upon injuries incurring medical attention. Understanding how different injury definitions influence injury incidence will help inform future consensus agreements and facilitate standardisation of injury reporting. Therefore, the aim of this study was to investigate the influence of injury definition on injury incidence rates in a squad of elite hockey players across a 6-week period.
METHODS: Ethical approval was obtained from the Human Research Ethics Board in UCD. Elite Irish field hockey players self-reported physical complaints daily, using the AthleteMonitoring software. All complaints were subsequently assessed by the team's physiotherapist. Injuries were categorised as (i) all physical complaints, (ii) medical attention (those requiring treatment) and (iii) time-loss (unable to take a full part in future hockey training or match-play).
RESULTS: 18 players participated in the study, training an average of 10.8h/wk and playing 6 matches in the six-week study period (1,227 exposure hours; 1,161 training hours; 66 match-play hours). Of the 26 all physical complaints injuries (14 match; 12 training) during the 6-week period, 13 (50%) were logged by the athlete and would not have come to the attention of the medical team, had the AthleteMonitoring software not been used. The remaining 13 (50%) injuries were categorised as medical attention injuries, of which 7 (27%) incurred time-loss. This gave rise to match-play and training incidence rates of 212.1/1000h and 10.3/1000h respectively. For match-play, self-reported injuries (not medical attention) (n=8) had an incidence of 121.2/1000h, medical attention with/without time loss (n=6) of 90.9/1000h and time-loss (n=3) of 45.5/1000h. In training, self-reported injuries (n=5) had an incidence of 4.3/1000h, medical attention with/without time loss (n=7) of 6.0/1000h and time-loss (n=4) of 3.4/1000h.
CONCLUSION: A large proportion of elite field hockey injuries are not medical attention and do not result in time-loss from sport. Using only a medical attention or time-loss definition would have missed many of the injuries sustained by the players. While further research in this area is required, it may be useful for epidemiological studies of injury in field hockey to include physical complaints as an injury definition.

THE EFFECT OF ARTHROSCOPIC TREATMENT FOR FEMOROACETABULAR IMPINGEMENT ON ATHLETIC PERFORMANCE IN COMPETITIVE SPORTSMEN.

MULLINS, K.1, HANLON, M.1, CARTON, P.1,2

1 WATERFORD INSTITUTE OF TECHNOLOGY 2 THE HIP AND GROIN CLINIC, WHITFIELD CLINIC, WATERFORD

INTRODUCTION: Objective measurements of athletic function have not been examined following arthroscopic treatment of femoroacetabular impingement despite it being a common pathology among athletes , and subjective outcomes measures following surgery showing favourable results. The aim of the research was to determine changes in functional performance variables necessary for field sport participation following arthroscopy for FAI among male athletes.
METHODS: Competitive male athletes undergoing surgery for FAI, were compared to an age and activity-level matched control group. Patients and controls were tested at three timepoints; patients at baseline , 12-weeks post-surgery and 1 year following the procedure . While controls were tested initially , 12-weeks and 1 year later . All participants were tested for acceleration, change of direction speed by use of a modified agility T test, maximal deep squatting ability and a single leg drop jump for the calculation of reactive strength index .

Maximal hip range of motion which included flexion, abduction and internal rotation were assessed using a goniometer. Participants were asked to report any anterior groin pain during the testing. Return to play status of the patient group was also recorded at the 1-year follow up. Paired samples t tests were used to determine within group changes over time, while a repeated measures ANOVA was used to examine time x group interaction effects, in all cases $p<0.05$ was considered significant.
RESULTS: Prior to surgery, patients were significantly slower than controls for acceleration and COD <3% and 8% respectively, $p<0.05$> with significantly lower levels of hip ROM in all directions . The patient group had significantly improved on all three measures of ROM and the COD test at 12-weeks. Further improvements were recorded for squatting depth and RSI 1 year later. Changes among the control group at 12-weeks and 1 year were not significant. Pain measures at 1 year reduced for acceleration <47% pre-op to 8%>, COD <60% to 8%> and for the squatting depth measures <52% to 8%>. Eighty three percent of patients had returned to full training and competition at 1 year
CONCLUSION: Symptomatic FAI negatively effects athletic performance; arthroscopic correction of FAI is recommended for athletes wishing to continue with sports participation and improve performance. Improvements in agility and ROM as well as reductions in activity related pain were noted as early as 12-weeks.

EVALUATION OF ECCENTRIC HAMSTRINGS STRENGTH ASSESSMENTS THROUGH ISOKINETIC DYNAMOMETRY AND NORDIC HAMSTRING DEVICE

GRESSENBAUER, C., WIESINGER, H.P., SCHARINGER, M., KÖSTERS, A., MÜLLER, E.

UNIVERSITY OF SALZBURG

INTRODUCTION: High, bilateral evenly distributed eccentric knee flexion strength is critical in injury prevention (Al Attar et al., 2017) and/or athletic performance (Morin et al., 2015). However, ischiocrural muscles are, inter alia, region-specifically activated in hamstring exercises (Hegyi et al., 2017) and their strength assessment remains challenging. Moreover, pilot tests revealed divergent torque levels when measured with an isokinetic dynamometer (IKD) or the Nordic hamstring device (NHD). This study examined these ischiocrural strength differences obtained by the current test devices in a broader context.
METHODS: A three session repeated measurement and a counterbalanced within-subject design were used for reliability and device comparison, respectively. Twenty-five healthy male adults (26±3 yrs) were tested on an IKD and a NHD. Eccentric peak torque (EPT), bilateral strength ratios (BSR) and the maximal voluntary isometric contraction (MVC) normalized activity of the biceps femoris (BF) and semitendinosus (ST) muscles were assessed.
RESULTS: Both methods showed moderate reliability for EPT (IKD: ICC2.1=.86, CVTE=7.2%; NHE: ICC2.1=.85, CVTE=7.2%) and low reliability for BSR (IKD: ICC2.1= .30, CVTE =11.6%; NHE: ICC2.1= 0.37, CVTE=7.9%). There was a moderate correlation in EPT (r=.69, p<.001) between the devices; however, values were higher on the NHD (30%; p<.001). BSR measured on each device did not correlate (p<.43). MVC normalized electromyography revealed a significant higher activation for ST (15%; p<.018), but no significant difference for BF (p<.88).
CONCLUSION: The systematically higher eccentric knee flexion torque obtained by the NHD compared to the IKD illustrates that current devices cannot be used interchangeably. It also indicates the importance to account for the assessment when interpreting eccentric knee flexor strength data in the context of prevention, screening, or performance monitoring.
References: 1. Al Attar, W. S. A., Soomro, N., Sinclair, P. J., Pappas, E., & Sanders, R. H. (2017). Effect of injury prevention programs that include the Nordic hamstring exercise on hamstring injury rates in soccer players: a systematic review and meta-analysis. Sports medicine, 47(5), 907-916.
2. Morin, J. B., Gimenez, P., Edouard, P., Arnal, P., Jiménez-Reyes, P., Samozino, P., Brughelli, M. & Mendiguchia, J. (2015). Sprint acceleration mechanics: the major role of hamstrings in horizontal force production. Frontiers in physiology, 6, 404.
3. Hegyi A, Peter A, Finni T, Cronin NJ. Region-dependent hamstrings activity in Nordic hamstring exercise and stiff-leg deadlift defined with high-density EMG. Scand J Med Sci Sports, 2017.
Contact:
christoph.gressenbauer@sbg.ac.at

RATE OF FORCE DEVELOPMENT SCALING FACTOR IS A PROMISING INDEX TO IDENTIFY INTER-LIMB ASYMMETRIES IN SOCCER PLAYERS

BOCCIA, G.1, BRUSTIO, P.R.1, BUTTACCHIO, G.2, CALABRESE, M.2, CASALE, R.2, RAINOLDI, A.1

1: NEUROMUSCULAR FUNCTION RESEARCH GROUP , 2: HABILITA CARE & RESEARCH REHABILITATION UNIT

INTRODUCTION: Muscle strength asymmetries between lower limbs are common in soccer players and crucial for performance and injury prevention. Peak torque exerted during concentric isokinetic contraction is widely adopted to provide and index of inter-limb asymmetry. In this study we compared inter-limb asymmetry measured in concentric contraction with the rate of force development (RFD) scaling factor (RFD-SF). In a series of fast force pulses performed across a range of submaximal values, there is a linear relationship between the force peak and the RFD peak obtained in each pulse. RFD-SF is the slope of this relationship, thus RFD-SF quantifies the extent to which RFD scales with the intensity of the contraction.
METHODS: Knee flexors and extensors strength was evaluated in both limbs of elite young soccer players (22 males, 17±1 years). Seated on an ergometer, participants performed three concentric isokinetic contractions at 240°/s and the RFD-SF protocol. The inter-limb difference was calculated for each parameter and players presenting an inter-limb difference > 15% were identified. The ratio between dominant and non-dominant side was also calculated.
RESULTS: The percentage of players that presented an inter-limb difference higher than 15%, was 10 and 40% in knee extensors, and 35 and 55% in knee flexors for concentric contraction and RFD-SF, respectively. Dominant limb showed higher concentric strength (139±31 vs. 134±26 Nm, p=0.04) in knee extensors, and higher RFD-SF in knee flexors (8.9±1.6 vs. 8.0±1.6, p=0.05) compared to the non-dominant limb.
CONCLUSION: Adopting RFD-SF it was possible to identify more players with a relevant interlimb asymmetry than adopting concentric contractions, both in knee extensors and flexors. RFD-SF was particularly compromised in the knee flexors of non-dominant limb. It is unknown if this imbalance may be seen as a risk factor for musculoskeletal injury. However, since RFD-SF provides meaningful information about the quickness of producing force across a wide rage of contraction intensities, we advance that future study should investigate if RFD-SF imbalance may be considered as a risk factor.

Oral presentations

OP-BN51 Applied sport biomechanics 1

FRONT-CRAWL SWIMMING: DETECTION OF THE STROKE PHASES THROUGH 3D WRIST TRAJECTORY USING INERTIAL SENSORS

FANTOZZI, S.1,2, GATTA, G., MANGIA, A.2, BARTOLOMEI, S.4, DI MICHELE, R.4, NIGRO, F. 3,4, CORTESI, M.3

UNIVERSITY OF BOLOGNA

INTRODUCTION: The arm-stroke technique is a key factor for the improvement of swimmer performance using the hand as thrust. The arm-stroke cycle in front crawl is typically described by four phases (entry, pull, push, recovery), commonly expressed as a percentage of the stroke duration. To overcome the limitations of video-based motion analysis in swimming, Dadashi et al. (2013) and Callaway (2015) proposed two algorithms based on the angular velocity of the forearm or on the body roll position, respectively. This study introduces, for the first time, an approach for automatic temporal stroke phase detection in swimming using inertial measurement units (IMMUs) based on the 3D position of the upper arm. The validity of the proposed method is compared with a video-based system considered as gold standard.
METHODS: Kinematics of 6 national-level male swimmers was evaluated during 25m swimming trial performed at sub-maximal velocity. Data collection was performed using a IMMUs system (APDM Opals, 5 units, 128 Hz). IMMU devices were built and firmly fixed onto the swimmer body segments (thorax, upper-arms, and forearms). The four stroke phases duration (time between the following described events) were automatically recognized through an algorithm that identified the start events of arm-stroke phases: Tentry occured when the derivative of antero-posterior position of the wrist is for the first time lower than a threshold (60 cm/s); Tpull occurred when the derivative of medio-lateral position of the wrist is for the first time lower than a threshold fixed at -50 cm/s; Tpush occurred when the dorsal-ventral position of the wrist reach the minimum value; Trecovery occurred when the angle between the forearm and thorax anterior-posterior axes starts to decrease. The validation was performed using 2D sagittal video analyses as gold standard for temporal events identification.
RESULTS: The mean (±SD) values of the Tentry, Tpull, Tpush and Trecovery detected using 3DIMMU and TLC expressed as percentage of the stroke duration were 36.3 (± 9.3)%, 22.9 (± 7.3)%, 13.2 (± 3.1)%, 27.6 (± 3.7)% and 34.9 (± 8.8)%, 22.3 (± 7.6)%, 13.5 (± 3.3)%, 29.3 (± 4.3)%, respectively. A strong mean correlation (R=0.80) for the stroke phase duration was observed between two methods. The Bland-Altman plot indicated a good agreement and an acceptable mean error between the stroke phases detection with video-based and the IMMU methods (the bias and the limits of agreements were always lower than 1.8% and 4.4%, respectively).
CONCLUSION: The present findings confirmed the practical use of IMMU technology for the detection of the stroke phase based on upper arm trajectory. The obtained accuracy can be considered sufficient to satisfy the coaches and athletes training purposes.
REFERENCES:
Dadashi F, Crettenand F, Millet GP, Seifert L, Komar, J, Aminian K. (2013). J Sport Sci, 31(11), 1251-1260.
Callaway AJ. (2015). Sensors, 15(5), 11363-11386.

A KINEMATIC ANALYSIS OF THE TENNIS SERVE: INFLUENCE OF SERVE VELOCITY

FETT, J., VUONG, J., OBERSCHELP, N., FERRAUTI, A.

RUHR-UNIVERSITY BOCHUM

INTRODUCTION: In tennis, modern game has evolved from a primary technical to the current explosive sport becoming increasingly dynamic and faster. Coaches and scientists agree that the serve is one of the most important techniques in todays top level tennis. In the high performance tennis, the effectiveness of the first serve is substantially dependent on post impact ball speed. Consequently, identifying predictors of the service would be hugely valuable in developing and refining training strategies. In the present study, fast and slow servers of the elite male junior section were compared with respect to different kinematic parameters during the service motion.
METHODS: The service motion of five players with a fast serve in relation to their age group (group fast (F); serve velocity [V]>70% (data basis: n=853), age:14.2±1.2years, weight:60.3±10.5kg, height:173.8±11.9cm) were compared to those of five players with a low relative serve velocity (group slow (S); V<30% (data basis: n=853), age:15.2±1.0years, weight:52.4±9.1kg, height:169.7±11.2cm) by using a Vicon Motion Capturing System. A modified version of the whole body model originally designed by the University of Western Australia was used to record the kinematic parameters. Right-handed players served from the deuce court, left-handed players from the ad-court. After a brief warm-up consisting of serves with increasing velocity, eight first serves were performed. For comparative analysis of the parameters, the respective values of the fastest three serves were averaged.
RESULTS: Regarding the maximum angular range, the fast servers showed major lateral flexions during the preparation phase of the motion (F 16.9±2.5° vs S 10.5±5.4°; ES1.70; p<.05) as well as at impact (F 28.9±3.1° vs S 21.2±10.7°; ES1.09). This tendency was also evident for the maximum angular velocities for the knee extension of the rear leg (F 544.4±69.0°/s vs S 470.9±51.9°/s; ES-1.35), elbow extension (F 1729.5±195.5°/s vs S 1492.1±439.7°/s; ES-0.78) and internal rotation of the striking arm (F 2185.3±240.7°/s vs S 1911.7±239.0°/s; ES-1.28). Further, in the temporal difference of the maximum angular velocities to impact, divergences between the groups occurred with respect to the parameters of knee extension, core flexion, elbow extension and wrist flexion.
CONCLUSION: The results indicate that regarding movement characteristics only the lateral flexion differs amongst the groups while concerning the angular velocities more differences could be found. In this regard, especially the upper body power has to be highlighted (i.e. elbow extension, internal rotation). Furthermore, obtained results indicate divergences in the temporal motion coupling of the partial impulses (kinetic chain).
REFERENCES:
Girard O et al. (2005). Med Sci Sports Exerc, 37, 1021–29.
Kovacs MS. (2007). Sports Med, 37, 189–98.
Reid M et al. (2008). Med Sci Sports and Exerc, 40, 308-15.
ACKNOWLEDGEMENT:
The study was supported by the Federal Institute of Sport Science, Germany (ZMVI4-072017/16).

DIGITAL MONITORING OF CREW MOVEMENT AND SAILBOAT MANOEUVRABILITY IN ELITE-LEVEL OLYMPIC CLASS SAILING

SCHULTZ, A., CARTER, D., RALPHS, G., ELLIS, S.

UNIVERSITY OF NEWCASTLE

INTRODUCTION: Training models in sailing rely primarily on subjective identification of shortfalls in sailing technique for maneuvres of interest. Correspondingly, there is a paucity of research reporting objective variable analysis when describing the interaction between crew movement, sailboat maneuverability and environmental factors while sailing. This research aims to identify key variables contributing to sailing performance whilst maneuvering in elite-level 49er and 49erFX sailing.
METHODS: Three 49er (males, n=6, age 24±3.4 yrs) and three 49erFX (females, n=6, age 20±2.3 yrs) teams from the Australian Sailing Team and Australian Sailing Squad were recruited for this study. Prior to data collection inertial measurement units (IMUs) were placed on the T12 vertebrae of both the crew and skipper of each team, as well as on the hull of each skiff, in order to monitor sailors trunk movements and boat movement whilst sailing. On-board video sensors were located on each skiffs mast and stern, to record sailors positions on the boat, while enviro-sensors were located on a coach-boat to monitor wind speed and direction. Participants then performed 20 tacks and 20 gybes with maximal effort, in flat-water conditions, in wind speeds ranging between 5-14 knots.
RESULTS: Two-factor Principle Components Analysis revealed that sailing performance (velocity made good) whilst tacking in the 49er teams were primarily a factor of the sailors movements (accounting for 48% of variance in performance), and a combination of the sailors movements and positioning of the combined body mass of the crew on the boat whilst gybing (accounting for 51% of variance in performance), with lighter crews performing better. In contrast, sailing performance whilst tacking for the 49erFX teams were primarily a function of starting tack, increasing boat pitch during the middle-end portion of a tack, and to a lesser degree sailors movements (accounting for 72% of variance in performance). When gybing, sailing performance in the 49erFX teams were primarily a function of starting tack, increasing boat yaw during the start-middle portion of a gybe, GPS speed and sailors movements (accounting for 56% of variance in performance).
CONCLUSION: This research identified novel relationships between key sailing performance variables, and highlights sailing technique differences between 49er and 49erFX sailors. Further research is however needed to confirm the findings reported here. Future research should include IMU data post-processing in order to allow inverse-kinematic calculations to be performed. Specifically, mapping the plane and direction of the sailors movement relative to the boat whilst sailing should be a primary focus.

PROFILE OF ELITE TAEKWONDO COMBAT USING TIME MOTION ANALYSIS.

IONA, T., TORNELLO, F., VONO, S., AMMENDOLIA, A.

UNIVERSITY OF CATANZARO

INTRODUCTION: Taekwondo is an evolving Olympic Game: significant changes in patterns emerged over time, mirroring evolution of new competition rules adopted by the World Taekwondo Federation. Aim is to define the profile of elite Taekwondo athletes analyzing the time-motion of different combat phases (fighting: F, nonfighting: NF, and stoppage time: ST) during finals of 2017 World Taekwondo Championships in Korea.
METHODS: All finals, (three 2-minute rounds, with 1-minute rest in between) in official male weight categories were analyzed in order to evidence combat duration phases in relation to F, NF and ST phases and the number of tactical movements and technical exchanges in relation to F phase. A descriptive statistical analysis was applied to the study, data were presented as mean ± SD.
RESULTS: Data showed that mean duration for F phases in all weight-categories (2.9±2.5s) and for each official weight categories respectively (<54 kg.: 3.4 ±3.3s; <58 kg.: 2.7 ±2.2s; <63 kg.: 2.9 ±2.1s; <68 kg.: 3.4 ±3.3s; <74 kg.: 3.4 ± 1.9s; <80 kg.: 2.1 ±1.5s; <87 kg.: 1.9 ±1.0s; >87 kg.: 2.6 ±1.8s;) always lasted about equally than those of NF (3.2±2.4s) and respectively <54 kg.: 1.9±1.3s; <58 kg.: 3.7±2.3s; <63 kg.: 3.5±2.3s; <68 kg.: 2.0±1.1s; <74 kg.: 4.1± 2.4s; <80 kg.: 2.3±1.5s; <87 kg.: 4.2±3.1s; >87 kg.: 4.6 ±2.9s. The analysis of ST phase showed for all 13.7±18.9s and for each weight categories <54 kg.: 15.5±2.6s; <58 kg.: 9.4±1.0s; <63 kg.: 17.7±1.5s; <68 kg.: 28.8±3.7s; <74 kg.: 7.8±1.9s; <80 kg.: 20.8±3.3s; <87 kg.: 6.0±2.1s; >87 kg.: 7.1±1.8s. During F phase, 4.5±4.0 tactical movements and 3.1±2.9 technical exchanges were performed, these findings testify the intermittent nature of combat, characterized by a high occurrence of movements.
CONCLUSION: This may be consider one of the first attempt to define the actual combat performance model using time-motion analysis after last changes of the Competition Rules by World Taekwondo Federation (Nov-15-2016). Data demonstrated that, after 12 months from application of new rules, elite athletes tend to engage in fighting periods for around 3 seconds, alternating F and NF with a 1:2 ratio, compared to investigating activity profiles of elite TKD athletes in the past.
The elevated number of tactical movements and technical exchanges during F phases demonstrated the high intensity of combats. These results have important implications related to training program design and support the need for coaches to modify tactical and technical training of elite athletes.

LOWER LIMB EMG ACTIVIY INDUCED BY OVERLOADED MUAY THAI ROUNDHOUSE KICKS OF THE STRIKING LEG

CIMADORO, G.1, PAIZIS, C.2, BABAULT, N.2

1: SHAS; ST MARY'S UNIVERSITY TWICKENHAM , 2: UFR STAPS;

INTRODUCTION: In Muay Thai, the roundhouse kick is the most powerful striking technique (Cimadoro et al., 2018). Its biomechanical features were studied across different kicking styles (Gavagan and Sayers, 2017). However, no data exists about muscle activation when striking (Thai-style) with additional overloads. Muscle activation strategies should inform Muay Thai training to maximize striking impact force. Thus, the goal of this study was to quantify lower limb electromyographic (EMG) activity during Thai-style roundhouse kick with a loaded vest and an ankle weight cuff.
METHODS: Ten professional Muay Thai fighters (age=25.8±5.7yrs; height=174.4±9.4cm; mass=66.0±6.4kg) took part in this randomized cross-over trial. All were experienced (training11±7.2h/week) and free from lower-limb. After a warm-up fighters performed maximal roundhouse kicks against a 60kg bag. Three striking conditions 1) body weight (BW) 2) additional ankle weight (AW) and 3) additional loaded vest (VT) were randomly performed. Ten maximal strikes for each condition were executed with a rest of 24h between conditions. Peak EMG (pEMG) activity of gastrocnemius lateralis (GL), biceps femoris (BF), rectus femoris (RF) and vastus lateralis (VL) of the striking leg was recorded and normalised to a maximal voluntary contraction of each muscle.

RESULTS: A significant muscle effect was found ($p<0.05$). For BW, pEMG for BF was significantly lower than GL, RF and VL muscles ($p<0.05$). For AW, pEMG was significantly greater in BF as compared to RF ($p<0.05$). For VT, pEMG was significantly lower in BF as compared to GL and VL ($p<0.05$). There was a condition effect for all muscles ($p<0.05$). pEMG was significantly lower in AW condition as compared to BW and VT for GL, RF and VL. No difference was obtained between BW and VT for these three muscles. pEMG was significantly greater in AW condition as compared to BW and VT for BF muscle. No difference was found between BW and VT for BF.
CONCLUSION: BW showed greater RF, VL and GL pEMG activity compared to BF providing the standard muscle activation behaviour. AW promotes greater BF activation compared to RF. Probably there is a greater effort to extend the hip to restore boxing stance implying a change of coordination strategy, making AW an exercise option to emphasize hip extensors recruitment, and to alter knee extensor muscles coordination. VT potentially matches muscle activation behaviour of the BW perhaps because it is less of a constraint on the striking leg reducing coordination changes during the swing phase otherwise produced by AW. VT may enhance the muscle activation without coordination changes

SPRINT FORCE-VELOCITY PROFILING: ABILITY TO PREDICT BOBSLEIGH PUSH START PERFORMANCE

CONDLIFFE, R.1,2, OLIVER, J.1,3, LLOYD, R.1,3, CRONIN, J.3, WOOLLEY, C.2

CARDIFF METROPOLITAN UNIVERSITY

INTRODUCTION: In bobsleigh, the push start has been identified as an important component of successful performance (Brüggemann et al. 1997). Previous literature has shown a link between the push start and sprint time over distances up to 100m (Osbeck et al. 1996). However, which mechanical properties of sprint performance underpin this relationship is not fully understood. Therefore, the aim of this study was to compare the bobsleigh push start predictive ability of traditional sprint split times measured in elite bobsleigh and force-velocity mechanical variables quantified during sprinting.
METHODS: Eleven elite male bobsleigh athletes (mean ±SD: age 27 ± 4 yrs.; mass 98.4 ± 8.3 kg; height 185 ± 6 cm) performed a maximal 60m sprint. Split times were collected using the standard elite bobsleigh protocol of 30m and 60m timing gates. Also, during the sprint each athletes force velocity mechanical profile was modelled using the validated split time method (Samozino et al. 2016), with additional gates placed at 5m intervals up to 25m. On a separate occasion, all athletes undertook a push start assessment on an outdoor track, with performance measured over a 50m section (15-65m). Pearson correlation coefficients were determined to assess the push start predictive ability of traditional sprint split time measurements (30m, 30-60m & 60m), as well as sprint force velocity mechanical variables.
RESULTS: Moderate to large relationships were observed for push start performance with 30m ($r = 0.69$, $P < 0.05$), 60m ($r = 0.59$, $P < 0.10$) and 30-60m flying sprint time ($r = 0.42$). A very large correlation was detected between the push start and absolute maximal power ($r = -0.80$, $P < 0.05$). Finally, the push start was shown to be either moderately or largely related to the remaining force velocity mechanical variables; relative maximal power ($r = -0.55$, $P < 0.10$), theoretical maximal force ($r = -0.58$, $P < 0.10$), relative theoretical maximal force ($r = -0.37$), theoretical maximal velocity ($r = -0.37$) and velocity at maximal power ($r = -0.38$).
CONCLUSION: The results indicate that force velocity profiling during sprinting may have better push start predictive value than traditional split time measurements. Hence, practitioners in bobsleigh looking to enhance push start performance should tailor training programmes towards optimising power during sprinting.
REFERENCES:
Brüggemann GB. Morlock M. Zatsiorsky V. (1997). J Appl Bio. 13. 98-108.
Osbeck J. Maiorca S. Rundell K. (1996). JSSR, 10(4), 239-245.
Samozino P. Rabita G. Dorel S. Slawinski J. Peyrot N. Saez de Villarreal E. Morin JB. (2016). Scand J Med Sci Sports, 26(6), 648-658.
CONTACT:
rocondliffe@cardiffmet.ac.uk

Mini-Orals

MO-SH04 Psychological skills, well being and performance in sport

THE EFFECT OF PETTLEP IMAGERY IN OPEN AND CLOSE SKILL OF BADMINTON.

SIRIPATT, A.

SRINAKHARINWIROT UNIVERSITY

The Effect of PETTLEP Imagery in Open and Close Skill of Badminton.
Siripatt, A., Luangon, S., Puengsoonthonsirimas, T., & Boonveerabut, S.
(Srinakharinwirot University, Thailand)
Introduction: Badminton serves (BS) and returning badminton serve (RBS) are very important in the badminton game, that very fast and a lot of pressure, so new player hard to control BS and RBS. BS is a closed skill. They are distraction free and are given the opportunity to serve the shuttlecock by uninterrupted. RBS is an open skill that takes place in a dynamic and changing environment. Player trying to move around the court for return serve and multiple other variables that could affect them. The use of sports psychology techniques is an alternative for help new player to control their abilities. This study explores the effect of PETTLEP imagery in open and close skill of badminton sport.
Methods: Eighty male who no experience in badminton, sport imagery and competition. Accuracy scores were divided into 4 groups; G1a practice BS only, G1b practice BS with PETTLEP, G2a practice RBS only and G2b practice RBS with PETTLEP. The data collecting from BS and RBS accuracy test at before training, after week 4 and week 8 of participating the program. Mean, SD, t-test, one-way ANOVA with repeated measures, and Bonferroni were used to analyze the data significant at .05 level.
Results: The results revealed that, there were significant difference within BS groups (G1a, G2a) ($p<.001$) and RBS groups (G1b, G2b) ($p<.05$) between prior, 4th wk. and 8th wk. There were no significant difference between group a and b of BS and RBS. However, the group practiced badminton with PETTLEP Imagery model training showed better results than those who practiced the badminton only.
Discussion: This research shown that practiced BS and RBS with PETTLEP imagery model training showed tendency better results than badminton skill only, due to imagery is what happens in the mind, which caused physical characteristics that can't be determined. The 7 components of PETTLEP model are the imagery of physical, environment, task, timing, learning, emotion and perspective. Each letter of

the PETTLEP acronym represents an important issue to consider when implementing imagery interventions. The model was originally designed to be used as a minimum checklist when designing imagery interventions (Holmes & Collins, 2001). Understood that the imagery is not limited to still images. It means motion pictures and can change with conditions. (Morris, et al., 2005). PETTLEP imagery model combined with skills training, allows the beginner to learn and had experiences in their mind similarly actual practice.
References: Holmes, P.S. & Collins, D.J. (2001). The PETTLEP approach to motor imagery: A functional equivalence model for sport psychologists. Journal of Applied Sport Psychology, 13(1), 60-83.
Morris, T., Spittle, M. & Watt, A.P. (2005). Imagery in Sport. Illinois: Human Kinetics.
Contact: apanchanit@g.swu.ac.th

UNDERSTANDING THE MENTAL CHALLENGES ENCOUNTERED IN ELITE FOOTBALL-A BRIEF SURVEY.

THOMPSON, C., TOWLSON, C., SKORSKI, S., FRANSEN, J., MEYER, T.
SAARLAND UNIVERSITY

Understanding the mental challenges encountered in elite football-A brief survey.
Thompson, C. 1, Towlson, C. 2, Skorski, S. 1. Fransen, J. 3, Lane, A. 4. Coutts, A. 3. Meyer, T. 1.
1: ISPM (Saarland, Germany), 2: UoH (Hull, England), 3: UTS (Sydney, Australia), 4: UoW (Wolverhampton, England)
Introduction: Mental fatigue is a psychobiological state experienced following exposure to cognitively demanding tasks. Five studies have collectively shown that exposure to prolonged demanding cognitive activity has a negative influence on physical, technical, tactical, decision making and skill performance in football (Badin et al., 2016; Smith et al., 2016a; Smith et al., 2016b; Coutinho et al., 2017; Smithet al., 2017). The current literature has predominantly used a 30 minute modified Stroop task to induce mental fatigue, which provides low ecological validity in football. Furthermore, all aforementioned studies have investigated recreational/sub elite players. It is possible that the cognitive demands of the modified Stroop task may differ compared to the cognitive demands faced in the multifaceted lifestyle of a football player. Therefore, it is imperative to explore the real life tasks completed by elite football players to detect mentally demanding activity.
Methods: 21 elite football players from the Swedish 1st Division completed an online survey (Eanalyzer.com) consisting of five overall themes: Travel, Training, Pre Match, Match-play and Fixture congestion. Questions were related to the occurrence and frequency of numerous lifestyle activities, along with player perception of the mental demands of several football related scenarios.
Results: Overall, the mental demands of all five themes were reported as low. 85.7% of players drive their car to training in a journey lasting up to 30 minutes. Players perceive the intake of tactical information from coaches as either never (19%) or rarely (81%) mentally demanding. The mental demands of fixture congestion were reported to be low (9.6% somewhat agree, 4.8% strongly agree).
Discussion: These results interestingly show a low perceived mental demand of lifestyle activities, and of the matches, even in a congested period. These results may possibly differ in players from more prominent elite leagues, which are likely to have greater media coverage, further travel demands and exacerbated pressure to succeed.
References: Badin, O. O., Smith, M. R., Conte, D., & Coutts, A. J. (2016). IJSPP, 11 (8), 1100-1105.
Coutinho, D, Gonçalves, B, Travassos, B, Wong, P, Coutts, A, Sampaio, J. (2017). Front Psychol, 8, 1645.
Smith, M, Coutts, A, Merlini, M, Deprez, D, Lenoir, M, Marcora, S. (2016a). Med. Sci. Sports Exerc, 48 (2), 267-276.
Smith, M, Fransen, J, Deprez, D, Lenoir, M, Coutts, A. (2017). Science and Medicine in Football, 1 (1), 48-52.
Smith, M. R., Zeuwts, L., Lenoir, M., Hens, N., De Jong, L. M., & Coutts, A. J. (2016b). J Sports Sci, 34 (14), 1297-1304.
Contact: chris.thompson@uni-saarland

THE INDEPENDENT EFFECTS OF MATCH LOCATION, MATCH RESULT AND THE QUALITY OF OPPOSITION ON SUBJECTIVE WELL-BEING IN UNDER 23 SOCCER PLAYERS: A TEAM CASE STUDY.

CLIFFORD, T.1, BROWNLEE, T.2, HARPER, L.D.3, NAUGHTON, R.J.3, ABBOTT, W.4
NEWCASTLE UNIVERSITY

INTRODUCTION: Although it has been established that subjective measures of wellbeing, such as mood and sleep, are sensitive to changes in training load, less is understood about the non-physical factors that could affect subjective wellbeing. Such non-physical factors include the situational variables, match location, the quality of the match opposition, and the match result. The aim of this study was to establish whether subjective wellbeing was affected by match location, match result and the opposition quality in a team of professional soccer players.
METHODS: Eleven male soccer players from the under 23 squad of a Premier League 2 team in England participated in this study (Age, 19.5±1.2years; height, 1.80±5.20m; body mass, 76.1±7.5kg). Before (PRE), 1 day (POST-1), and 3 days (POST-3) following 17 matches subjective wellbeing (mood, stress, soreness, sleep quality and fatigue) were recorded. Each was scored between 1-5; 1 representing a positive score and 5 a negative score. Match training loads were estimated from session-rating perceived exertion (sRPE) scores. A repeated measures ANOVA was used to explore interaction effects in the subjective wellbeing variables and the situational variables over time (PRE, POST-1, POST-3).
RESULTS: Match training loads (sRPE) did not differ, regardless of the location, result, or quality of opposition faced ($P>0.05$). None of the subjective wellbeing measures were different at PRE ($P> 0.05$); however, at POST-1 and POST-3, stress and mood were =20% lower after playing away from home or losing ($P<0.05$). Stress, mood and sleep were =12% worse after playing against a higher-level opposition at POST-1. Sleep quality was worse at POST-1 after playing a top-team vs. a bottom team (3.6±0.4 vs. 3.1±0.5, respectively; $P=0.033$; ES=0.99). Similarly, stress was higher and mood lower at POST-1 after playing against top teams vs. bottom teams ($P<0.05$).
CONCLUSION: This study provides the first evidence that the quality of opposition, and especially the match location and match result, might negatively influence the subjective wellbeing of soccer players for several days after matches. These findings highlight that practitioners working in soccer might need to factor in the potential influence of these specific situational match variables when prescribing training load between matches. The data also suggests that players might need additional psychological support (e.g., effective coping strategies) after fixtures that might be affected by these specific variables.

EFFECTS OF STAR WATCHING EXPERIENCES ON THE SENSE OF HUMAN'S SPIRITUALITY AND ON OTHER PSYCHOLOGICAL FACTORS.

KIJI, M.1, KASE, T.2, NIGORIKAWA, T.3

RIKKYO UNIVERSITY

Introduction: Many studies have shown that human's health and spirituality have close relations. Our previous study revealed that there would be certain relations between the habits of daily exercise and the tendency of spirituality. On the other hand, several studies mentioned that staying in the natural field could enhance one's sense of spirituality. Moreover, our previous study also showed that outdoor activities could enhance one's tendency of spirituality more efficiently than ordinary competitive sports. However, there are many kinds of outdoor activities, which are extremely varied. This study focused on the act of watching stars as an outdoor activity being generally supposed to deeply impress a lot of people (in different ways), and it tried to examine the effects of star watching on the sense of human's spirituality and on other psychological factors.
Methods: The subjects of the study consisted of 22 male and 22 female university students (mean age = 20.0). They were divided into two groups: the natural star watching group (n=21) and the planetarium group (n=23). Further, these two groups were also divided into the high spirituality group and the low spirituality group, respectively. The tendencies toward spirituality and health were measured using The Japanese Youth Spirituality Rating Scale (JYS). Other psychological factors measured in this study were as follows: The Purpose In Life Test (PIL), Profile of Mood States (POMS) and The Natural Health Questioner (GHQ). Finally, PIL, POMS and GHQ scores were compared before and after the act of watching stars.
Results: In regard to POMS, there was no significant difference between the high spirituality group and the low spirituality group in the natural star watching group. However, for the planetarium group, there were significant differences in several factors between the high spirituality group and the low spirituality group regarding the POMS. These factors were Depression-Dejection ($p<.05$), Vigor-Activity ($p<.10$) and Friendship ($p<.05$). The other psychological factors as for PIL and GHQ, there was no significant difference between the high spirituality group and the low spirituality group.
Discussion: Our previous study suggested that outdoor activities could enhance one's tendency of spirituality. As one outdoor activity, this study aimed to examine effects of star watching on the sense of human's spirituality and other psychological factors. As a result, it was revealed that there was only a small relation between one's tendency of spirituality and the effects of watching stars. Further investigation is demanded to clear this relation because this study could not prepare and test a sufficient amount of subjects.

THE EXAMINATION OF FEAR-AVOIDANCE BELIEFS AS A PSYCHOLOGICAL REACTION TO MUSCULOSKELETAL INJURY IN MALE ADOLESCENT GAELIC FOOTBALLERS

OKEEFFE, S., NÍ CHÉILLEACHAIR, N., OCONNOR, S.

ATHLONE INSTITUTE OF TECHNOLOGY

Introduction: Participation in Gaelic football provides a wealth of benefits but a risk of musculoskeletal injury also exists, bringing obvious physical consequences. However, concurrently associated psychological consequences can also occur, such as fear-avoidance beliefs and behaviours. No previous research has examined fear-avoidance as a psychological response to injury in the GAA. Therefore, the aim of this study is to examine fear-avoidance beliefs in male adolescent Gaelic footballers post-injury.
Methods: Male adolescent Gaelic footballers (n=97, 13.4±1.1 years) were recruited. A modified Athlete Fear Avoidance Questionnaire (mAFAQ) was completed at baseline as a predictor of fear-avoidance beliefs. Injuries were assessed and recorded weekly by a Certified Athletic and Rehabilitation Therapist using a standardised injury report form. An injury was defined as any injury sustained during training or competition resulting in restricted performance or time lost from play. Injuries that required the player to miss time from Gaelic football participation were classed as time-loss injuries. The athlete completed the Athlete Fear Avoidance Questionnaire (AFAQ), a measure of injury related fear-avoidance following injury assessment (AFAQ1). With time-loss injuries, the AFAQ was completed again (AFAQ2) prior to return to play.
Results: Twenty-two injuries were recorded during the season. Fear-avoidance beliefs were evident in male adolescent Gaelic footballers who sustain time-loss (26.8±4.9) and non-time-loss (21.0±7.2) injuries, however, no significant difference between both was noted ($p>0.05$). With time-loss injuries, fear avoidance beliefs decreased significantly before return to play (14.3±4.9) ($p=0.01$). Significant moderate correlations were evident between AFAQ1 and pain at the time of injury ($r= 0.563$; $p= 0.006$) and at the time of injury assessment ($r= 0.596$; $p=0.003$). However, no significant relationships were found between AFAQ2 and pain or between time loss from Gaelic football participation and AFAQ ($p>0.05$). Previous injury was a significant predictor of AFAQ2 scores ($p=0.003$) only. Baseline mAFAQ and previous injury were not significant predictors of injury and mAFAQ was not a significant predictor of AFAQ1. Similarly, mAFAQ, AFAQ1 and AFAQ2 were not significant predictors of time loss from Gaelic football participation.
Conclusion: Male adolescent Gaelic footballers experience fear-avoidance beliefs post-injury that decrease before return to play in those who sustain a time-loss injury. Greater pain at the time of injury and at the time of injury assessment by a clinician indicates greater fear-avoidance beliefs. Appropriate intervention programmes are necessary for addressing potential psychological barriers to rehabilitation.

DISCRETE AIMING MOVEMENT OF NON-DOMINANT HAND USING WIIMOTE

KIM, H.

PURDUE UNIVERSITY

INTRODUCTION: A combination of speed and accuracy is a critical aspect to determine whether a successful performance or not. Fitts(1954) quantified the speed-accuracy trade-off, which is the most robust relation in motor control and discovered the log-linear relation between the movement time and ID (index of difficulty). We addressed whether Fitts law also holds for non-dominant hand, furthermore whether the performance of the non-dominant hand can enhance through extended practice. Therefore, the purpose of this study is to assess the non-dominant hand movement on discrete aiming task and the effect of practice.
METHODS: Three experimental conditions were assigned to the subjects. A handheld Wiimote was used and the measurement of acceleration was obtained from Wiimote accelerometer during every trial by open-source software. Subjects performed a discrete aiming movement with the distance (D) of 32 cm and with the differently sized target width (W) of 4 cm, 1 cm, and 0.25 cm. Thus, the ID of the task was 4 (easy), 6 (moderate), and 8 (difficult) respectively. Each subject completed the task with left hand (or non-dominant) and right hand (or dominant). The total number of trials was 450 (10 trials x 3 conditions x 15 blocks) for left hand and 450 (10 trials x 3 conditions x 15 blocks) for right hand as well.

RESULTS: The mean value of the right-handed was 0.916 s (SD: 0.489) and 1.087 s (SD: 0.321) in the result of the movement time regardless of task conditions. There was no significant difference between the means of movement time (t88=-1.954, p=0.053), however very close to being statistically significant. In the easy task, the movement time for the right hand was 0.659 s (SD: 0.116) and the velocity was 49.905 cm/s, 1.077 s (SD: 0.409) and 32.724 cm/s for the left hand in average. In the moderate task, the movement time for the right hand was 0.829 s (SD: 0.107) and the velocity was 39.149 cm/s, 1.108 s (SD: 0.353) and 31.356 cm/s for the left hand in average. In the difficult task, the movement time for the right hand was 1.26 s (SD: 0.723) and the velocity was 32.724 cm/s, 1.075 s (SD: 0.181) and 30.578 cm/s for the left hand in average. As the ID of the task increases the movement time increases and the velocity decreases contrarily.
CONCLUSION: We predicted that the right hand would show superior performance than the left hand, however, no significant difference between the dominant hand and non-dominant hand was found regardless of task difficulty. Also, this study showed that the dominant hand took more time to perform the tasks in different task conditions. On the contrary, the non-dominant hand took similar time to perform the tasks regardless of task difficulty. The results indicated that an increase in the movement time with a decrease of speed, as well as we couldnt find out the effect of practice. Future research should include more task conditions and more participants to examine and compare.

Oral presentations

OP-SH01 Inclusion

BEING DERBY: NEGOTIATING BELONGING IN THE ROLLER DERBY SCENE

ALEXANDER, J.

WESTERN SYDNEY UNIVERSITY

Contemporary roller derby has been widely recognised in scholarly work and popular culture as a womens, Do-It-Yourself, grassroots level sport that maintains a shared By the skaters, for the skaters mantra. In valorising skater practice, however, there can be an erasure and dismissal of other modes of involvement and more fluid relationships with roller derby. A further consequence is a failure-both in academia and roller derby life-to recognise the potential continuities between groups of individuals (such as skaters and spectators) in their involvement practices and feelings of attachment and belonging to roller derby. This paper is concerned with the question who is roller derby? Using data generated through an ethnographic study of roller derby, I argue that regardless of their role, participants utilise a language of desire-for belonging, community, bodily challenges, and for something different in their lives-to make sense of their attraction to roller derby and motivation for joining. Central amongst these is a pursuit for more involvement; where more signifies movement, transformation, and alterations to social, cultural, and sensory affordances that facilitate feelings of inclusion, connection, community, and belonging. By not privileging skater experiences in my analysis of participants elective belongings, I aim to illuminate some of the ways that non-skaters (such as spectators, non-skating officials, announcers, and media producers) navigate the roller derby scene and actively pursue inclusion in the communal identity of being derby.

A CROSS-NATIONAL STUDY OF POLICIES FOR PARALYMPICS IN UK, GERMANY AND JAPAN: INCLUSION OR EXCLUSION?

YAMAGUCHI, Y.

KOBE UNIVERSITY

A CROSS-NATIONAL STUDY OF POLICIES FOR PARALYMPICS IN UK, GERMANY AND JAPAN: INCLUSION OR EXCLUSION?
Yamaguchi, Y.1, Tanaka,N.2, Okuda, M.3
1:Kobe University (Kobe, Japan), 2:Toin University of Yokohama (Yokohama, Japan), 3. Kyoto Sangyo University (Kyoto, Japan)
Introduction: Since the inclusion strategy of the London Organizing Committee of the Olympic and Paralympic Games (LOCOG) produced significant changes in people's attitude toward Paralympic Games as well as the disabled. In IOC congress in Rio de Janeiro in 2013, Tokyo was selected as a host city for the 2020 Olympics and Paralympics. We have a national training center for Olympics in Tokyo, although there is no place for Paralympic athletes. As a result, an important theme of discussions rises "inclusion or exclusion". The purpose of this study was to compare the policies and training centers for Paralympics in UK, Germany and Japan.
Methods: Field works were conducted in UK, Germany and Japan in 2014. Interviews were also undertaken to 16 government staffs, coaches and researchers in UK, 3 in Germany, and 25 in Japan. Interviews consisted of organizational structures (government, NF), national and regional training centers, support from sport medicine and sciences, and relationship with NOC. Content analysis was applied to the data and information by using triangulation methods among three researchers.
Results: Sport in UK has been governed by Department of Culture, Media and Sports (DCMS). National training centers for Paralympic athletes are located in each region. UK Sport focuses on Olympics and Paralympics, while their policy is the "concentration and centralization". Each NF sets training centers with quality standard. Paralympic athletes receive financial aid with different amount based on evaluation standard.
Under the Ministry of Interior in Germany, German Paralympic Sport Federation (DOSB) is the central body. German Disability Sport Federation (DBS) and National Paralympic Committee Germany (NPC) control disability sport. Germany is the federal state, while DBS collaborates each state to promote disability sport with regional training facilities.
Influenced by the enactment of Sport Basic Law (2011) in Japan, the promotion division for disability sport moved from Ministry of Health and Welfare to the Ministry of Education, Culture, Sport, Science and Technology (MEXT) in 2014. In same year 2014, advisory board on training and research centers for Olympics and Paralympics was established. Japan Olympic Committee (JOC) emphasized the NTC in Tokyo is for the athletes of JOC and there is no place for Paralympic athletes.
Japan Paralympic Committee (JPC) insisted to construct new NTC for only Paralympic athletes.
Discussion: The findings of this study provide some insights into the inclusion subject in sport. First, policy of social inclusion and inclusion sport has been pervasive in UK and Germany. Cooperation and collaboration between Olympic sport and Paralympic sport have been promoted. Furthermore, co-use of National/regional training centers among Olympians and Paralympians is taken for granted.
Second, one of the major reason for the inclusion policy is the enactment of the Disability Discrimination Act. UK government enacted the Disability Discrimination Act in 1995. Finally, Japanese government adopted the inclusion policy for the Olympic and Paralympic athletes

in 2014. In 2018, current NTC in Tokyo renovated to universal design for Paralympic athletes, while new co-use NTC has been constructing for Tokyo Olympic and Paralympic Games in 2020.
References: Yamaguchi, Y. (2014:ed.) A Research Report on Training and Research Centers for Top Athletes. An Investigation Entrusted by MEXT, Kobe University.
Contact yasuo@main.h.kobe-u.ac.jp

LEVERAGING TOKYO 2020: CAN THE OLYMPIC AND PARALYMPIC GAMES CHANGE BEHAVIORAL INTENTION FOR PHYSICAL ACTIVITY AND SPORTS PARTICIPATION AMONG MIDDLE-AGED AND OLDER ADULTS IN JAPAN?

ANNEAR, M., SHIMIZU, Y., SATO, K., TAKANASHI, M., YAMAUCHI, H., KIDOKORO, T.
INTERNATIONAL CHRISTIAN UNIVERSITY

Introduction: Middle-aged and older Japanese people are long-lived, yet comparatively inactive and frail compared to cohorts in similarly developed nations. With a rapid increase in the 65 and older cohort, preventable and age-associated chronic diseases are also rising in Japan and interventions are required to arrest this public health challenge. Physical activity and sport participation have been shown to compress morbidity in later life, yet few population-level interventions have succeeded at mobilizing inactive cohorts. We hypothesize that consolidated environmental changes, public health marketing, and psycho-social factors associated with hosting the Tokyo 2020 Olympic and Paralympic Games offer a potential population-level intervention to support behavior change in Japan.
Methods: Two complementary research approaches inform this study. A systematic literature review consistent with the international PRISMA guidelines was undertaken to assess global evidence for reported physical activity outcomes among middle-aged and older adults associated with hosting mega-sporting events. A subsequent Delphi study with academics from across the Asia-Pacific region was undertaken to assess expert consensus regarding middle-aged and older-adult activity levels, barriers and facilitators to participation, and legacy outcomes associated with previous regional Olympic hosting. Experts were deliberately selected for their knowledge in the areas of gerontology, sports and recreation studies, and population health.
Results: Research into the effects and outcomes of hosting mega-sporting events suggests that physical activity related behavior change is a potentially achievable outcome of the Tokyo 2020 Games. However, a coordinated and multifaceted approach will be required to achieve population-level behavior change. Regional experts highlighted that challenges of motivating aging populations to higher activity levels, including overcoming age-related social norms and environmental constraints. In the Asia-Pacific region, research into physical activity and sports related outcomes of mega-events is limited in scope and rigor and there has been a lack of systematic data collected before and after regional Olympic Games to facilitate effective comparisons. This suggests that there is a rapidly closing window within which to establish baseline measures prior to Tokyo 2020.
Discussion: A range of evidence-informed scenarios are identified for facilitating behavior change interventions with middle-aged and older adults in Japan. Options for environmental remediation and sustainability, policy changes, health marketing, and psycho-social interventions are explored with reference to the international literature and regional expert consensus. Options for baseline research are also presented to facilitate accurate assessments of physical activity, sports participation and potential behavior change prior to Tokyo 2020.

A STUDY ON CHILDRENS PHYSICAL GAMES OF MINORITIES IN SICHUAN

YAJING, D.
GUANGZHOU UNIVERSITY

A STUDY ON CHILDRENS PHYSICAL GAMES OF MINORITIES IN SICHUAN
Yajing Du.1,Ye Guo.2 1:GZU (Guangzhou,China), 2: GZU(Guangzhou, China)
Background
Minority sports play a big important role in Chinese traditional culture. Childrens game is not only an integral part of minority sports, but also the only way for children to socialize. Although there are few studies focusing on minority childrens physical games, we cannot deny the fact that researches on childrens physical games have a positive impact on children's healthy growth and the internationalization of Chinese culture.
Objective
By studying the minority childrens physical games and classifying the games of different minorities, this thesis aims to find out the factors that impact the development of physical games and provide certain theoretical references for the inheritance and improvement of traditional Chinese culture and enrich children' life and entertainment.
Methods: This study mainly focuses on four representative minorities of childrens physical game in Sichuan, including the minorities of Yi, Qiang, Tujia and Zhuang. The first method is by the literature, to know their customs and childrens physical games of the four minorities. The second step is to use field study method to respectively investigate into childrens physical games of minorities of Yi, Qiang, Tujia and Zhuang and to conduct a detailed investigation. The third step is to make interviews with 184 subjects about the types of ethnic childrens physical games, methods, rules and the environment of the games. Physical games of children in this thesis were all collected and sorted out from their memories and dictations. Meanwhile, the games of the four ethnic groups were also classified.
Results: The minority childrens physical games of Yi, Qiang, Tujia and Zhuang were divided into three categories: physical games, games played with equipments, and intelligence-promoting linguistic game; Compared with the majority (Han nationality), childrens physical games of the minorities have their unique characteristics: generally speaking, the game of the minorities fit in with their natural environment, in combination with the characteristics of their geography and climate. And the minorities play the games in their traditional festivals. Besides, the games also reflect their ethnic beliefs and myths; The constraints of the game development mainly caused by the changes in living environment, the impact of network technology and the integration of external cultures.
Conclusion
There are high quantities of sports games for minority children in Sichuan, and the traditional culture is preserved, which has been reflected in the games. Through the study of childrens physical games of minorities in Sichuan, we can see that there are big differences between the minorities and the majority (Han nationality); however, due to the continuous development of modern society, many games are gradually disappearing.
Contact: yajingdu@yahoo.com

SOCIAL INTEGRATION OF REFUGEES IN GERMAN SOCIETY: BETWEEN PRACTICING SPORTS AND CLUB'S RESPONSIBILITY

ABDELKHALEK, M.

FACULTY OF PHYSICAL EDUCATION, MANSOURA UNIVERSITY, EGYPT.

Social Integration of Refugees in German Society: Between Practicing Sports and Club's Responsibility
Abdelkhalek, M.
Faculty of Physical Education, Mansoura University, Egypt
Introduction: Crises of revolutions recently have left a continuous increase in the influx of refugees in Germany. Cultures, attitudes, and beliefs variation impose some challenges towards integration of refugees in the society. Therere about 91000 sports clubs spread throughout Germany, which shall contribute to integration process based on refugees needs through two pathways; practicing sports and clubs social responsibility and these are the research aims.
Methods: The qualitative approach was utilized by documentary analysis of clubs initiatives and activities (N=18). Consequently, semi-structured interviews were conducted with individuals: members or athletes in sports clubs (N=27). Samples were selected by a snowball sampling (Patton, 1990). The interview questions were about ideas that consider in relation to "What are the integrations barriers?" "How practicing sports contribute to integration?" "What are the predictions from sports clubs institutionally?"
Results: Documentary and thematic analysis indicated two themes; a) Personal and social aspects of practicing sports. b) Integration core social issues (ICSI) by sports clubs. So the Foucauldian theoretical lens was utilized to interpret how (a) and (b) are working as a formula to accelerate the integration process.
Conclusion
This study highlights how sports organizations have the power to appeal and communicate with people (Tacon and Walters, 2010). Practicing sports conclude personal skills that change refugees behaviours such as; self-confidence, adaption to stress and getting rid of shyness. Also, it involves many social skills like; acceptance of others with different cultures and religions, friendship, social dialogue and socio-psychological security. Alongside, ICSI by sports clubs have been determined as a multidimensional concept to express the soft power of sports clubs in social interaction, further treating the integration barriers which create social problems in society. ICSI should be managed by sports clubs or in conjunction with other organizations in light of national integration plans to establish human solidarity and social responsibility values. Therefore, ICSI can achieve the integration across the awareness with these issues; a) Legal knowledge, human rights and equality. b) Renounce violence and racism and spreading reconciliation culture. c) Maintenance of environment and resources. d) Participation in community development. e) Personal, social and educational development. f) Health.
References: Patton, M. 1990, Qualitative Evaluation and Research Methods, Beverly Hills, CA: Sage.
Tacon, R. and Walters, G. 2010, Corporate Social Responsibility in Sport: Stakeholder Management in the UK Football Industry, J. of Management and Organization, 16(4): 566-586.
Contact: dr_m_mamdouh@mans.edu.eg

09:45 - 11:15

Invited symposia

IS-BN06 Force-Velocity-Power profiling in explosive sports, from theory to field methods and training applications

FORCE-VELOCITY-POWER PROFILING: THEORY AND CONCEPTS

SAMOZINO, P.

UNIVERSITY SAVOIE MONT BLANC

INTRODUCTION: Force-Velocity-Power profiling: theory and concepts
SAMOZINO, P.
University Savoie Mont Blanc, LIBM (Chambéry, France)
The mechanical capabilities of the lower limb neuromuscular system have been well described by inverse linear force-velocity (FV) and maximal power output (Pmax) during various multi-joint movements, characterizing the Force-Velocity-Power (FVP) profile. Maximal force quality represents the capability to produce high level of force at low velocities while maximal velocity quality refers to the capability to develop force at high movement velocities. Accelerating its own body mass as quickly as possible (jumps, sprint acceleration), which are a key factor of performance in many sport activities, have been shown to largely depend on Pmax. Since Pmax can be improved by shifting the force or velocity sides of the FV curve, recurrent questions scientists, coaches or athletes ask when exploring/training factors for optimizing such a performance are to know how to evaluate FV relationships in field conditions and what to focus on: force or velocity capability?
Macroscopic biomechanical models applied to the body center of mass during jumping and sprinting were developed to propose new simple field methods and original concepts to better understand and improve such performances.
A computational method was validated to determine individual FVP profile from 3 simple parameters obtained during loaded jumps: body mass, extension range and jump height (Samozino et al 2008). Recently, another simple method was validated to assess sprinting FVP profile from only anthropometric and spatiotemporal data obtained during one single overground running acceleration (Samozino et al 2016). Both methods present high reliability and concurrent validity when compared to force plate measurements.
Biomechanical models made possible to show that, in ballistic movements (jumps), an optimal FV profile (slope of the FV relationship) exists for each individual and maximizes performance (Samozino et al 2012). The relative difference between actual and optimal FV profiles for a given individual characterizing the unfavorable balance between force and velocity qualities, and in turn individual force or velocity deficit. The same finding of an individual optimal FV profile as been obtained in sprinting (publication in progress).
This concept of optimal FV profile maximizing performance in jumps and sprints were then supported by experimental data showing that actual performance is affected by both Pmax and the magnitude of force or velocity deficits computed from optimal FV profile.
References: 1-Samozino P, Morin JB, Hintzy F, Belli A. (2008) J Biomech 41:2940-5

2-Samozino P, Rabita G, Dorel S, Slawinski J, Peyrot N, Saez de Villarreal E, Morin JB. (2016) Scand J Med Sci Sports 26:648-58
3-Samozino P, Rejc E, Di Prampero PE, Belli A, Morin JB. (2012) Med Sci Sports Exerc 44:313-22
Contact: pierre.samozino@univ-smb.fr

FORCE-VELOCITY-POWER PROFILING: TRAINING APPLICATIONS IN BALLISTIC MOVEMENTS

JIMENEZ-REYES, P.

CATHOLIC UNIVERSITY OF SAN ANTONIO, MURCIA, ESPAÑA

INTRODUCTION: Ballistic performances are determined by both lower limb maximal power output (Pmax) and individual force-velocity (FV) mechanical profile, especially the FV imbalance (FVimb): difference between the athlete's actual and optimal profile maximizing this kind of performances (Samozino et al. 2014; Samozino et al. 2012). FVimb makes possible to quantify the magnitude of individual force and velocity deficits. Thus, training program designed based on individual FVimb (optimized training) could be efficient to improve ballistic performance (Jiménez-Reyes et al. 2017; Morin & Samozino, 2016). The aim was therefore to test the effectiveness of such an optimized training on jumping performance.
The actual individual F-v profile and Pmax can be easily determined from a series of loaded vertical jumps (Jiménez-Reyes et al. 2016; Samozino et al. 2008, 2014), while the optimal F-v profile can be computed using previously proposed equations based on a biomechanical model (Samozino et al. 2012, 2014). The key FVP outputs (maximal theoretical force, velocity and power, and FVimb) may help better characterize athletes' capabilities and design more individualized and effective training interventions (Jiménez-Reyes et al. 2017; Morin & Samozino, 2016), based on prioritizing the under-developed mechanical capability to shift the Force-velocity profile toward an optimal value.
Recent evidence shows that (i) an individualized training program based on the FVimb in the FV profile of each individual is more effective in improving jump performance than a traditional resistance training common to all subjects and designed without taking account of individual differences in the initial FV profiles and imbalances, and that (ii) for subjects with an initial substantial FVimb (i.e., force or a velocity deficit) this higher jump performance was associated with the sensitivity of the force-velocity profile to the specific training program tailored to the athlete's individual needs, which has led to a reduced FVimb with no change in Pmax (Jiménez-Reyes et al. 2017).
Individual FV profile and FVimb should be taken into account as a starting point for prescribing specific loads and training program for a more effective training to improve jump performance, being an evidence-based step for a better understanding of FV profile based training for new insights in strength and conditioning practice. FVimb could therefore be considered as a potentially useful variable for prescribing optimal resistance training to improve ballistic (e.g., jumping) performance.
References: Jiménez-Reyes P et al (2017) Front Physiol, 7, 677
Jiménez-Reyes P (2016) Int J Sports Physiol Perform, 12(1):36-43
Morin JB & Samozino P (2016) Int J Sports Physiol Perform, 11(2), 267–272
Samozino P (2014) Int J Sports Med, 35(6), 505–510
Samozino P (2008) J Biomech, 41(14), 2940–2945
Samozino P (2012) Med Sci Sports Exerc, 44(2), 313–22
Contact: peterjr49@hotmail.com

METHODS: RESULTS: CONCLUSION: FORCE-VELOCITY-POWER PROFILING: TRAINING APPLICATIONS IN SPRINT ACCELERATION

MORIN, J.B.

UNIVERSITÉ CÔTE D'AZUR

INTRODUCTION: Force-Velocity-Power profiling: training applications in sprint acceleration
Morin, J-B.
UCA, LAMHESS (Nice, France)
The laws of dynamics dictate that the external net force applied to a mass induces a proportional acceleration in the direction of the force vector. Our "motor" is skeletal muscle, and physiology dictates that there is an inverse relationship between the velocity of muscular contraction and its force output capability. The complexity of ballistic movements such as sprinting is that the force-velocity-power (FVP) spectrum (or profile), must be established to know the force capability of athletes across various velocities. An athlete may be "strong", producing high amounts of force at low velocity (typically at the beginning of an unresisted sprint or under significant external resistance) but much "weaker" at high velocity, or vice versa.
During sprint acceleration, the linear FV profile (hitherto only assessable using complex laboratory grade devices) may now be accurately established using distance- or velocity-time data (Samozino et al. 2016). Key FVP variables (maximal theoretical force, velocity and power, and orientation of force application) may better characterize athletes' capabilities and help guide individualized and effective training interventions (Morin and Samozino, 2016).
Recent evidence shows that (i) training with very-heavy sled resistance (>80% of body mass) was an effective solution to improve the left side of the sprint FV profile (maximal horizontal force) through a more horizontally-oriented force application (Morin et al. 2017) and (ii) the conditions under which to train maximal power output at maximum resisted velocity corresponded to a resistance that halved athlete's absolute maximal running velocity (Cross et al. 2017).
While more research is ongoing regarding training interventions, recent experimental data showed that this sprint-specific force capability was impaired in the context of previous or forthcoming (case-study) sprint-related hamstring injury (Mendiguchia et al. 2014, 2016). The latter results open a new track for research into a "win-win" strategy putting hamstring function at the center of a performance-prevention continuum.
References: Cross M.R., Samozino P. Brown S.R., Morin J-B. (2017). Eur J Appl Physiol, In Press.
Mendiguchia J., Samozino P., Martinez-Ruiz E., Brughelli M., Schmikli S., Morin J-B., Mendez-Villanueva A. (2014). Int J Sports Med, 35(8), 690-695.
Mendiguchia J., Edouard P., Samozino P., Brughelli M., Cross M.R., Ross A., Gill N., Morin J-B. (2016). J Sport Sci, 34(6), 535-541.
Morin J-B., Samozino P. (2016). Int J Sport Physiol Perf, 11(2), 267-272.
Morin J-B., Petrakos G., Jiménez-Reyes P., Brown S.R., Samozino P., Cross M.R. (2017). Int J Sport Physiol Perf, 12(6), 840-844.
Samozino P., Rabita G., Dorel S., Slawinski J., Peyrot N., Saez de Villarreal E., Morin J-B. (2016). Scand J Med Sci Sport, 26(6), 648-658.
Contact: jean-benoit.morin@unice.fr

Oral presentations

OP-PM11 HEART

CARDIOVASCULAR RESPONSES TO DISTINCT EXERCISE MODALITIES IN MONOZYGOTIC TWINS

MARSH, C.E.1, THOMAS, H.J.1, SCURRAH, K.2, NAYLOR, L.H.1, GREEN, D.J.1

1: UNIVERSITY OF WESTERN AUSTRALIA , 2: THE UNIVERSITY OF MELBOURNE

INTRODUCTION: Previous studies have suggested that responses to exercise training vary between individuals, with some subjects responding to a larger degree than others. We posed the questions: 1). is (non)response to exercise universal for an individual, or does it differ according to the modality of exercise undertaken, and 2). is responsiveness to exercise genetically determined.
METHODS: We performed a randomised cross-over study investigating individual cardiovascular responses in nine pairs (n=18) of untrained female monozygotic (identical) twins (25.5 +/- 10.1 years). Each twin pair underwent three months of endurance (END; 1hr x 3/wk, running/cycling, 60-90%VO2max) and resistance (RES; 1hr x 3/wk, upper/lower body, 60-90%1RM) exercise training together, separated by a three-month washout period. Outcomes included cardiac MRI derived left ventricular end-diastolic volume (LVEDV), myocardial mass (LVMM) and ejection fraction (EF), body composition (DXA) for visceral adipose tissue (VAT) and fat mass, fitness (VO2max) and compound muscle strength (1RM). Within-twin-pair correlations of response to END and RES for each outcome were estimated using intraclass correlations (ICC).
RESULTS: Mean changes with END exceeded those of RES for LVEDV (1.37 vs -0.25ml, P>0.05), fat mass (-871 vs -599g, P>0.05), VO2max (172 vs 5ml.min-1, P<0.01), whereas RES induced larger changes than END for LVMM (1.82 vs 3.48g, P>0.05), EF (2.17 vs 0.10%, P>0.05), VAT (-58 vs -32g, P>0.05) and 1RM (37 vs 2kg, P<0.01). Estimated ICC's were higher for changes induced by END than RES for VO2max (r=0.37 vs -0.13), LVMM (r=0.04 vs -0.54), EF (r=0.39 vs -0.19), fat mass (r=0.36 vs 0.03) and VAT (r=0.41 vs -0.11), whereas ICC's for RES exceeded those of END for LVEDV (r=0.19 vs 0.09) and 1RM (r=0.55 vs -0.05).
CONCLUSION: These findings suggest that individuals respond differently to END and RES training and that those who are relatively insensitive to one form of training may nonetheless respond to the other. The twin analysis suggests that individuals who share 100% of their DNA do not respond identically in terms of all physiological outcomes, and that degree of similarity in response differs according to the variable of interest. The level of concordant change between monozygotic twins was higher as a result of endurance training for some variables (cardiac function and body composition), and resistance training for others (muscular strength and cardiac structural change). Our approach to studying twins can be used in future to estimate the genetic and environmental contributions to exercise responsiveness in humans.

AEROBIC TRAINING PROTECTS CARDIAC FUNCTION DURING ADVANCING AGE: A META-ANALYSIS OF FOUR-DECADES OF CONTROLLED STUDIES

BEAUMONT, A., GRACE, F., RICHARDS, J., CAMPBELL, A., SCULTHORPE, N.

UNIVERSITY OF THE WEST OF SCOTLAND

INTRODUCTION: There have been no attempts to systematically synthesise the body of literature to unpick the complex interrelationship between cardiac structure and function in older aerobic trained men. Encouragingly, a steady accumulation of evidence during the past four decades provides a sufficient body of data to allow for meaningful analysis. We conducted a systematic review and meta-analysis of controlled echocardiography studies comparing left ventricular (LV) structure and function in aerobically trained older athletes (>45 years) with age-matched untrained controls. Further, we investigated the influence of chronological age within the same body of literature.
METHODS: Major electronic databases were searched from inception to January 2018 before conducting a random-effects meta-analysis to calculate pooled differences in means, effect size and 95% CI's. Data extraction included measures of LV morphology, conventionally derived systolic and diastolic function, and speckle-tracking derived global longitudinal strain (GLS) to determine potential differences between male athletes and untrained older adults. Study quality was assessed and heterogeneity reported using Cochran's Q and I2 statistic. Meta-regression was used to establish the influence of chronological age on the differences in LV structure and function between athletes and controls.
RESULTS: Overall, 32 studies (644 athletes; 582 controls) were included. Athletes had larger LV-end-diastolic diameter (3.65 mm, 2.66-4.64), interventricular septal (1.23 mm, 0.85-1.60), and posterior wall thicknesses (1.20 mm, 0.83-1.56), LV mass (72 g, 46-98), LV mass index (LVMi, d=1.78, 1.32-2.24) and LV end-diastolic volume (16.11 mL, 7.80-24.43) stroke volume (13.59 mL, 7.20-19.98) (all p<0.01). In contrast, ejection fraction (0.43%, -1.57-2.44), fractional shortening (-0.34%, -2.32-1.63), systolic tissue velocity (0.09 cm.s-1, -0.53-0.70) and GLS (-0.06%, -1.20-1.09) did not differ between trained and untrained. Athletes had more favourable global diastolic function (E/A, 0.18, 0.13-0.24, p<0.01; e'/a', 0.23, 0.06-0.40, p=0.01), lower late mitral and tissue filling velocities (A, 8.20 cm.s-1, 11.90-4.51, p<0.01; a', 0.72 cm.s-1, 1.31-0.12, p=0.02) with more rapid early-diastolic tissue velocity (e', 0.96 cm.s-1, 0.05-1.86, p=0.04). Interestingly, meta-regression for chronological age, identified that athlete-control differences are maintained during advancing age.
CONCLUSION: This study provides external validity for the body of literature observing larger cardiac dimensions, and more favourable cardiac function in masters' athletes compared with healthy, non-athletic age-matched counterparts. Notably, masters' athletes appear to maintain more favourable cardiac function into the eighth decade.

EFFECTS OF EXERCISE TRAINING ON ER STRESS AND MITOCHONDRIAL BIOGENESIS OF THE CARDIAC MUSCLE IN HIGH-FAT DIET-INDUCED OBESE MIDDLE-AGED RATS

KIM, K., AHN, N., LEE, K.

KEIMYUNG UNIVERSITY

INTRODUCTION: Age-related alterations in muscle cells are mainly caused by increased ER stress, altered metabolism, intracellular oxidative stress resulting from qualitative and quantitative changes in mitochondria, and modified Ca2+ signaling . To identify an exercise method capable of effectively preventing cardiovascular diseases through protection of cardiac muscle, this study compared the effects of two 12-week exercise regimes on ER stress and mitochondrial biogenesis in the cardiac muscle of middle-aged rats with high-fat-diet-induced obesity.

METHODS: 30 male, middle-aged Sprague-Dawley rats were induced to become obese with 6 weeks of a high-fat diet, and were randomly divided into three experimental groups: sedentary control , resistance exercise , and aerobic exercise . The exercising groups underwent high-intensity intermittent training using a ladder-climbing and weight exercise or treadmill-running exercises 3 days/week for a total of 12 weeks. Heart tissue was analyzed the protein expressions of phospho-PERK, PERK, CHOP, GRP78, cytochrome c, PGC-1α, phospho-AMPK, AMPK, or β-actin by western blotting.
RESULTS: Rats in the AE group showed significantly lower increases in body weight and intraperitoneal fat than those in SC group . The 12-week exercise regimes resulted in significantly increased expression of mitochondrial biogenesis markers and levels of PGC-1α, an upstream signaling molecule, in the cardiac muscle of obese middle-aged rats , but these factors did not differ according to exercise type. Phosphorylation of PERK, an ER stress marker, decreased significantly after the exercise training. Although a trend for decreased CHOP protein expression was observed in both exercise groups, only AE led to a statistically significant decrease . Levels of GRP78, an ER stress marker that protects cardiac muscle, did not significantly differ among the groups. Although only AE decreased body weight and fat mass, the two exercise regimes had similar effects on cardiac muscle.
CONCLUSION: Chronic ER stress causes oxidative stress and inflammatory responses, and obesity is known to increase ER stress in metabolically active tissues . In this study, phosphorylation of PERK and expression of CHOP protein, which are markers of ER stress , significantly decreased after exercise training. We observed increased mitochondrial biogenesis and decreased ER stress after RE, comprising ladder climbing, and AE, consisting of treadmill running. Therefore, aerobic training resulting in weight loss, as well as resistance training not necessarily leading to weight loss, can contribute to the prevention of aging- and obesity-associated decreases in cardiac function.
References: Carter et al. Physiology , 2015, 30<3>, 208-223.
Hong et al. Int J Vasc Med, 2017, 2049217.
Paula et al. FASEB J, 2017, pii: fj.201700710R.
Contact to e-mail : kjk744@kmu.ac.kr

CARDIAC BIOMARKERS FLUCTUATION IN RUNNERS OF MARATHONS, SEMI-MARATHONS AND UNTRAINED RUNNERS

LE GOFF, C., VRANKEN, L., KAUX, J.F., LENNARTZ, L., CAVALIER, E.

UNIVERSITY HOSPITAL OF LIÈGE

INTRODUCTION: Regular exercise like running is one important part of the prevention program of cardiovascular disease. There are several studies on biomarker changes during marathons especially cardiac biomarkers have been studied and mild to moderate elevations have been described as a results of a running exercise Exact underlying mechanism for these biomarker elevations reflecting physiological or even pathobiological changes is unknown and less trained athletes might exhibit a higher risk compared to well trained The aim of our study was to compare three cardiac biomarkers for ischemic condition , cardiac stretch and fibrotic processes were tested in different type of runners, trained marathon and semi-marathon runners and untrained runners before, directly after and 3 hours after the running exercise.
METHODS: 23 marathon runners, 15 semi-marathon runners <44.1±8.4yo> and 17 healthy sedentary subjects < 37± 4.4 yo> were enrolled in our study.
Blood samples were taken just before , just after and 3 hours after the race, centrifuged , aliquoted and stored frozen at -80°C before further analysis. The study was approved by the Ethical Committee of our University Hospital.
The analyses were performed on the Abbott ARCHITECT i2000SR for the hs cTnI, BNP and Gal-3 and on the C8000 for hs-cTnT and NT-proBNP according to the manufacturer's instructions for use.
RESULTS: In all 3 running groups there is an increase of cardiac biomarkers Troponin I, BNP, Galectin-3 and NT-ProBNP after completion of the physical exercise. Biomarkers increase is depending on the intensity and duration of the exercise and is higher in long distance marathon and semi-marathon runners compared to the control group with a 1 hour run. Cardiac biomarker levels between trained marathon and semi-marathon runners were not statistically different in the pre-exercise baseline samples for BNP, NT-Pro-BNP and Galectin-3. Compared to untrained runners only Troponin I levels were higher in baseline sample of marathon runners when compared to controls, cardiac Troponin T was less significant.
CONCLUSION: In conclusion, the question whether running exercise of different intensity could be harmful to the heart has no simple answer. We could show that running exercise can be associated with biochemical abnormalities that may reflect adverse consequences on the heart like possible micro necrosis, oxidative stress, fibrosis and myocardial stretch. With exception of Troponin where levels continue to raise after end of running, NPs and Gal-3 levels normalized relatively fast after the exercise. The possible harmful effect of longer term cardiac consequences of repeated intensive sport acitvities still needs to be demonstrated.

CARDIAC ETIOLOGY OF EXERCISE INDUCED HYPOXEMIA

DOSTAL, J., KOCKOVA, R., KOCKA, V.

INSTITUTE OF SPORTS MEDICINE

INTRODUCTION: Exercise induced hypoxemia (EIH) is common finding within a group of elite athletes. It is generally thought, that the causality lies in the pulmonary circulation with anatomical and/or functional shunts. We report a group of 8 consecutive elite athletes with severe EIH (SpO2 below 90%) examined for the origin of the EIH. The task was to perform differential diagnoses to locate the shunt into the pulmonary circulation or cardiac shunts.
METHODS: Eight consecutive elite endurance athletes (cycling, running, triathlon) with severe EIH (SpO2 reproducibly below 90% during previous exercise testing) has been examined with stress transthoracic echocardiography with injection of agitated saline (microbubbles). Agitated saline was administered via cubital vein during the last two steps of the stress echo and the presence of the hypoxemia. Differential diagnoses of cardiac or non-cardiac shunt was based on previously published reports for evaluation of cardiac shunts – number of microbubbles and latency (number of cardiac cycles) between the injection and the appearance of the microbubbles in the left atrium or left ventricle. Trans-esophageal echo has been performed in the follow up procedure in the case of presence of cardiac origin of the hypoxemia to evaluate the exact etiology of the shunt.
RESULTS: Four athletes out of eight have presented pulmonary etiology of the hypoxemia. Four remaining athletes have presented cardiac origin with hemodynamically severe right to left shunts during the maximal exercise causing the EIH. Concurrent transesophageal echocardiography discovered one atrial septal defect and three patent foramen ovale (PFO). One athlete out of three with present PFO underwent later catheterization closure of the PFO. Follow up exercise testing and stress echocardiography confirmed no signs of shunt and no signs of presence of EIH in that individual patient. Also, performance measures of that athlete were improved significantly.

CONCLUSION: Exercise induced hypoxemia is generally thought to be caused by anatomical or functional shunts within the pulmonary circulation. Our findings suggest possibly higher prevalence than originally thought of cardiac etiology of the exercise induced hypoxemia within a group of elite athletes. Successful treatment by catheter-based closure device improves performance and eliminate other clinical signs of the right to left cardiac shunt. Further evaluation of larger group of elite athletes with EIH is warranted to understand better the real prevalence and possible treatment of the cardiac origin of the EIH.

CARDIAC RISK BIOMARKERS RELEASE AFTER HIGH-INTENSITY INTERVAL EXERCISE IN MARATHON RUNNERS

LI, F.

HEBEI NORMAL UNIVERSITY

INTRODUCTION: The effect of exercise in regard to the exercise-induced cardiac biomarkers release requires further investigation to address the information of mechanism and clinical relevance. High-intensity intermittent exercise (HIIT) is highly recommended, but the potential impact of HIIT on cardiac risk biomarkers release requires further investigation. This study is to compare the cardiac biomarkers release after workload matched HIIT and continuous exercises (CE).
METHODS: Twelve experienced marathon runners[sex, 11 males and 1 female; age, 23.5±5.5 y; body mass, 63.3±3.9 kg; height, 170.5±5.5 cm; % body fat, 12.6±3.9%; VO2max, 62.4±5.4 ml·kg−1·min−1; velocity of VO2max (vVO2max), 17.1±1.4 km·h−1] completed HIIT and CE in random order. Each bout of HIIT included hard run at 90% vVO2max for 2 min followed by easy run at 50% vVO2max for 2 min, 23 bouts in 92 min totally. In CE trial, subjects continuously run in 70% vVO2max for 92 min. Heart rate (HR) and Rating of Perceived Exertion (RPE) were recorded during each exercise trial. Blood samples were drawn on the first visit before all exercises (pre 0) and then in HIIT and CE trials before exercise (pre1), immediately after (0 h), and 1, 4, 24 and 48 h after the completion of exercise. High-sensitivity cardiac troponin T (hs-cTnT), high-sensitivity cardiac troponin I (hs-cTnI), N-terminal pro brain natriuretic peptide (NT-pro-BNP), C-reactive protein (CRP), creatine kinase-MB (CK-MB) and creatine kinase (CK) was determined at all of these time points. Each analysis was performed with mixed model using the general linear mixed-model procedure (Proc Mixed) in the Statistical Analysis System (version 9.4, SAS Institute, Cary NC). All measures were log transformed before analysis then back-transformed to express the differences between HIIT and CE in standardized units of assessment of magnitude. Uncertainty in the differences was expressed as 90% confidence intervals and interpreted via the non-clinical magnitude-based approach. For clear effects the likelihood that the true effect was substantial was indicated with the following scale: possibly (25-75%), likely (75 to <95%), very likely (95-99%), and most likely (>99.5%).
RESULTS: Compared with trial CE, percentage of HR reserve (% HRR) during HIIT was possibly lower (-22%, 90% confidence limits ±37%). RPE during CE was very likely lower than that of HIIT (1.7, ±1.0). Hs-cTnI was very likely higher (1.05, 90% confidence limits ±0.66) in HIIT compared with CE.
CONCLUSION: HIIT could trigger more cardiac biomarkers release.

Oral presentations

IS-SP04 TRAINING & NUTRITION: CONSIDERATIONS FOR FOOTBALL - SPONSORED BY GSSI

FUELLING AND ENERGY REQUIREMENTS FOR FOOTBALL: TRAINING VERSUS MATCH PLAY

MORTON, J.

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: The fundamental goal of nutrition for soccer is to enhance training adaptations, achieve the desired body composition and ultimately, promote match day performance and recovery. Professional players typically train 4-5 times per week as well as compete in 1-3 competitive games. Daily training may also consist of a pitch based session (focusing on technical, tactical and physical development) and a resistance-based session where the aim is development of strength and power. Nonetheless, the overall weekly loading pattern is dependent on competitive fixture schedule, players' starting status and individualized training goals. As such, daily fuelling requirements should operate on a sliding scale dependent on the specific context and in accordance with the aforementioned factors. In this presentation, the author will present data on habitual energy intake and expenditure of Premiership soccer players as well as share personal reflections of implementing a nutritional programme in elite adult and youth soccer players.

METHODS: RESULTS: CONCLUSION: TRAINING INTERVENTIONS: OPTIMISING THE ADAPTIVE RESPONSE OF PHYSICAL CAPABILITIES IMPORTANT TO IMPROVE FOOTBALL PERFORMANCE

BISHOP, D.

VICTORIA UNIVERSITY

Football requires athletes to repeatedly produce skilful actions, and maximal or near maximal efforts (e.g. accelerations, changes in pace and direction, sprints, jumps and kicks), interspersed with brief recovery intervals (consisting of rest or low- to moderate-intensity activity), over an extended period of time (1 to 2 hours). While performance in football is dominated by technical and tactical proficiencies, successful athletes must also have highly developed physical capabilities. Much effort goes into designing training programs to improve these physical capabilities, with expected benefits for football performance. However, training is often based on tradition and "ecological validity" (i.e., replicating what occurs during a match). More evidence is required to support the use of different training approaches to improve physical capabilities important for football performance. In this presentation there will be a discussion of the physical capabilities important for football performance, followed by evidence related to the best training approaches to improve these capabilities.

NUTRITION IN FOOTBALL - IMPLEMENTING THE SCIENCE IN PROFESSIONAL FOOTBALL

COLLINS, J.

THE CENTRE FOR HEALTH AND HUMAN PERFORMANCE

Nutrition has an important role to support optimal training adaptation, performance and recovery, with nutrition strategies such as; fuelling, hydration and recovery forming an integral part of teams training and match day protocols. The 2018 UEFA Football Nutrition

Consensus recently brought together a group of the sports leading applied researchers and practitioners to update best-practice guidelines. This presentation will draw upon these updated guidelines and explore some of the key considerations around applied nutrition support in elite football, incorporating contemporary evidence alongside the practical challenges when working with a professional club.

Invited symposia

IS-PM14 Injury Risk and Injury Prevention in Rugby Union

EPIDEMIOLOGY OF RUGBY UNION INJURIES

BLEAKLEY, C.

HIGH POINT UNIVERSITY

Rugby Union is played by over 8.5 million people across 121 countries. It is an exciting sport that requires multiple components of fitness, self-discipline, social interaction and team skills. However, its high speed and collision nature means that Rugby Union carries a high propensity for injury. Determining the burden of Rugby Union injury is essential for informing primary and secondary strategies for prevention. Rugby Union injury patterns were first reported in the 1950s, with an increasing number of publications becoming available after the advent of professionalism in the early 2000s. A further milestone in this field of research occurred in 2007 with the development of a consensus statement on injury definitions and data collection procedures. Currently there are epidemiological data available from over 70 prospective research studies in Rugby Union. This will be the first presentation as part of a symposium on Injury Risk and Injury Prevention in Rugby Union. The aim of this presentation will be to quantify the injury burden associated with Rugby Union. It will describe and compare injury patterns across the following key rugby subpopulations: professional, amateur / community level and adolescent/schoolboy. A primary objective will be to use available injury incidence and severity data to highlight the injury diagnoses that incur the highest burden within each population; with additional discussion of important risk factors and mechanisms of injury. It is anticipated that this presentation will facilitate debate on the acceptability of risks associated with Rugby Union. The data presented will be contextualized further through the subsequent presentations in this symposium which will discuss the effectiveness of current injury prevention approach within Rugby Union.

IS THERE ANY EVIDENCE TO SUPPORT BANNING THE TACKLE IN JUNIOR RUGBY?

MCKAY, C.

UNIVERSITY OF BATH

IS THERE ANY EVIDENCE TO SUPPORT BANNING THE TACKLE IN JUNIOR RUGBY?
McKay, C.D.1 1: University of Bath (Bath, UK)
Introduction: Rugby union, as a full contact sport, carries an inherent risk of injury. Tackling is one of the most common mechanisms of injury in the sport and significantly contributes to both injury incidence and injury burden (Freitag et al., 2015; Yeomans et al., 2018). Although a significant amount of research has aimed to quantify the risks associated with tackling in the adult game, much less is known about youth rugby contexts Yet, there is considerable concern about the safety of the sport for young athletes, particularly because musculoskeletal trauma or head injury may have immediate and lifelong consequences in this population. With increasing public debate over the merits of banning tackling in youth rugby, this talk will use evidence from the research literature to highlight the complexities of the issue.
Methods: The rugby injury literature will be summarised with emphasis on epidemiological data specific to youth players, considering injury rates, types, and burden (e.g., time loss/severity). Risk estimates associated with tackling in both adult and youth leagues will be presented to enable contextual comparison. Additionally, evidence from other youth sports where rule changes have reduced/eliminated body contact will be explored as analogues for potential effects on injury risk, health care costs, and sport participation rates. The discussion will be acknowledge the implications of policy change at various stakeholder levels (Hulme & Finch, 2015).
Discussion: Injury prevention is of primary importance in sport, both from performance and health/wellbeing perspectives. For youth athletes in particular, there is also a need to provide sporting environments that encourage skill development, social interaction, and personal enjoyment. Keeping young people engaged in physical activity is an important goal, so weighing the risks and benefits of rugby participation is a salient public health issue. Therefore, any decision to ban tackling in junior rugby must be based on objective medical evidence, but will inevitably be informed by sport culture and social values.
References: Hulme A, Finch CF. (2015). Injury Epidemiology, 2, 31.
Freitag A, Kirkwoos G, Scharer S, et al. (2015). Br J Sports Med, 49, 511-519.
Yeomans C, Kenny IC, Cahalan R, et al. (2018). Sports Med, Published online first: https://doi.org/10.1007/s40279-017-0838-4.
Contact: c.d.mckay@bath.ac.uk; @Dr_CMcKay

INJURY PREVENTION IN RUGBY UNION; ARE WE WINNING OR IS THIS A LOSING BATTLE?

BROWN, J.

STELLENBOSCH UNIVERSITY

INTRODUCTION: Injury Prevention in Rugby Union; are we Winning or is this a Losing Battle?
Brown, J.1,2
1: Institute of Sport and Exercise Medicine, Faculty of Medicine and Health Sciences, Francie Van Zijl Drive, Tygerberg, Stellenbosch University, South Africa
2: International Olympic Committee Research Centre, South Africa
Rugby union is currently one of the most popular sports in the world. However, as demonstrated by the previous two talks in the session, this popular sport is also associated with a high injury burden to its participants. There are a plethora of injury prevention interventions, in a variety of contexts, attempting to reduce this risk. But how is one to know whether these interventions are effective or not? Evaluation of these interventions using established frameworks , has produced some positive results, particularly with the RugbySmart and BokSmart programmes. However, improved awareness of player welfare and the associated increase in the reporting of injuries - especially concussions - might confound future intervention evaluations. Specifically, the recent rise in rugby-related concussions rates at various levels

of play is difficult to interpret with traditional evaluations. This is just one example that could leave epidemiologists, clinicians, players, players parents, the media and general public confused about the state of injury prevention in rugby. Nonetheless, two recent randomised controlled trials in the United Kingdom demonstrated up to 60% reductions in concussion rates in youth and adult populations through a progressive exercise-based intervention that included neck strengthening. However, are two RCTs sufficient evidence for us to confidently say we are winning the fight to reduce rugby-related injuries? By building on the foundations laid by the other two presentations in this symposium, this talk will try to make sense of whether the future is bleak or bright for rugby participants.
References: Freitag A, Kirkwood G, Pollock AM <2015>. Rugby injury surveillance and prevention programmes: are they effective? BMJ, 350 .
Hislop M, Stokes KA, Williams S, McKay CD, England M, Kemp SPT, Trewartha G <2016>. The efficacy of a movement control exercise programme to reduce injuries in youth rugby: a cluster randomised controlled trial. BMJ Open Sport Exercise Med, 2 <1>.
Hislop M, Stokes KA, Williams S, McKay CD, England M, Kemp SPT, Trewartha G <2017>. Reducing musculoskeletal injury and concussion risk in schoolboy rugby players with a pre-activity movement control exercise programme: a cluster randomised controlled trial. BJSM.
Williams S, Trewartha G, Kemp SPT, Stokes KA <2016>. A meta-analysis of injuries in senior mens professional Rugby Union. Sports Med 43 <10>.
Contact: jamesbrown06@gmail.com

METHODS: RESULTS: CONCLUSION: Oral presentations

OP-PM12 OBESITY

SUCCESSFUL IMPLEMENTATION OF A 12-WEEK HOME-BASED HIT INTERVENTION IN OBESE INDIVIDUALS WITH ELEVATED CARDIOVASCULAR DISEASE RISK

SCOTT, S.1, SHEPHERD, S.O.1, HOPKINS, N.1, DAWSON, E.A.1, WRIGHT, D.J.2, COOPER, R.G.3, WAGENMAKERS, A.J.M.1, COCKS, M.1

1LIVERPOOL JOHN MOORES UNIVERSITY; 2LIVERPOOL HEART AND CHEST HOSPITAL; 3UNIVERSITY OF LIVERPOOL

INTRODUCTION: The applicability of current high intensity interval training (HIT) protocols to the sedentary obese population has been disputed by public health experts. This is because existing HIT interventions have been successful only under optimal conditions with high levels of supervision and specialised equipment, creating further barriers to exercise in those most in need. Therefore, we aimed to eliminate many of these barriers by modifying existing HIT protocols to create a new home-based HIT (Home-HIT) intervention tailored to individuals with low fitness and mobility. It was hypothesised that Home-HIT would 1) have high adherence to the prescribed exercise intensity (compliance) and 2) improve markers of cardiovascular disease (CVD) risk.
METHODS: 32 Obese adults with at least 3 additional CVD risk factors (age 36±2 y; BMI 34.3±0.8 kg·m-2; VO2peak 24.6±1.0 ml·kg·min-1), completed one of three 12-week training programmes 3x/week: Home-HIT (n=9); Laboratory-based supervised HIT (Lab-HIT; n=10) or home-based moderate intensity continuous training (Home-MICT; n=13). Adherence and compliance were monitored online in almost "real time" using a heart rate monitor and mobile app. The Home-HIT group completed 4 progressing to 8 1min intervals interspersed with 1min of rest in an unsupervised place of their choosing. The intervals were composed of simple bodyweight exercises that required no equipment. Changes in VO2peak, insulin sensitivity, body composition, flow-mediated dilation (FMD) and aortic pulse wave velocity (PWV) were assessed. Muscle biopsies were taken to assess changes in capillarisation, mitochondrial density, intramuscular triglyceride (IMTG) content and eNOS and GLUT4 protein expression using quantitative immunofluorescence microscopy. Results are presented ±SEM.
RESULTS: Adherence and compliance (Home-HIT 96±3% & 99±1%; Home-MICT 88±4% & 100±0%; Lab-HIT 97±1% & 100±0%, respectively) to training did not differ between groups. Training increased VO2peak (Home-HIT 15%, Home-MICT 11%, Lab-HIT 20%; $P<0.001$) and Matsuda insulin sensitivity index (Home-HIT 39%, Home-MICT 8%, Lab-HIT 13%; $P=0.033$). BMI, body fat percentage and visceral fat decreased ($P<0.05$). FMD increased and aortic PWV decreased in each group ($P<0.05$). Immunofluorescence microscopy revealed increased capillarisation, mitochondrial density, IMTG content and eNOS and GLUT4 protein expression ($P<0.05$). There were no differences in any variables between groups.
CONCLUSION: Despite having no external motivation or supervision during exercise, the Home-HIT group had high adherence at the prescribed exercise intensity, resulting in improved cardiovascular and metabolic health. We provide strong evidence that our novel Home-HIT protocol is an effective strategy to remove barriers to exercise and improve health in the obese population most in need.

EFFECT OF SPRINT INTERVAL TRAINING ON CHRONIC INFLAMMATION IN SEDENTARY OBESE MEN

KEBSI, W.1,3, RAUT LE GALLIC, L.1, ZOUHAL, H.1, SALIGAUT-ALLAIN, D.1, ADELA, H.2, HAMBLI, M.2, AMRI, M.3, LEMOINE-MOREL, S.1

RENNES 2 UNIVERSITY

INTRODUCTION: Aerobic exercise is the most common exercise protocols designed to reduce chronic inflammation (you et al. 2013). However, one of the most cited barriers to performing this type of exercise is lack of time. Previous studies suggest that sprint interval training (SIT) represent a time-efficient strategy for inducing health benefits (Gillen and Gibala, 2014). However, there is no data concerning its impact on inflammatory mediators in obese subjects. Therefore, we aim to investigate the effect of SIT on circulating inflammatory markers in obese men.
METHODS: Thirteen participants (age, 24±0.74 years; Body mass index (BMI), 33.38±4.30 kg.m-2) performed 10 weeks of SIT (3-4 sessions/wk; 3(3-4 x 8s sprints at 75%-95% peak power (Ppeak) measured during Force/Velocity exercise). Body composition, fasting blood markers (glucose, insulin, HbA1c, HDL- and LDL-cholesterol, triglycerides) and fitness measurements: aerobic capacity (from maximal incremental test), and anaerobic performance (from cycling sprint test (CST): 7 x 6s of "all out" sprints interspersed with 90s of recovery) were assessed at baseline and post SIT. Circulatory levels of inflammatory biomarkers (Interleulkin (IL)-6, tumor necrosis factor (TNF)-α, high-sensitivity C-reactive protein (hs-CRP), adiponectin) were assessed in rest and in response to CST before and after SIT.
RESULTS: Our results showed a trend of weight drop (-5.68%, $p=0.052$), and a significant decrease in fat mass (FM), android fat mass (AndFM), and gynoid fat mass (GynFM) were found ($p<0.05$). Aerobic and anaerobic power output were enhanced significantly ($p<0.05$) after the training intervention. No significant changes in metabolic blood markers and inflammatory parameters were observed in re-

sponse to CST and SIT. At baseline, hs-CRP was correlated with fasting insulin (r=0.650, p<0.05). In response to SIT, changes in FM (r=0.717, p<0.05), AndFM (r=0.683, p<0.05), and fasting insulin (r=0.886, p<0.05) were associated with reduction in hs-CRP.
CONCLUSION: The current study demonstrated that SIT didn't increase the risk factors associated to chronic inflammation in obese individuals, and found a significant correlation between the reduction in hs-CRP and insulin, AndFM, and FM which was in agreement with Swift et al. 2012. These observations supported the growing evidence that SIT was a promising strategy to induce wellbeing and better health condition.

ASSOCIATION BETWEEN A COMPREHENSIVE MOVEMENT ASSESSMENT AND METABOLICALLY HEALTHY OBESE ADULTS

SENECHAL, M., MACLEOD, L., HÉBERT, J.J., BOUDREAU, J., BOUCHARD, D.R.

UNIVERSITY OF NEW BRUNSWICK

INTRODUCTION: Moderate-to-vigorous physical activity (MVPA) is associated with cardio-metabolic health in obese individuals. Recent data in children emphasize a more comprehensive assessment of movement to quantify the impact of PA on health. However, similar adult evidence is lacking and the impact of a comprehensive movement assessment on the Metabolically Healthy Obese (MHO) phenotype is unknown. The objective of this study was to determine whether meeting the comprehensive movement guideline or each individual component was associated with a greater likelihood of being MHO compared to non-MHO adults.
METHODS: The sample included 513 adults overweight-obese (body mass index 25kgm2) aged 19 to 85 years from cycle 2005-2006 of the National Health and Nutrition Examination Survey. The comprehensive movement assessment and its individuals threshold include: 150 minutes of MVPA in 10-minute bouts, being in the highest quartile of light PA, sleeping 7 to 9 hours per night, and less than 2 hours of recreational screen time. Participants were categorized as MHO when all cardio-metabolic risk factors (triglycerides, HDL-cholesterol, glucose, and systolic and diastolic blood pressure) were within normal limits.
RESULTS: The proportion of MHO was 13.8%. There was no difference in comprehensive assessment of movement score between MHO and non-MHO individuals (MHO: 18.3% vs. non-MHO: 10.9%; p> 0.05). Recreational screen time was lower in MHO compared to non-MHO individuals (1.8 1.4 hrs/day vs. 2.5 1.6 hrs/day; p< 0.01). Meeting the recreational screen time recommendation was the only variable associated with the MHO phenotype (OR:4.84 95%CI: 2.33-10.07). This association remained after adjusting for age, sex, ethnicity, and BMI (OR: 3.86 95%CI: 1.75-8.52). Meeting two components of the comprehensive movement assessment was independently associated with the MHO phenotype (OR: 2.45 95%CI: 1.23-4.90).
CONCLUSION: Our results support the importance of limiting recreational screen time in adults to optimize the cardio-metabolic risk profile of individuals living with obesity. Applying a more comprehensive assessment of movement, beyond health-related PA, to assess the risk associated with health outcomes in adult appears to provide a better assessment. Additional studies evaluating hard endpoints such as cardio-vascular diseases and premature mortality are warranted.

Oral presentations

OP-BN25 Balance and postural control

MODULAR ORGANIZATION OF A POSTURAL TASK ON STABLE AND UNSTABLE SURFACES

MUNOZ MARTEL, V., SANTUZ, A., ARAMPATZIS, A.

HUMBOLDT-UNIVERSITÄT ZU BERLIN - BERLIN SCHOOL OF MOVEMENT SCIENCE

INTRODUCTION: Maintaining balance is a necessary requirement for most activities and critical for human locomotion [1]. Daily life activities involve unexpected perturbations which challenge the system to modify its control strategies [2]. A modular recruitment of muscles, referred to as muscle synergies, has been proposed to provide a simplified control of movement [3]. The main purpose of the current study was to investigate the modular organization of the neuromuscular system for a postural task in different ground stability contexts. We hypothesized a reorganization of the time-dependent activation coefficients (motor primitives) in order to increase motor outputs robustness (ability to cope with errors) [2], and a general conservation of the time-invariant muscle weightings (motor modules).
METHODS: Thirteen young, healthy participants (9 males, 4 females, age 28.7 ± 5.2 years, height 1.75 ± 0.11 m, weight 67.9 ± 9.8 kg) were asked to pass from a double- to a single-leg standing (SLS), maintain the position for 3 s, return to the bipedal position and after 1 s repeat the task. Timing was aided by a metronome. Participants performed 30 cycles on two different surfaces: hard uniform stable ground (SG) and a damped oscillating unstable platform (Unstable Ground – UG) (Haider Gmbh. Germany). Order of conditions was randomized.
Muscle synergies were extracted from 13 ipsilateral lower limb EMG activities using non-negative matrix factorization. Full width at half maximum and center of activity were used as metrics for comparing SG and UG motor primitives (paired sample t-test). Motor modules were compared by a two-way ANOVA with repeated measures, followed by a Tukey post-hoc analysis with false discovery rate p-value adjustment.
RESULTS: On average, we extracted one synergy less from SG compared to UG data (2.5 ± 0.8 SG and 3.1 ± 0.5 UG, p = 0.027). One synergy was functionally referred to the double stance and another to the SLS. The extra synergy found in the UG condition described the SLS and included, amongst others, the contribution of mediolateral stabilizers of hip and lower leg (mainly peroneus longus, p<0.001). Motor primitives and motor modules showed no differences for the two synergies shared by SG and UG. The extra SLS synergy found in UG showed a narrower primitive (-20.8%, p=0.006) compared to the original SLS synergy in both condition.
CONCLUSION: On previous locomotion studies, we observed a consistent set of motor modules with a widening of motor primitives, indicating a transition from an accurate to a more robust control in presence of continuously variable perturbations [2]. The current results show the emergence of a latent postural synergy in UG trials. This new synergy might reflect the systems answer to the increased postural demands induced by UG compared to SG.
References.
[1] Toebes et al. Gait Posture 2012
[2]Santuz et al. Sci Rep. 2018
[3]Bizzi et al. Science. 1991

DYNAMIC POSTURAL CONTROL PREDICT OVERHEAD THROWING PERFORMANCE IN ELITE FEMALE TEAM HANDBALL PLAYERS

ERIKSRUD, O., SÆLAND, F., FEDEROLF, P.A., CABRI, J.

NORWEGIAN SCHOOL OF SPORT SCIENCES

INTRODUCTION: Throwing performance is dependent on different neuromuscular qualities of the full kinetic chain. Two such qualities are the magnitude of joint movements (mobility) and the ability to control them (dynamic postural control). However, the relationship between these qualities and handball throwing performance is not well documented. The hand reach star excursion balance test (HSEBT) is a newly developed test of dynamic postural control based on hand reach measurements from a standing position in the same directions as the star excursion balance test (SEBT). These hand reaches require functional mobility, the combination of range of motion (ROM) of multiple joints in ecological movements, similar to those observed for the different phases of handball throwing. The purpose of this study was to determine the relationship between the HSEBT and handball throwing performance.
METHODS: Elite female team handball players (n=11; age: 21.71.8 years; weight: 71.3 9.6 kg; height: 174.9 6.8 cm; wingspan: 173.8 9.0 cm) executed selected HSEBT reaches (flexion, extension and rotational movement patterns) before performing a 3-step-up overhead throw using an International Handball Federation standard size womens handball until five valid throws (inside 1x1m target) were obtained. Throwing performance was quantified by throwing velocity (m·s-1) using motion capture (Qualisys; 240 Hz) and accuracy (mean radial error) using videography (Basler acA2000 - 165uc video camera and Dartfish). The relationships between HSEBT measurements (individual reaches, overall, flexion and extension composite scores (CS)) and throwing performance were assessed using correlational analysis ($p<.05$).
RESULTS: Significant relationships between HSEBT measures and accuracy but not throwing velocity were established. Specifically, overall CS on the dominant foot ($r=.622$, $p<.05$) and extension CS for both dominant ($r=.756$, $p<.05$) and non-dominant foot ($r=.656$, $p<.05$) were found.
CONCLUSION: We hypothesized that greater reach measurements in the posterior overhead reaches would allow for a greater excursion for acceleration of the ball and thereby influence throwing velocity. The non-significant findings could be due to players having sufficient mobility and that the influence of other neuromuscular qualities, strength and power, on available excursion were not assessed. However, the significant relationship of the posterior overhead reaches to accuracy might reflect other components of dynamic postural control such as balance and proprioception. Based on the current findings the HSEBT offers a platform from which dynamic postural control can be further explored.

THE EFFECTS OF PROPRIOCEPTIVE BALANCE TRAINING USING THE SHUTTLE TNT SYSTEM ON VERTICAL JUMP PERFORMANCE IN FEMALE NAIA VOLLEYBALL PLAYERS

BUBKE, C., SHIM, A., CANNAVAN, D., WALLER, M., RUPPERT, T.

COLLEGE OF SAINT MARY

INTRODUCTION: The central nervous system's (CNS) role is to deliver signals through the afferent neural pathways to produce awareness of limb, trunk, and head position and movement, which contributes to reflexive and cognitive motor skills (2). Past injuries due to developmental delays can result in slower synapses through the CNS. Proprioceptive receptors communicate with the brain, in order to confirm the position and motion of the lower limbs and relay the correct motor response to the muscles to make corrections in attempt to prevent injury and improve motor control. If neural adaptations do not occur, motor performance is delayed the risk of injury is present (1). Increasing stability in the lower extremity should be considered supplemental to a strength and conditioning program amongst practitioners. To date, there is a lack of research examining the efficacy of the Shuttle TNT System for improving lower limb stability.
METHODS: There were two intentions behind the study: [a] to determine if the Shuttle TNT System can be used to improve LoS scores in female collegiate volleyball players and [b] investigate whether a correlation exists between LoS scores and VJ performance. Nine female NAIA volleyball players volunteered for the study (age 19.66±.87, height 174.77±4.12 cm, mass 76.56±9.17 kg, body mass index 25.06±2.75). LoS in four directions (forward, backward, left, and right) and vertical jump scores were taken both before and after a periodized four week intervention. The intervention consisted of both unilateral and bilateral leg press exercises on the Shuttle TNT System. To incorporate proprioceptive components, all exercises were performed while standing on a volleyball. A repeated measures ANOVA and a Pearson product moment correlation were conducted using SPSS ver. 24 for pre-post differences.
RESULTS: There was a significant difference ($p = .05$) between all LoS directions tested (LoSF +40.6%, LoSB -7.8%, LoSL +8.2%, LosR +17.2%) and VJ scores (-3.4%). Correlations of .643 and .696 were also found between post-intervention values of LoSL and LoSF when compared against post-intervention values of VJ scores.
CONCLUSION: The authors concluded the Shuttle TNT System is a viable option to improve LoS scores in female collegiate volleyball players, although proprioceptive balance training does not improve VJ scores.

BALANCE TRAINING IMPROVES SELECTIVE DUAL-TASKING GAIT PARAMETERS AT HOME OR UNDER THERAPIST-SUPERVISION

ATTERBURY, E., WELMAN, K.

STELLENBOSCH UNIVERSITY

INTRODUCTION: Individuals with Parkinsons disease (IwPD) presents with a loss of automaticity, and as a result gait dysfunction occurs. Often IwPD experience freezing of gait which further hampers their functional capacity for ambulation and can result in subsequent falls which reduces independence and quality of life. Fall risk is furthermore aggravated when IwPD attempt to perform multiple tasks at the same time (i.e. dual-tasking). Previous research has shown that balance training can effectively improve motor-cognitive integration in IwPD; however, the effects on freezers compared to non-freezers and the influence of exercise delivery remains unclear. The study set out to investigate the efficacy of a home-based compared to therapist-supervised balance training programme on dual-task gait of IwPD who experiencing freezing.
METHODS: Forty individuals diagnosed with PD (Hoehn&Yahr: II-III) were randomized into a therapist-supervised (n = 24, age 65.4 ± 8.3 years) or home-based (n=16, age 64.9 ± 7.1 years) group. Within each group 50% of individuals were classified as freezers. Both groups followed an eight-week balance training program (3x week for 45-50minutes) under the supervision of a therapist or on their own with a DVD. Duration, stride length, stride velocity and cadence were measured with a 7m Timed-Up-and-Go test and the APDM mobility lab®, during dual-task conditions. Fear of falling was also assessed before and after the intervention with the Fall Self- Efficacy Scale.

RESULTS: The freezers differed from the non-freezers in both therapist-supervised (TS) and home-based (HB) groups at pre-test for stride velocity ($p<0.04$); for pre-test values of stride length the HB group differed ($p=0.002$) and TS group showed a tendency ($p=0.061$) to differ from their non-freezing counterparts. The freezers in the TS group improved their stride length over the 8-week balance intervention ($p<0.05$). The freezers of the HB group took longer to complete the dual-task after the intervention ($p<0.001$). Dual-tasking cadence improved for the non-freezers of the HB group ($p=0.01$) and the non-freezers showed a tendency ($p=0.08$) towards improvement. Only the non- freezers of the HB group showed improvement ($p<0.03$) in their fear of fallings scores.
CONCLUSION: Findings suggest that when IwPD who freeze follow a balance programme under supervision of a therapist, they are able to improve their dual-task stride length. Decreased stride length have been related to freezing of gait and increase fall risk, thus the improvement of the TS freezers stride length is a significant finding. Even though a balance training in a home environment can improve dual-task cadence; it does not result in improved gait speed. It can be postulated that balance training, whether with a therapist or at home, for individuals who experience freezing can improve their gait quality during motor-cognitive interference. The "posture first" strategy could be promoted by balance training, thus resulting in safer ambulation.

A DIGITAL HOME-BASED PHYSICAL TRAINING PROGRAMME TO IMPROVE BALANCE AND MOBILITY PERFORMANCE AMONG OLDER ADULTS

HELLER, M., STÜBLER, A., SANDNER, E., KROPF, J., KUMPF, A., OPPENAUER-MEERSKRAUT, C., STAMM, T., LAMPEL, K.
ST. PÖLTEN UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Physical activity in older adults is an important protective factor for preventing morbidity and mortality and increases well-being and independent living. Therefore, the overall aim of the so-called "Train and Win"project* is to develop a training module at the user's home using their own TV with a motivating avatar. Recently, two user-centered design studies revealed that, contrary to published literature and our expectations, a majority of participants explicitly refused gamification elements, such as competitions between the participants or motivational design inputs for process feedback (Oppenauer-Meerskraut et al., 2017). Thus, a training programme should be related to the physical training experiences of the participants, which were mainly sports and be "realistic" in terms of the presentation and interaction with an avatar.
METHODS: A set of 60 selected physiotherapy and occupational therapy conform exercises aiming to improve the quality of physical fitness (balance, strengthening of upper and lower extremities) has been designed for an exercise programme („FitDaheim", http://fitdaheim.com/). Real body movements of these exercises were captured using motion capture technology (Perception Neuron®) and used to animate an avatars' movement. During training sessions at user's home, a Microsoft Kinect Camera captures motion data of the participant. The evaluation of the performance of the participant is done by the analysis of key frames of body positions on a MiniPC. Each exercise session consists of eight randomly selected exercises with individual numbers of repetitions, sets, and durations. There are three different levels of progression (low, medium, high) varying in number of repetitions per set, reached body position angles, and movement times. Levels are assigned with respect to baseline measures as well as continuing the exercise programme during period of participation. An exercise runs as follows: the avatar shows and explains the exercise, and then he or she will ask the participant to perform the exercise one to three times just after the demonstration to ensure the participant understands how to do the exercise correctly. After that, the avatar and the participant „together" perform the exercise. Visual and acoustic feedback is given for each repetition to improve performance. A whole exercise session is expected to take 30–40 minutes on average, including rests.
RESULTS: Now, a pilot study with 30 participants is carried out. Several screening and assessment measures during baseline and after eight weeks of intervention programme are used to get insights into usability and acceptance of the system as well as possible effects on balance, mobility, and quality of life.
CONCLUSION: *The project has been funded by grants from the Austrian Federal Ministry for Transportation, Innovation and Technology (BMVIT) as part of the BENEFIT-Program of the Austrian Research Promotion Agency (FFG registration number 856184).

Oral presentations

OP-BN26 Neuromuscular testing

TAP REFLEX INHIBITION FOLLOWING 30 SEC OF STATIC STRETCHING IS REDUCED BY DYNAMIC OR ISOMETRIC CONTRACTIONS

TILP, M., BUDINI, F.
UNIVERSITY GRAZ

INTRODUCTION: Afferents from muscle spindles are important for muscle contraction. Static stretching (SS) reduces muscle spindle sensitivity as indicated by a decreased tap reflex (TR) observed following 10 min of SS (Weir et al., 2005). Lately, Budini et al. (2016) reported that the TR is inhibited even after 1 min of SS but recovered within 5 min. However, athletes who use stretching as preparation for competition or training stretch less than 1 min and perform several muscle contractions before they start, possibly restoring muscle spindle sensitivity. Hence, the primary aim of this study was to investigate the effect of 30 sec of SS on the TR. A secondary aim was to investigate the effect of isometric or dynamic contractions following SS on the TR.
METHODS: Eleven participants reached individual maximal ankle dorsiflexion through an isokinetic rotation and maintained it for 30 s. A motorized hammer was used for inducing a TRs in the soleus muscle for 5 min at baseline and for 10 min after SS with one tap delivered every 30 s. The procedure was repeated 3 times with 3 randomized conditions between baseline and post SS. Conditions were: control (no contraction (noCon)), a maximum isometric contraction (isoCon), 3 (dynamic) counter movement jumps (dynCon). We tested the group mean changes of reflex amplitude for differences between the three conditions with Friedman test and post-hoc Wilcoxon test because data was not normally distributed. Comparisons between baseline values and data at each time point (from 30 s to 10 min after SS) were tested in each condition either with paired t-tests or Wilcoxon tests.
RESULTS: The comparison of the three conditions revealed that the overall inhibition was greater in the noCon (-18.3+/-7.2%) compared to both the isoCon (-0.1+/-6.2%) and the dynCon (0.5+/-15.4%) condition, respectively, whilst no difference between the isoCon and dynCon conditions was observed. In the noCon condition, 6 out of the 20 time investigated points were inhibited and further 4 time points showed a tendency of a reduced tap-reflex ($p<0.1$). While in the isoCon condition, tap reflex was not significantly reduced, the counter movement jumps (dynCon) induced an inhibition in the first 3 time points.

CONCLUSION: This study shows that 30 s SS reduces muscle spindle sensitivity up to 10 min (although not at every investigated time point). This inhibition is an undesired side effect of stretching that athletes might avoid. We demonstrated that both isometric and dynamic contractions significantly reduced the amount of inhibition over the period of 10 minutes. However, the dynamic contraction induced a significant inhibition of the tap reflex by 30% for about 2-3 minutes, probably due to an induced slack of intrafusal fibres due to the eccentric part of the movement.
Budini F, Gallasch E, Christova M, Rafolt D, Rauscher AB, Tilp M. Exp Physiol 2017; 102(8): 901-910.
Weir DE, Tingley J & Elder GC. Eur J Appl Physiol 2005; 93: 614–623.

SPORT-RELATED DIFFERENCES IN TRUNK ROTATIONAL POWER IN STANDING AND SITTING POSITIONS

ZEMKOVÁ, E.1,2, POÓR, O.1, JELEN, M.2

1: FACULTY OF PHYSICAL EDUCATION AND SPORT, COMENIUS UNIVERSITY IN BRATISLAVA, 2: FACULTY OF ELECTRICAL ENGINEERING AND INFORMATION TECHNOLOGY, SLOVAK UNIVERSITY OF TECHNOLOGY

INTRODUCTION: Previous study showed significantly higher power during standing than seated trunk rotations with weights ≥10.5 kg in a group of physically fit men (Zemková et al., 2017). Similar finding may be expected in athletes performing rotational movements of the trunk while standing under unloading or loading conditions. Still, the questions remains as to what muscle power is produced by athletes that used to perform seated trunk rotations in their sports. Therefore, this study compares trunk rotational power at different weights in standing and sitting positions in athletes of various sports.
METHODS: Forty two athletes (age 23.1±3.9 y, height 181.0±8.7 cm, body mass 89.1±12.7 kg) of selected sports (box, canoeing, hockey, judo, karate, kayaking, tennis, wrestling) completed four trials of trunk rotations in both standing and seated positions with a barbell of different weights (increasing stepwise from 5.5 kg up to a maximal value of power) placed on the shoulders. Basic biomechanical parameters throughout the movement were monitored using the FiTRO Torso Premium.
RESULTS: As expected, mean power in the acceleration phase of trunk rotations was significantly higher in standing compared to sitting at weights of 10.5 kg (20.4%, p=0.017), 15.5 kg (22.4%, p=0.009), 20 kg (23.0%, p=0.008), and 25 kg (27.1%, p=0.005) but not at 5.5 kg (13.6%, p=0.085) in a group of athletes that used to perform standing trunk rotational movements. However, its values did not differ significantly during standing and seated trunk rotations in canoeists and kayakers at all weights used (from -4.6% to 5.1%). Although the respective angular displacement during trunk rotations showed similar tendencies, its values only moderately correlated with trunk rotational power in both the standing (r=0.532, p=0.044, 95%CI [0.511, 0.567]) and sitting (r=0.616, p=0.037, 95%CI [0.588, 0.651]). This indicates that athletes were able to produce forceful movement, regardless of their range of trunk rotational motion.
CONCLUSION: Greater trunk rotational power in either a standing or a seated position is undoubtedly due to a predominant exercise mode used during athletic performance. Therefore, the exercise that closely replicates the upper/lower body rotation movements should be preferred in testing in order to assess sport-specific power.
References: Zemková E, Jeleň M, Zapletalová L, Hamar D (2017). Sport Mont, 15(3), 17–23, doi: 10.26773/smj.2017.10.003.
Acknowledgment: This work was supported by the Slovak Research and Development Agency under the contract No. APVV-15-0704.
Contact: erika.zemkova@uniba.sk

RELIABILITY AND CONCURRENT VALIDITY OF FORCE-VELOCITY PARAMETERS OBTAINED FROM LINEAR AND CURVILINEAR REGRESSION MODELS

RIAL VAZQUEZ, J.

UNIVERSITY OF A CORUNA

INTRODUCTION: When multi-joint exercises are considered the inverse relationship between muscle force and shortening velocity (FV) has been typically fitted by linear regression models. Previous studies have analysed de feasibility of the variables calculated from linear models but not for parameters calculated from non-linear models.
METHODS: 21 athletes (rugby players and judokas) were recruited. The FV of bench press (BP) and parallel squat (SQ) performed with a Smith Machine were obtained twice by a protocol of progressive increments loads until 1RM. Three models were considered for obtaining each individual FV: linear (LM), quadratic polynomial (PM) and exponential model (EM).
The parameters obtained were: velocity axis intercept (V0), the force axis intercept (F0) the maximum estimated power (Pmax), quadratic coefficient of PM (a) and the proportion represented by the velocity (V1RM) and force (F1RM) associated to 1RM respect to V0 and F0 respectively.
RESULTS: The results confirmed the linearity of FV for multi-joint exercises. The reliability coefficients were higher for LM in comparison with PM. The reliability of V1RM was not acceptable (CV% = 19 and 18% for BP and SQ) but high reliability was observed for F1RM (CV% = 3 and 2% for BP and SQ) and for the ratio between F1RM and F0 (CV% = 2 and 4% for BP and SQ).
CONCLUSION: This study confirmed the linearity of FV for multi-joint exercises even within a wide range of loads, since the goodness of fit for LM were better than EM and the quadratic coefficient of PM was extremely low (i.e. low concavity).
The reliability of the parameters was consistently higher for LM than for PM, and BP in comparison with SQ. Previous studies reported a lower reliability of V0 for exercises such as press throws (García-Ramos et al, 2016), squat and countermovement jumps (Cuk et al, 2014). By contrast, a recent study reported lower reliability of F0 in comparison with V0 for deadlift high pull (Lu et al, 2017), which suggests that the reliability depends on the type of exercise.
The high reliability of the relative values of F1RM around 92 and 87% of F0 for BP and SQ, respectively suggests the use of these values as reference for monitoring resistance training programs.
REFERENCES: Cuk, I, Markovic, M, Nedeljkovic, A, Ugarkovic, D, Kukolj, M, and Jaric, S. Eur J Appl Physiol 114: 1703-1714, 2014.
Fenn, WO, Marsh BS. J Physiol 85: 277-297, 1935
Garcia-Ramos, A, Jaric, S, Padial, P, and Feriche, B. J Appl Biomech 32: 178-185, 2016
Lu, W, Boyas, S, Jubeau, M, and Rahmani, A. Sports Biomech, 2017, Epub ahead of print.

DETERMINANTS OF LOADING RATE OF VERTICAL IMPACT FORCES IN LEISURE-TIME RUNNERS

MALISOUX, L., GETTE, P., DELATTRE, N., THEISEN, D.

LUXEMBOURG INSTITUTE OF HEALTH

INTRODUCTION: Vertical ground reaction forces generated during running are considered key factors in the mechanism leading to some types of overuse injuries. Especially, loading rate of vertical impact force has been associated with injury risk in running. As a consequence, the identification of modifiable factors influencing vertical instantaneous loading rate (VILR) could represent a promising approach toward injury prevention. Therefore, this study aimed to identify determinants of VILR among personal and running style characteristics in leisure-time runners.
METHODS: This cross-sectional study includes anthropometric measurements, bio-impedancemetry body composition analysis, as well as running technique analyses performed on an instrumented treadmill in 874 leisure-time runners (61% male, age: 40±10 years, height: 1.74±0.09 m, body mass: 73.4±12.7 kg). After a 5-minute warm-up, the participants ran for 10 minutes at their self-reported usual training speed. A record of ground reaction forces (2 kHz) was performed during the last 2 minutes. The outcome of interest was VILR, calculated as the maximal slope of the vertical ground reaction force signal before the first vertical impact peak force. A multivariable linear regression analysis was performed to identify factors associated with VILR (coefficient b [95% confidence interval]). Accepted significance was set at $p<0.05$.
RESULTS: On average (±SD), running speed was 9.9±1.5 km/h and VILR was 43.76±12.65 kN/s, based on a total of 326±19 steps analysed per record. Modifiable factors associated with a higher VILR were higher body fat mass (%, b = 0.83 [0.72; 0.95], $p<0.001$), lower step cadence (steps/min, b = -0.41 [-0.63; -0.19], $p<0.001$), greater vertical stiffness (kN/m/bodyweight, b = 1.41 [1.17; 1.65], $p<0.001$), greater vertical oscillation (% leg length, b = 1.69 [0.31; 3.08], $p<0.017$), and higher running speed (km/h, b = 1.95 [1.28; 2.61], $p<0.001$). Some non-modifiable factors were also associated with VILR: height (m, b = 52.5 [40.8; 64.1], $p<0.001$), and age (years, b = 0.08 [0.02; 0.13], $p=0.009$). Finally, a higher VILR was found in males compared with females (b = 11.74 [9.77; 13.71], $p<0.001$). Contact time (ms, b = -0.01 [-0.07; 0.05], $p=0.778$) and leg length discrepancy (cm, b = -0.03 [-0.19; 0.13], $p=0.778$) were not associated with VILR.
CONCLUSION: Decrease of body fat mass, vertical oscillation and running speed, softer landing, and increase of step cadence represent modifiable targets to decrease VILR. This study provides clinicians and sports trainers with important information on cues that should be given to leisure-time runners to potentially prevent running injuries.

LOAD-VELOCITY REALTIONSHIP OF ARM MUSCLES OBTAINED FROM MEDICINE BALL THROW TES

MIRKOV, D.M.1, MAROVIC, I.P.1, KNEZEVIC, O.M.2, PREBEG, G.1, JARIC, S.3

1: UB FSPE , 2: UB IMR , 3: UDEL BIOMS

INTRODUCTION: Routine tests used to assess muscle mechanical capacities are typically conducted under a single mechanical condition. Consequently, the outcomes of these procedures are of limited informational value regarding specific muscle capacities. Recent studies exploring force- i.e. load-velocity (F-V, L-V) relationship observed from functional movements tested under varying loading conditions have revealed reliable and valid parameters depicting the force (F)-, velocity (V)-, and power (P)-producing capacities of the tested muscles. Therefore, the aims of the present study were to evaluate the strength, shape and reliability, and external validity of L-V relationship of arm muscles obtained from medicine ball throw test.
METHODS: Twelve healthy subjects performed maximum throws using medicine balls of four different weights. In addition, maximum strength of arm muscles was assessed through maximum isometric force (Fmax) and 1RM bench press. L-V relationships were assessed from the applied loads L and V variables (separately for their maximum and averaged values). The linear regressions were extrapolated to determine the L- (L0; L at zero V) and V-intercepts (V0; the velocity at zero L), as well as the regression slopes (a = L0/V0). Finally, the maximum power output was calculated from the linear regression parameters as Pmax = (L0V0)/4
RESULTS: The observed L-V relationships were exceptionally strong ($r = 0.92–0.99$; all $P < 0.01$) and linear. The reliability of parameters obtained from the linear L-V regression proved to be mainly high (ICC > 0.80), while their concurrent validity regarding directly measured Fmax and 1RM ranged from medium-to-high.
CONCLUSION: The present findings revealed a strong and approximately linear L–V and, consequently, parabolic P–V relationship of arm muscles tested through maximum throws of medicine balls. Furthermore, parameters (maximum L, V and P) obtained from L-V relationship could be reliable and valid indices of various mechanical capacities of the tested muscles. Therefore, we conclude that the maximum throw of medicine balls of different weights could be developed into a quick routine test for assessment of various mechanical capacities of arm muscles.
References: Jaric S (2016). Int J Sports Med.
Contact: [dragan.mirkov@fsfv.bg.ac.rs]

Oral presentations

OP-PM86 Stroke

NON-INVASIVE ASSESSMENT OF CENTRAL HAEMODYNAMICS IN ACUTE STROKE PATIENTS – BETWEEN-DAY RELIABILITY AND THE EFFECT OF FASTING STATE AND POSTURE

MITCHELMORE, A., STONER, L., LAMBRICK, D., SYKES, L., EGLINTON, C., JOBSON, S., FAULKNER, J.

UNIVERSITY OF WINCHESTER

INTRODUCTION: Novel oscillometric measures of central blood pressure and central systolic loading offer a more comprehensive view of cardiovascular health than peripheral blood pressure. These non-invasive assessments may become commonplace in clinical practice in the future. Whilst these devices have been shown to be reliable in a younger sample, the between-day reliability of the instruments capturing these measures has not been demonstrated in clinical populations such as stroke, where they are particularly pertinent in terms of patient care and pharmaceutical choices.
METHODS: Twenty-two acute stroke in-patients (72 ± 10y) had peripheral blood pressure, central blood pressure and central systolic loading variables measured using the SphygmoCor XCEL on three consecutive mornings in both fasted and non-fasted states whilst in supine and seated postures.

RESULTS: Acceptable between-day reliability was observed for all peripheral and central blood pressures in all conditions, and for measures of central systolic loading in both fasted postures (ICC >0.75). Food intake significantly decreased all peripheral and central blood pressure and central systolic loading variables ($p < 0.05$; $\eta 2p = 0.20$-0.55). A seated posture caused a significant increase in measures of central systolic loading ($p < 0.05$; $\eta 2p = 0.22$).
CONCLUSION: Non-invasive measures of central haemodynamics can be reliably measured in an acute stroke population, but markers of systolic loading should be assessed in a fasted state where possible. Food consumption caused a significant drop in peripheral and central blood pressures – a finding which should be taken into account when assessing vascular health in an in-patient environment.

COGNITIVE-MOTOR INTERFERENCE IMPROVES WITH EIGHT WEEKS OF SENSORY-MOTOR TRAINING IN CHRONIC STROKE SURVIVORS: A PILOT STUDY.

LA GRANGE, R., WELMAN, K.E.

STELLENBOSCH UNIVERSITY

INTRODUCTION: Due to executive dysfunction, the ability to walk while concurrently engaging in a second cognitive task deteriorates in stroke survivors. Furthermore, this cognitive-motor interference (CMI) is related to high incidence of falls, poor balance, and reduction in health-related quality of life (QoL). To the researchers knowledge, no study to date has specifically investigated the influence of a sensory-motor training (SMT) on CMI in chronic stroke survivors (>6 months). Consequently, this study aimed to determine if an eight-week SMT would influence CMI during ambulation in chronic stroke survivors.
METHODS: A quasi-experimental study design. Ten chronic stroke survivors (67±14 years; 121.8±114.5 months since stroke) with ≥18 Montreal Cognitive Assessment participated in the SMT, three times a week for 45- 60 minutes per session. Outcome measures included QoL with SF-36 questionnaire and gait quality via a two-minute walk test during single-task and dual-task conditions; from this CMI was determined.
RESULTS: Improvements were found in CMI paretic single-limb stance ($p=0.05$, $d=1.06$, 95%CI: 1.23-6.62) and overall single-limb stance ($p=0.04$, $d=0.78$, 95%CI: -0.02-3.61). QoL improve over time in 'physical functioning' ($p=0.01$; $d=0.64$, 95%CI: -14.51-38.85), 'role limitations due to physical health' ($p=0.02$; $d=0.93$, 95%CI: -47.94-92.94) and 'social functioning' ($p=0.04$; $d=0.78$, 95%CI: -74.31-106.91).
CONCLUSION: The SMT was effective in improving motor-cognitive interference during ambulation as well as QoL in chronic stroke survivors.

SENSORY-MOTOR TRAINING LOWERS SURFACE DEPENDENCE IN CHRONIC STROKE SURVIVORS

ZASTRON, T., WELMAN, K.E.

UNIVERSITY OF STELLENBOSCH

INTRODUCTION: Balance is a complex sensory-motor process that allows an individual to maintain their balance through feedback and feed-forward mechanisms from the visual, vestibular and somatosensory systems (Barros et al., 2008). Following stroke, sensory integration and reweighting, i.e. the ability to choose and rely on the appropriate sensory input, can be impaired. Thus, abnormal interactions between the visual, vestibular and somatosensory system could be the source of abnormal postural control (Bonan e al., 2004). The primary objective was to assess the influence of sensory-motor training on postural stability in chronic stroke survivors. Additionally, intrinsic motivation was assessed after the intervention.
METHODS: This was a double-blind randomized control trial. Twenty-two individuals with chronic stroke (≥ 6 months) were randomly divided into two groups i.e. sensory-motor training group (n = 12; 68 ± 13 years old) and attention-control group (n = 10; 71 ± 11 years old). The sensory-motor training and educational talks were delivered in a group setting, three times a week for 45-60 minute sessions over an eight-week period for a total of 24 sessions. The sensory-motor training included task-specific balance training, which focused on manipulating the visual, vestibular and proprioceptive sensory systems. Postural sway was measured with APDM's Mobility Lab™ body-worn inertial sensors using the modified Clinical Test for Sensory Integration and Balance (m-CTSIB). The m-CTSIB was measured for one 30 second trial under four different sensory conditions: (1) eyes open on firm surface, (2) eyes closed on firm surface, (3) eyes open on foam surface and (4) eyes closed on foam surface. Participants were evaluated one week before beginning the intervention (pre-test) and within one week after completing the intervention (post-test). Lastly, intrinsic motivation was measured with the Intrinsic Motivation Inventory (IMI) after the intervention.
RESULTS: The main findings showed that the sensory-motor training group improved their sway area during condition three ($p = 0.04$) and showed a reduction in proprioceptive dependence ($p = 0.02$) after the intervention. Both groups showed high intrinsic motivation after the sensory-motor training and educational talks.
CONCLUSION: The present study demonstrates that participating in a sensory-motor training program could improve a chronic stroke survivor's ability to choose and rely on the appropriate sensory input during balance tasks.
REFERENCES:
Barros de Oliveira C, Torres de Medeiros ÍR, Frota NAF, Greters ME, Conforto AB. Balance control in hemiparetic stroke patients: Main tools for evaluation. J Rehabil Res Dev 2008;45:1215.
Bonan IV, Colle FM, Guichard JP, Vicaut E, Eisenfisz M, Tran Ba Huy P, et al. Reliance on Visual Information after Stroke. Part I: Balance on Dynamic Posturography. Arch Phys Med Rehabil 2004;85:268–73.

DUAL-TASK COST GAIT SPEED REVEALS EXECUTIVE DYSFUNCTION IN CHRONIC STROKE SURVIVORS

WELMAN, K.E., WATSON, J., LA GRANGE, R.

STELLENBSOCH UNIVERSITY

INTRODUCTION: Rehabilitation research has often viewed gait and executive functioning (EF) as separate entities. However, recent research on healthy and elderly individuals, as well as acute stroke survivors suggest that EF and gait should be evaluated together owing to the motor-cognitive interaction that is also found in everyday life. Executive functioning is responsible for planning and coordination of complex processes, as well as allocating the necessary amount of attention during dual-task activities. The aim of this study was to determine if a relationship exist between EF and gait speed under single-, dual-task and dual-task cost (DTC) in chronic stroke survivors (onset stroke ≥6 months) compared to healthy adults. To the authors' knowledge, this was the first study to examine the independent association of DTC on EF in chronic stroke survivors.

METHODS: A cross-sectional observational design. Community-dwelling chronic stroke survivors (n=25; 71.36±14.06 years) and healthy (n=24; 73.92±9.30 years) age-matched healthy adults were included. The Rapid Assessment of Physical Activity (RAPA) for physical activity status, Patient Health Questionnaire-9 (PHQ-9) for depressive moods and the Montreal Cognitive Assessment (MoCA) for global cognition were used as descriptive outcomes. Gait speed was measured using the two-minute walk test during single- and dual-task conditions to determine DTC. Executive functioning was assessed by means of an adapted Stroop, Trail Making (TMT Part A and B) and Verbal Digit Span Forward and Backward tests. Data was log transformed if it did not follow a normal distribution.
RESULTS: Multiple linear regression analysis showed a significant association between DTC and EF in chronic stroke survivors. Specifically, DTC correlated with Stroop incongruent (R2=0.127, F (1,24)=4.352; β=-0.065, p=0.049) and interference ratio (R2=0.201, F(1,24)=6.780; β=0.005, p=0.016). Healthy individuals' ST gait speed related to Stroop incongruent (R2=0.514, F(1,23)=23.235; β=-4.796, p<0.001), LogTMT B (R2=0.376, F(1,23)=14.841; β=-0.783, p=0.001) and LogTMT difference (R2=0.393, F(1,23)=15.891; β=-0.976, p=0.001) while dual-task gait speed predicted LogTMT B (R2=0.424, F(1,23)=17.940; β=-0.505, p<0.001) and LogTMT difference (R2=0.382, F(1,23)=15.214; β=-0.589, p=0.001). Results were significant even if controlled for age and education (p<0.05).
CONCLUSION: Gait speed DTC is independently associated with inhibitory control, and possibly to working memory and cognitive flexibility in chronic stroke survivors. These findings support the motor-cognitive relationship during walking tasks in chronic stroke survivors and age-matched healthy individuals. Moreover, supports to use of dual-task gait assessments for an ecological alternative to assess EF.

PREDICTORS OF PEAK VO2 CHANGE AND THE EFFECTIVENESS OF LONG-TERM PARTICIPATION IN A REAL-LIFE SETTING CARDIAC REHABILITATION PROGRAM

PERNICK, Y., MOORE, J., KUBIS, H.P., ZYSSMAN, I., VERED, Z.

ASAF HAROFE MEDICAL CENTRE, ZERIFIN, ISRAEL; BANGOR UNIVERSITY, BANGOR, WALES, UK.

INTRODUCTION: The benefits of exercise-based cardiac rehabilitation programs are well known . Maximal exercise capacity is considered the most important predictor of cardiac and all-cause mortality .
The purpose of this study was to define the factors that may affect VO2max change in cardiac patients who attend a CR program. Another purpose was to determine if there is an advantage in maintaining to exercise in a CR program.
METHODS: 72 subjects exercised in a standard CR program for 3 months. Outcomes included cardiorespiratory variables, blood lipids, hemodynamic parameters, body composition, quality of life , and systolic and diastolic function. Measurements were obtained at baseline, after 3 months of supervised training, and following 6 months. After 3 months, a multiple linear regression analysis was performed to investigate predictors of changes in peak VO2. Following 6 months, a 2-way ANOVA analysis was performed to compare the cardiac measurements between patients who continued to exercise in the CR center and patients who left the center .
RESULTS: VO2 peak was improved by 6.0 ± 10.2% from baseline to 3 months . Also, maximal output in the cardiopulmonary exercise test and anaerobic threshold increased significantly.
The variables that predicted peak VO2 improvement included: peak VO2 at baseline, body fat percentage, maximal rate pressure product, QoL score, ejection fraction, and number of sessions. These factors accounted for 38.5% of the variance, p<.001.
At 6 months follow up, peak VO2 was maintained only in the CR-based group, while there was a decrease among non-CR-based subjects . Maximal output declined among non-CR-based patients . Body mass index and percent of body fat were increased in the non-CR-based group while they were preserved in the CR-based group.
CONCLUSION: This real-life comprehensive study identified several factors that can predict the change in peak VO2. Moreover, the long-term preservations of peak VO2 and other important cardiac related parameters in CR-based exercisers were noteworthy. Taken together, our findings can enable CR professionals to target and assist patients in improving their functional capacity and thus their prognosis. Furthermore, the importance of long-term CR programs in preserving attainments of functional capacity and body composition should be recognized. Subsequently, CR professionals should consider prolonging the standard CR programs.
References:
1. Lavie, C. J., Thomas, R. J., Squires, R. W., Allison, T. G., & Milani, R. V. <2009>. Exercise training and cardiac rehabilitation in primary and secondary prevention of coronary heart disease. Mayo Clinic Proceedings, 84<4>, 373-383.
2. Feuerstadt, P., Chai, A., & Kligfield, P. <2007>. Submaximal effort tolerance as a predictor of all-cause mortality in patients undergoing cardiac rehabilitation. Clinical Cardioloy, 30<5>, 234-238.

Oral presentations

OP-PM43 Ergogenic Aids

EFFECTS OF A COMMERCIAL SUPPLEMENT OF OPHIOCORDYCEPS SINENSIS, AND GANODERMA LUCIDUM ON PHYSIOLOGICAL RESPONSES TO MAXIMAL EXERCISE IN HEALTHY YOUNG PARTICIPANTS

TSUK, S.

WINGATE COLLEGE

INTRODUCTION: Cordyceps sinensis (Cs) and Ganoderma lucidum (Gl) are two medicinal mushrooms, which were suggested to have a potential to enhance exercise capacity.
METHODS: We used a combined commercial supplement of Cs and Gl and tested their effects on human physical, aerobic, and anaerobic capacities. Ninety-six physical education students (43 women; age 26.3±3.21) were randomly divided into three groups: low dose treatment, high dose treatment, and placebo. Participants received supplement or placebo for 28-33 days. Participants performed the following tests before and after one month of interventios: 1. a graded maximal VO2max test on a treadmill 2. on a different day a Wingate anaerobic cycle test. From the maximal graded treadmill test the following parameters were measured and recorded: heart rate (HR); oxygen consumption (VO2); respiratory exchange ratio (RER); and ventilation (VE). From the Wingate, anaerobic cycle test the following parameters were calculated: maximal anaerobic power; mean anaerobic power; and fatigue index.
RESULTS: The supplements did not affect VO2max or the physiological responses at maximal exercise during the graded treadmill test. Similarly, there was no effect on peak and mean power or fatigue index as measured by the Wingate anaerobic test. A borderline interaction indicated a somewhat lower HR at rest post treatment, however, post hoc analysis did not reveal any further significant statistical differences, (P=0.047* F=3.169).

CONCLUSION: The findings indicate that the dual supplementation with Cs and Gl had no effect on maximal oxygen consumption, on physiological responses at peak exercise load of a graded maximal treadmill test, or on the parameters of anaerobic capacity.

REPRESSED EXERCISE-INDUCED HEPCIDIN LEVELS AFTER DANGGUI BUXUE TANG SUPPLEMENTATION IN MALE RECREATIONAL RUNNERS

CHANG, C.W., CHEN, C.Y., YEN, C.C., WU, Y.T., HSU, M.C.

KAOHSIUNG MEDICAL UNIVERSITY

INTRODUCTION: The aim of this study is to investigate the protective and recovery effects of Danggui Buxue Tang (DBT)—a Chinese herbal decoction containing the roots of Astragalus membranaceus and Angelica sinensis—supplementation on iron status, oxidative stress, complete blood count, inflammatory markers, and metabolic markers after participants were challenged by a single bout of intense aerobic exercise.
METHODS: Twenty-eight recreationally active males were pair-matched and randomly assigned to receive DBT (DBT group) or a placebo (control group) for 11 d, using clusters based on their aerobic capacities. On the eighth day of the supplementation, the participants performed a 13-km run with maximal effort. Blood and urine samples were collected and analyzed before treatment (Pre-Tre) and immediately after (Post-Ex), 24 h after (24-h Rec), and 72 h after (72-h Rec) the run.
RESULTS: DBT supplementation markedly shortened the finish times by 14.0% (12.3 min) compared with the control group ($p = 0.024$), with a larger improvement revealed in participants with lower aerobic capacity levels. Significant group×time effects were observed in serum hepcidin and iron levels ($p < 0.050$). DBT supplementation repressed exercise-induced hepcidin levels at Post-Ex and 24-h Rec, and was even decreased by 26.2% at 72-h Rec ($p = 0.012$). DBT supplementation thereby caused a significant increase in iron levels by 63.3% and 31.4% at Post-Ex ($p = 0.019$) and 72-h Rec ($p = 0.025$), respectively. However, DBT supplementation was not determined to prevent the immediate production of hematuria after exercise.
CONCLUSION: Short-term DBT supplementation improved exercise performance and repressed exercise-induced hepcidin, thereby boosting iron absorption and accelerating iron homeostasis during recovery. DBT is thus a promising ergogenic aid for athletic performance.

MANGIFERA INDICA L. LEAF EXTRACT IN COMBINATION WITH LUTEOLIN OR QUERCETIN ENHANCES VO2PEAK AND PEAK POWER OUTPUT, AND PRESERVES SKELETAL MUSCLE FUNCTION DURING ISCHEMIA-REPERFUSION IN HUMANS

GELABERT REBATO, M.1,2, WIEBE, J.C.2, MARTIN-RINCON, M.1, GERICKE, N.2, PEREZ-VALERA, M.1, CURTELIN, D.1, GALVAN-ALVAREZ, V.1, LOPEZ-RIOS, L.1, MORALES-ALAMO, D.1, CALBET, J.A.L.1

1 UNIVERSITY OF LAS PALMAS DE GRAN CANARIA; 2 NEKTIUM PHARMA

INTRODUCTION: Most polyphenols may act as antioxidants and have properties which may confer performance-enhancing effects (ergogenic). It remains unknown whether polyphenols such as luteolin, mangiferin and quercetin have ergogenic effects during repeated all-out prolonged sprints in humans. Here we tested the effect of a proprietary Mangifera indica L. leaf extract (MLE) rich in mangiferin (Zynamite®) administered with either quercetin (Q) and tiger nut extract (TNE), or with luteolin (Lut) on sprint performance and recovery from ischemia/reperfusion.
METHODS: For these purposes, thirty young physically active volunteers (seventeen men and thirteen women) were randomly assigned to three treatments (double-blinded), 48 h before the main experiments: treatment A (placebo: 500 mg of maltodextrin/day); treatment B (140 mg of MLE (60% mangiferin) and 50 mg of Lut/day) and treatment C (140 mg of MLE, 600 mg of Q and 350 mg of TNE/day). The experimental day subjects performed two warm-up sprints (8s), followed by 6 min of submaximal exercise (80-100 W), and two Wingate tests (30s) interspaced by a four-min rest period. After another four min of rest, they performed a 60s all-out sprint which ended with an instantaneous bilateral occlusion of the circulation of both legs during 20s. Then, the circulation was re-open and they performed a 15s-sprint followed by 10s of recovery with open circulation, and another 15s-final sprint.
RESULTS: Both MLE containing supplements enhanced performance. Both peak power output (Wpeak) (mean effect: 5.0 and 6.0 %, for MLE+Lut and MLE+Q, respectively) and mean power output (Wmean) (mean effect: 6.2 and 6.7%, respectively, $P<0.01$) were improved. In the sprint performed after ischemia, supplement MLE+Q+TNE increased Wpeak by 19.4 and 10.2% compared with placebo ($P<0.001$) and MLE+Lut ($P<0.05$). MLE+Q+TNE increased Wmean post-ischemia by 11.2 and 6.7 % compared with placebo ($P<0.001$) and MLE+Lut ($P=0.012$). Mean VO2 during the sprints was unchanged, suggesting increased efficiency or recruitment of the anaerobic capacity after MLE ingestion. In women, peak VO2 during the repeated sprints was 5.8% greater after the administration of MLE, coinciding with better brain oxygenation. MLE attenuated the metaboreflex hyperpneic response observed in post- ischemia sprints and may have improved O2 extraction by the vastus lateralis (MLE+Q+TNE vs placebo, $P=0.056$), and reduced the pain felt during the ischemia ($P=0.068$). Blood lactate, acid base-balance and plasma electrolytes responses were not altered by the supplements.
CONCLUSION: In conclusion, a MLE extract rich in mangiferin combined with either quercetin and tiger nut extract or luteolin has a remarkable ergogenic effect, increasing muscle power in fatigued subjects and enhancing peak VO2 and brain oxygenation in women during prolonged sprinting. Importantly, the combination MLE+Q+TNE improves skeletal muscle contractile function during ischemia/reperfusion.

IMPACT OF MAPLE SYRUP AND SAP INGESTION ON COGNITIVE FLEXIBILITY DURING HIGH-INTENSITY INTERMITTENT EXERCISE

DUPUY, O.1, LEDUC-SAVARD, N.2, LAVOIE, L.2, TREMBLAY, J.2

1: MOVE LABORATORY, UNIVERSITY OF POITIERS, FRANCE; 2:DEPT. KINESIOLOGY, UNIVERSITY OF MONTREAL, CANADA

INTRODUCTION: Glucose ingestion at rest and during exercise was previously shown to improve cognitive function. However, the effect of maple products on cognitive function during exercise are currently unknown. The aim of this study was to compare the effects of carbohydrate (CHO) drinks (6% per volume) sweetened with maple (syrup or sap) to a commercial sports drink (Gatorade©), glucose, and a control solution (water), on cognitive flexibility during high-intensity intermittent exercise.
METHODS: 78 subjects completed six (6) 3-minute bouts at 95% of their maximal aerobic power (MAP) on a stationary bike, with 3 minutes of passive rest in between efforts. During each recovery bout, the Stroop Color and Word Test (SCWT) was completed followed by mental ratings of perceived exertion (mRPE) and by the ingestion of 166 mL of one of 5 possible drinks (water, glucose, Gatorade©, maple syrup, maple sap). The subjects were randomly allocated to a different drink ingestion and each group was composed of ~15 subjects.

Following each bout, subjects ingested 166 mL of the experimental solution, drinking a total of 1L of the same solution throughout the experimentation. Cognitive flexibility was measured using reaction time and accuracy to the SCWT. The cognitive task was performed a total of 10 times, including 15 and 30 minutes post-exercise. Statistical analysis was performed using a two-way ANOVA with repeated measures using R.
RESULTS: Reaction times decreased in all conditions (main effect, $p<0.05$). However, this reduction was more important with any of the CHO condition than with water. Maple syrup and maple sap both led to larger reductions in reaction time (-22% and -29%, respectively) when compared to glucose and Gatorade© ingestion (-16% and -15%, respectively). Accuracy in the cognitive task decreased for all conditions (main effect, $p<0.05$). However, when compared to water and Gatorade©, maple syrup and glucose ingestion led to a lesser deterioration in accuracy (-1.2% and 0.1% respectively, compared to -2.8% for water and -3.2% for Gatorade©). Overall, mRPE increased over the exercise protocol ($p<0.05$) and both maple syrup and maple sap ingestion led to a lower mRPE (20 and 22% of improvement, respectively) than water.
CONCLUSION: CHO ingestion significantly decreased reaction time and improved accuracy during intermittent high-intensity exercise compared to water. Moreover, maple syrup ingestion leading to a smaller decrease in accuracy coupled with a quicker reaction time than with Gatorade© ingestion suggests it could potentially serve as an effective natural sweetener in order to improve cognitive function during high-intensity intermittent exercise.

FUEL SELECTION DURING PROLONGED EXERCISE WITH MAPLE SYRUP OR SAP INGESTION: COMPARISON WITH GLUCOSE AND GATORADE©

TREMBLAY, J.1, LAVOIE, L.1, LEDUC-SAVARD, N.1

UNIVERSITÉ DE MONTRÉAL

INTRODUCTION: Maple (syrup or sap) is a natural source of carbohydrates (CHO), being mainly composed of sucrose accompanied by organic acids, phenolic compounds, flavonoids and minerals. This suggests it could potentially be used as a viable source of energy during exercise. The aim of this study was thus to compare exogenous CHO oxidation and its contribution to the energy yield (%En) between 5 conditions: ingestion of either maple syrup, sap, glucose, Gatorade©, and sweetened water (stevia) during prolonged exercise.
METHODS: Subjects (n = 76, mass = 73.7 ± 10.3 kg, VO2max = 4.4 ± 0.5 L/min, MAP = 309 ± 42 W) were randomly allocated to an experimental group where they ingested a 13C-labelled CHO solutions (60 g/L) or sweetened water (stevia) during 120 min of exercise on a cycle ergometer at 55% MAP. Solutions were administered before and during exercise, at every 30 min (6 x 333 mL). Fuel selection was measured using indirect respiratory calorimetry corrected for urea excretion in urine and sweat combined with tracer techniques. Statistical analysis was performed using a two-way ANOVA with repeated measures using R. Results are reported as mean ± standard deviation.
RESULTS: The %En from protein oxidation was higher when water was ingested compared to all other conditions (5.5 ± 3.4 vs 4.2 ± 1.6%, respectively). When CHO were ingested, the %En from total CHO oxidation was significantly higher (water: 107.9 ± 40.4, glucose: 139.6 ± 22.6, Gatorade©: 139.4 ± 33.4, maple sap: 128.7 ± 31.6 and maple syrup: 141.9 ± 28.5 g) as well as its %En (water: 47.8 ± 17.6, glucose: 59.7 ± 9.9, Gatorade©: 60.1 ± 12.7, maple sap:58.2 ± 15.4 and maple syrup: 64.4 ± 15.0%), although no significant difference was observed between conditions with CHO ingestion. The %En from exogenous glucose oxidation was greater with Gatorade© and maple sap (17.3 ± 2.9 and 16.1 ± 3.7%) than with glucose and maple syrup (14.0 ± 2.1 and 13.4 ± 3.6%), while no difference was observed between these individual comparisons.
CONCLUSION: These results show that both maple syrup and sap can be readily absorbed and used as a source of energy during prolonged exercise. Maple sap leads to a greater exogenous oxidation than maple syrup and to a similar contribution to the energy yield as Gatorade© during prolonged cycling. This finding suggests that maple products could be used as viable natural sweeteners in sports drinks and warrant further investigation on their potential role in improving performance.

IMPACT OF A NITRATE-RICH, VEGETABLE BEVERAGE ON COGNITION, MOOD AND CARDIOVASCULAR RESPONSES IN YOUNGER AND OLDER ADULTS

ALI, A., STANAWAY, L., RUTHERFURD-MARKWICK, K., PAGE, R.

MASSEY UNIVERSITY

INTRODUCTION: Supplementation with nitrate-rich (NO3-) beetroot juice has been shown to improve cardiovascular responses and cognitive function in both younger and older adults, through the pathway of increased nitric oxide (NO). However, it is currently unclear whether there are differences in effects of dietary NO3- supplementation when directly comparing younger and older adults. Older adults have been shown to have an age-related decline in epithelial vasodilation, cardiovascular function, cognitive function, and mood indicating a greater potential for improvements in these areas following nitrate supplementation relative to younger adults who possess optimal functional capability. The purpose of this study was therefore to investigate the age-related differences in acute dietary NO3- supplementation on cardiovascular response, cognition and mood in younger and older adults.
METHODS: Following familiarisation, 13 younger and 11 older healthy and recreationally active adults (mean ± SD; younger vs older: age 25 ± 3 y vs. 56 ± 6 y ($p = 0.001$), body mass 75.3 ± 14.9 kg vs. 74.7 ± 7.9 kg ($p = 0.90$), height 1.78 ± 0.10 m vs. 1.70 ± 0.07 m ($p = 0.026$)) were randomly assigned to consume an isocaloric beverage; either 150 ml of NO3- rich beetroot juice (BR; containing 651 mg of NO3-) or 150 ml of placebo solution (PL; 65.8 mg of NO3-) in a double blind, crossover design, 2.25 h prior to a 30-min moderate treadmill walk. Throughout each trial, blood samples (plasma nitrate and nitrite concentrations) cardiovascular (blood pressure, heart rate), oxygen uptake kinetics, cognitive (choice reaction, rapid visual image processing and Stroop tests), and mood and perceptual (feeling scale, felt arousal scale, profile of mood states, and rating of perceived exertion) tests were performed.
RESULTS: Beetroot juice consumption increased plasma nitrate ($p(0.001)$ and nitrite concentrations ($p=0.003$) and reduced systolic ($p(0.001)$ and diastolic blood pressure ($p=0.013$) compared to placebo. Older adults showed a greater reduction in diastolic blood pressure following BR consumption ($p=0.005$) compared to younger adults. Systolic blood pressure was also lower post-exercise following BR versus PL treatment ($p=0.008$). Additionally, reaction time was improved in the Stroop test following BR supplementation ($p=0.045$). However, there were no main effects of treatment or interaction of treatment, time and age for heart rate, oxygen uptake, choice reaction or rapid visual image tests, and mood or perception measures following BR supplementation (p) 0.05).
CONCLUSION: These results showed that acute supplementation of beetroot juice increased plasma nitrate and nitrite levels, reduced blood pressure, and improved aspects of cognitive performance. Additionally, they indicate a potential age difference in diastolic blood

pressure following acute supplementation of BR. Further research directly comparing younger and older adults with the inclusion of blood flow measures such as NIRS and MRI is warranted.

Invited symposia

IS-SH04 "It's no choke": Moving choking under pressure beyond definition debates…

"IT'S NO CHOKE": MOVING CHOKING UNDER PRESSURE BEYOND DEFINITION DEBATES, ATTENTION-BASED MODELS, AND INTO THEORY-MATCHED INTERVENTIONS

HILL, D.

SWANSEA UNIVERSITY

"Choking" in sport is a significant concern for athletes, coaches and sport psychologists, as failure to meet performance expectations in critical situations, can have a devastating impact on the athlete. Consequently, the antecedents, mechanisms and moderators of choking in sport have been investigated at length, to inform theory-matched interventions that can alleviate the likelihood of its occurrence. Of particular importance are the attention and anxiety-focused interventions, and the more recent development of psychological strategies based on the neurophysiological considerations of choking. However, a number of researchers have contested the operational definition(s) of choking in sport, and thereby question whether researchers have accurately identified, isolated and examined the choking phenomenon. Accordingly, this symposium will explore and address the recent debate regarding the definition of choking in sport, and thereby provide a cogent account of the choking experience. Thereafter, it will provide a detailed review of contemporary theory-matched interventions, that can effectively lower an athlete's vulnerability to choke under pressure.

CHOKING UNDER PRESSURE: ATTENTION AND ANXIETY-BASED MODELS AND THEORY-MATCHED INTERVENTIONS

MESAGNO, C.

FEDERATION UNIVERSITY

Performing successfully under pressure is an important element of being an elite athlete. When an athlete fails under pressure, it can have negative social and psychological ramifications, especially if they experience "choking in sport". Although there is no research consensus on why choking occurs, attention- and anxiety-based models have been developed to help understand the cognitive mechanisms associated with choking. With researchers attempting to further understand choking models, applied sport psychologists have now turned their attention toward developing theory-matched interventions to ameliorate choking in sport. Thus, this presentation will provide an overview of choking theories, with an emphasis on possible integration of choking models. Thereafter, theory-matched, evidence-based interventions that help athletes alleviate choking will be explained and demonstrated.

A CHOKING INTERVENTION BASED ON NEUROPHYSIOLOGICAL CONSIDERATIONS

BECKMANN, J.

TECHNICAL UNIVERSITY MUNICH

Over recent years, an understanding of the neurophysiological processes underlying choking under pressure has accumulated. This knowledge is compatible with the choking model of anxiety induced self-focus. That is, if the athlete increases their investment in the conscious control of a motor skill when performing under pressure, the neuro-efficiency achieved through practice will break down. This process consequently interferes with the smooth flow of skill execution, resulting in increased kinematic variance and performance decrements. Based on this model, an intervention has been derived that eliminates the athlete's attempts to consciously control the motor skill. EEG studies show that clenching the left fist results in high Alpha activation across the cortex, which inhibits the conscious control processes that interfere with neuro-efficiency. Thus, if experts clench their left fist before the execution of a motor skill under pressure, choking is alleviated. Hence, this presentation will review the evidence-base that demonstrates the neurophysiological determinants of choking in sport, and the efficacy of fist clenching as a theory-matched intervention that reduces the likelihood of choking.

Oral presentations

OP-PM75 Exercise and older Adults

THE EFFECTS OF AN INCREASED ELEVATION STEPPING PROGRAM (STEEP) ON MUSCLE MASS, STRENGTH AND FUNCTIONAL PERFORMANCE IN OLDER WOMEN

BAGGEN, R., VAN ROIE, E., VERSCHUEREN, S., VAN DRIESSCHE, S., VAN DIEËN, J., DELECLUSE, C.

KU LEUVEN & VRIJE UNIVERSITEIT AMSTERDAM

INTRODUCTION: Decreased lower limb strength and functional ability are important indicators for increased fall-risk in older adults. Therefore, training programs aimed at fall prevention should aim to improve both of these factors. Task-specific training modalities such as stepping exercise have been shown to improve functional ability in older adults. However, the ability of such exercises to improve muscle mass and strength have not yet been thoroughly investigated. This study explored the effects of a 12-week stepping program with progressive increase in step height on muscle mass, strength and functional ability in older women.
METHODS: Forty-five community-dwelling women (68.78y ± 3.87) were randomly assigned to the training (n = 24) or control group (n = 21). Training intensity was determined by step height up to 36 cm, and percentage body weight added using a weighted vest. Muscle volume (MV) of the upper leg, strength of the knee extensors, and functional ability were determined pre- and post-intervention. MV was measured by CT-scan. An isokinetic dynamometer was used to determine isometric peak torque (PT) at two knee joint angles (PTisom120 and PTisom90), dynamic PT at three different speeds (PTisok60, PTisok180, and PTisok300), and peak velocity (V) at a resistance of 1, 20, 40 and 60% of PTisom90 (V1, V20, V40, and V60). Functional ability was assessed using a short physical performance battery (SPPB),

timed stair ascent (SA), and countermovement jump height (CMJ). In addition, kinematic data were recorded at the lower back using a 3D-accelerometer to assess quality of performance.
RESULTS: Step training resulted in increased MV ($p = 0.006$), increased isometric PT in all conditions ($p < 0.001$), increased dynamic PT at 60 and 300°/s ($p = 0.001$ and 0.036 respectively), improved CMJ ($p = 0.026$), and decreased time for SA ($p = 0.001$). In the control group, no significant differences were found between pre- and post-conditions ($p > 0.05$).
CONCLUSION: These results indicate that step training with progressively increasing step height is an effective method to simultaneously improve muscle mass, strength and functional ability in older women. This makes increased elevation step training a time-efficient training modality which can be employed in both group and home-based settings.

EFFECTS OF UNILATERAL ISOKINETIC ECCENTRIC TRAINING (AND DETRAINING) ON MUSCULOSKELETAL CHARACTERISTICS IN OLDER PEOPLE

KAY, A.D.1, FRASER, M.1, HILL, M.2, BLAZEVICH, A.J.3

1: UON , 2: CU , 3: ECU

INTRODUCTION: Reductions in lower-limb strength and muscle mass are common in ageing, with a concomitant reduction in aerobic capacity also limiting exercise tolerance. However, eccentric-only exercise has a lower cardiovascular demand (Vallejo et al., 2006) and higher loading potential that may improve exercise tolerance whilst providing a high musculoskeletal adaptive stimulus. Therefore, the present study examined the impact of a 6-week seated isokinetic eccentric training programme and 8 weeks of detraining on lower-limb strength and muscle architectural characteristics in older people.
METHODS: Maximal eccentric lower-limb force, and vastus lateralis (VL) thickness, pennation angle and fascicle length were measured in 12 participants (age = 67.0 ± 6.3 y, mass = 80.6 ± 16.0 kg, height = 1.6 ± 0.1 m) before (on two occasions separated by 1 week to determine reliability) and after the 6-week training programme using isokinetic dynamometry and ultrasonography. All measures were then re-examined 8 weeks later to quantify detraining (i.e. regression) effects. Training was performed twice-weekly on a BTE Eccentron using an alternating unilateral leg press motion and consisted of 5 min (week 1) or 10 min (weeks 2-6) of isokinetic eccentric contractions performed at 50%MVC at a rate of 40 contractions per minute. Strength was reassessed every 2 weeks to ensure subjects' training intensities remained at 50%MVC, with rate of perceived exertion (RPE) recorded after each training session.
RESULTS: A significant ($P < 0.05$) increase in lower-limb eccentric strength (58.8 ± 39.9%), VL muscle thickness (9.8 ± 5.4%), pennation angle (4.4 ± 5.7%) and fascicle length (5.4 ± 4.3%) was detected immediately after the 6-week training programme. RPE remained consistently low throughout the programme (3.3-4.1 out of 10), despite the increased duration and absolute intensity of training. Eight weeks later, lower-limb eccentric strength (50.4 ± 38.0%), VL muscle thickness (6.1 ± 5.5%) and fascicle length (5.8 ± 7.5%) remained significantly greater than pre-training levels, while pennation angle (1.0 ± 6.7%) returned to baseline.
CONCLUSION: The substantial increases in strength and muscle size achieved whilst training with low RPE have important clinical and practical implications for exercise prescription in older people, with the practical application and functional outcomes of the exercise regime well-suited to the specific physical needs and challenges of older people. Furthermore, the limited regression detected eight weeks after the completion of the training programme is indicative that eccentric strength training provides prolonged musculoskeletal functional benefits.
REFERENCES:
Vallejo AF, Schroeder ET, Zheng L, Jensky NE, Sattler FR. (2006). Cardiopulmonary responses to eccentric and concentric resistance exercise in older adults. Age Ageing, 35(3), 291-297.
CONTACT:
tony.kay@northampton.ac.uk

THE EFFECT OF AEROBIC-STRENGTH TRAINING ON FUNCTIONAL STATE AND GAIT SPEED IN ELDERLY INDIVIDUALS.

SLOBODOVÁ, L.2,1, TIRPÁKOVÁ, V.4, KRUMPOLEC, P.1, VAJDA, M.3, VALLOVÁ, S.2,1, SCHÖN, M.2,1, ŠUTOVSKÝ, S.5, CVECKA, J.3, TURCÁNI, P.5, VALKOVIC, P.6, SEDLIAK M.3, UKROPEC, J.1, UKROPCOVÁ, B.1,2,3

<1>INST.OF EXP.ENDOCRINOLOGY, BMC SAS;<2>INST.OF PATHOLOGICAL PHYSIOLOGY,FMED CU;<3>F.OF PHYSICAL EDUC.AND SPORTS,CU;<4>INST.OF SPORTS MEDICINE,FOM SMU;<5>1ST&<6>2ND NEUROLOGY DEP.FMED CU&UH BA; SVK

INTRODUCTION: Gait speed is one of the major health-related risk factors and has a prognostic and predictive value in the assessment of functional capabilities in elderly population, when speed lower than 0,8m/s is associated with cognitive decline, risk of falls, functional impairment, extreme frailty and a higher risk of death. Regular exercise training could effectively affect components of functional state and thus gait speed.
METHODS: 62 seniors (age 68±6 years) underwent phenotyping before and after 12-week intervention. Body composition (quadrupedal bioimpedance), Resting Metabolic Rate (RMR, indirect calorimetry), habitual physical activity (Baecke questionnaire) were assessed. Physical fitness (Rockport Walking Test), muscle strength (Isometric Knee Extension Strength Test), walking performance (10-Meter Walk Test by maximal/preferred speed, MWS/PWS) and balance (Berg Balance Scale) were measured. Intervention consisted of twelve-week (i) aerobic-strength training (n=50, M13/F37) 3x1h/week, 60-70%VO2max or 60-70%1RM (work-load increased gradually) and (ii) stretching (control group, n=12, M4/F8) 2x45min/week.
RESULTS: Exercise induced an increase in lean body mass ($p=0.02$), a decrease in visceral adiposity ($p=0.01$) and total body fat ($p=0.06$) and an increase in RMR ($p<0.001$). No changes in body composition and RMR ($p>0.05$) were found in the control group. Muscle strength ($p=0.02$), physical fitness ($p<0.001$), PWS (+10%, $p<0.001$), MWS ($p=0.01$) and balance ($p=0.02$) improved significantly in the training group. Small improvements in PWS (+4%, $p=0.01$) and muscle strength ($p=0.02$), with no change in MWS ($p=0.1$) and physical fitness ($p=0.25$) were found after 12-week stretching. Interestingly, approximately 80% of participants in both groups improved their PWS. MWS ($r=-0.36$; $p<0.001$), but neither PWS nor an intervention-induced change in PWS were associated with age ($p>0.1$). PWS correlated with total body fat ($r=-0.59$; $p=0.003$) and muscle mass ($r=-0.61$; $p=0.002$) in the stretching group. Stretching group reported higher sport-activity index after intervention ($p=0.01$).
CONCLUSION: Twelve-week aerobic-strength training improved body composition, muscle strength and preferred gait speed of elderly individuals, with a much smaller or missing effect in the control stretching group. Aerobic-strength training has a potential not just prevent but increase physical capabilities in seniors. Seniors with functional disabilities could benefit also from stretching, which, despite small effects on physical fitness and body composition, seem to have a potential to prevent a decrease in gait speed.
Grant support: SAS – NSC Joint Research Cooperation grant, VEGA 2/0107/18, APVV 15/0253

PHYSICAL FUNCTION IN ELDERLY: THE IMPACT OF PAST AND PRESENT PHYSICAL ACTIVITY BEHAVIOURS

EDHOLM, P., KADI, F., NILSSON, A.

SCHOOL OF HEALTH AND MEDICAL SCIENCES

INTRODUCTION: Maintaining physical function throughout the ageing process is vital for preserving the ability to perform normal everyday activities, independently and safely, without excessive fatigue. However, to what extent physical function is independently influenced by past and present physical activity (PA) behaviours is currently unclear. Therefore, we investigated influences of past and present PA behaviours on physical function in elderly community-dwelling women.
METHODS: An aggregated physical function score was created based on six-minute walk, squat jump and single-leg-stance balance performance in 60 older women (67.5 ± 1.5 yrs). Present PA behaviour was assessed by accelerometry (Actigraph) and past leisure-time PA behaviour by the Historical Adulthood Physical Activity Questionnaire, where time in sports-related activities and in walking were analysed separately. Differences in physical function across tertiles of PA behaviours were analysed adjusted by DXA-derived fat mass.
RESULTS: Present PA level (mean counts per minute) was independent of past PA behaviour associated with physical function in elderly women ($P < 0.01$), whereas no such influence was seen for time spent in sedentary behaviour. In addition to present PA behaviour, engagement in past leisure-time sports activities, but not walking also had a significant impact on physical functional ($P < 0.05$), which was independent of present PA behaviour.
CONCLUSION: PA at old age seems to infer beneficial effects on physical function, even in individuals with a past sedentary lifestyle. In contrast, no association was seen between time spent in sedentary behaviour and physical function. Taken together, findings of the present study support current public health recommendations, which aim at increasing PA level in order to counteract age-related functional decline, thereby promoting a healthy ageing.

INFLAMMATION AND OXIDATIVE ENZYMES ARE REDUCED AFTER EXERCISE AND TAURINE SUPPLEMENTATION IN ELDERLY WOMEN WITH MILD COGNITIVE IMPAIRMENT.

TEIXEIRA, A.M., UBA-CHUPEL, M., MINUZZI, L., FURTADO, G., RAMA, L., FILAIRE, E.

UNIVERSITY OF COIMBRA, NIF:501617582

INTRODUCTION: Aging is associated with increased risk of developing chronic diseases where an increase in inflammatory cytokines and oxidative enzymes occurs. Sedentary lifestyle and risk of malnutrition aggravate these processes, as suggested by the elevated concentrations of pro-inflammatory cytokines and oxidative enzymes often seen in older people with several comorbidities. Thus, exercise and implementation of nutritional adjustments might be powerful strategies to improve health in this population. The objectives of this study were to verify the effect exercise training, associated, or not, with taurine supplementation, on blood inflammatory markers and oxidative enzymes of institutionalized octogenarian women.
METHODS: 48 women (age: 83.5±6.9) participated in the study, being allocated into one of four groups: combined exercise training (ET: n=13), taurine supplementation (ET: n=12), exercise plus taurine supplementation (ET+TS: n=11) and control group (CG: n=12). Exercise was applied twice a week for 14 weeks and included muscle strengthening, walking and stretching exercises. Taurine supplementation was given (1,5g/day) to the supplemented groups. CG did not take part in any kind of exercise classes or supplementation, but received care as usual. Plasma concentrations of IL-1β, IL-1ra, IL-6, TNF-α, IL-10, IL-17, and matrix-metalloproteinase 9 (MMP-9) were evaluated before and after intervention. Serum concentration of myeloperoxidase (MPO) was also measured. The ratios between pro and anti-inflammatory cytokines were calculated and cognition (Montreal Cognitive Assessment – MoCA) was also evaluated.
RESULTS: Repeated measures ANOVA showed a treatment*time effect on MPO levels ($p=0.03$), for TS and ET+TS where a decrease was observed. However, no interactions were observed for MMP-9, despite univariate analysis showing a decrease in MMP-9 levels in TS after intervention ($p=0.04$). No significant changes were observed for all groups in IL-1β and IL-1ra concentrations, but reductions in the IL-1β /IL-1ra ratio occurred in ET and TS groups ($p<0.05$). Decreases in TNF-α and IL-10 levels were observed in ET and CG, respectively ($p<0.05$), and a significant treatment*time effect occurred for the TNF-α /IL-10 ratio, with a decrease in the ET and increase in the CG ($p=0.01$). IL-6 concentration and IL-6/IL-10 ratio decreased only in the ET ($p=0.02$), and no significant changes were observed for IL-17 in all groups. MoCA score increased only in the ET+TS group ($p<0.05$).
CONCLUSION: Exercise training alone modulated immunity in octogenarian women by increasing their anti-inflammatory profile. Supplementation with taurine was effective in reducing oxidative enzymes. Increase in cognition was only observed in those women who exercised and ingested the supplement provided. It seems that even when started at advanced ages, exercise can produce physiological benefits, with the addition of taurine appearing to be an important nutritional strategy to decrease oxidative stress and improving cognition.

BENEFITS AND FEASIBILITY OF ADAPTED PHYSICAL ACTIVITY PROGRAM FOR WOMEN WITH OSTEOPOROSIS AND VERTEBRAL FRACTURES: RESULTS OF THE EXPERIMENTAL STUDY OSTEO-AFA / 2014

MARINI, S.1, MASINI, A.1, SANNA, T.1, RAGGI, A.1, BUFFA, A.2, MALAVOLTA, N.2, MAIETTA LATESSA, P.1, LEONI, E.1, DALLOLIO, L.1

ALMA MATER STUDIORUM UNIVERSITY OF BOLOGNA

INTRODUCTION: In Italy 3,5 million of women are affected by osteoporosis. The clinical and social implications of the disease are mainly due to osteoporotic fractures that reach 1/3 of menopausal women. Vertebral fractures are associated with a significant decline in quality of life and disability. Exercise is a form of conservative non-pharmacological treatment that can be prescribed for the purpose of reducing pain and restoring motor functions in patients with osteoporosis. However, in the literature no definitive conclusions are available regarding benefits of exercise for individuals with osteoporosis and vertebral fractures (Giangregorio LM et al., 2013). The aim of this study is to evaluate the benefits and the feasibility of an Adapted Physical Activity (APA) middle-low impact program for postmenopausal women with osteoporosis and vertebral fractures, in terms of quality of life, physical performance and fear of falling.
METHODS: The women assigned to the experimental group (EG) performed a specifically structured exercise program (1 hour twice a week for 6 months) administered by graduates in physical education, which includes postural and muscular reinforcement exercises. The women assigned to the control group (CG) received the generic indication on the importance of physical activity. The outcomes assessed at the baseline and at the end of the APA program were: quality of life (ECOS-16), fear of falling (FES-1), functional exercise capacity (6MWT), balance (Tinetti scale), flexibility of the column (Sit & Reach).

RESULTS: SantOrsola Malpighi Hospital in Bologna (Italy) have completed the study. At follow-up, APA program improved the quality of life (EG:-0.4±0.1 vs CG:-0.005±0.7 p=0.01) and reduced the fear of falling (EG:-4.4 ± 1.8 vs CG: 0.3 ± 2.1 p=0.03). The same trend was observed in the GS for the physical performance parameters: balance (0.9±0.3 vs -0.8±0.5 p=0.01) and gait (45±12.7 meters vs 1.9±13.9 meters p<0.01). Sit & Reach improved only in the EG, but not significantly. Adherence to the program was very high (> 70%). No injuries were observed.
CONCLUSION: The study showed that this APA program is feasible, safe and significantly able to improve the quality of life and the physical efficiency and to reduce the fear of falling in postmenopausal women with vertebral fractures.
REFERENCES: Giangregorio LM, MacIntyre NJ, Thabane L, Skidmore CJ, Papaioannou A. Exercise for improving outcomes after osteoporotic vertebral fracture. Cochrane Database Syst Rev. 2013 Jan 31;(1):CD008618.
CONTACT: Sofia Marini sofia.marini2@unibo.it

Oral presentations

OP-PM52 Energy intake, energy expenditure and fuel oxidation

ASSESSING THE IMPACT OF EXERCISE TIMING ON GLYCAEMIC CONTROL: A RANDOMIZED CONTROLLED TRIAL

TEO, S.Y.M., KANALEY, J.A., GUELFI, K.J., MARSTON, K.J., FAIRCHILD, T.J.

MURDOCH UNIVERSITY, PERTH WA

INTRODUCTION: Maintaining tight glycaemic control is a key objective in the management of individuals with Type 2 Diabetes Mellitus (T2DM) [1]. Despite exercise being acknowledged as an important component in the management plan for individuals with T2DM, the importance of exercise timing has only recently been considered. The aim of this study was to determine the impact of diurnal exercise timing on glycaemic control in individuals enrolled into a 12-week supervised multi-modal exercise training program.
METHODS: Forty sedentary overweight males (n = 17) and females (age: 51 ± 13 years; BMI: 30.9 ± 4.2 kg/m2) with (n = 20) or without T2DM diagnosis were randomly allocated to either a morning (amEX) or evening (pmEX) exercise training group. All participants completed a 12-week supervised multi-modal exercise training program (3 days per week), which consisted of 30 minutes of aerobic exercise (walking protocol) and 4 resistance-based exercises (3 sets of 12-18 repetitions). The amEX and pmEX training sessions occurred between 0700-0900h and 1700-1900h, respectively. Body anthropometrics (BMI; body fat %, BF%) and glycaemic outcomes (glycated haemoglobin, HbA1c; fasting glucose and insulin; Homeostatic model assessment, HOMA) were assessed at baseline and post-intervention at 12 weeks. All data is displayed as mean differences ± SD.
RESULTS: Exercise training reduced (main effect of time: All $p < 0.01$) BMI (amEX: -0.82 ± 0.33 kg/m-2; pmEX: -0.83 ± 0.69 kg/m-2), BF% (amEX: -2.29 ± 1.86%; pmEX: -2.18 ± 1.50%), HbA1c (amEX: -0.27 ± 0.24%; pmEX: -0.25 ± 0.23%), fasting glucose (amEX: -1.33 ± 0.96 mmol/L; pmEX: -1.32 ± 1.94 mmol/L) and HOMA (amEX: -0.52 ± 0.53 pmol/L and pmEX: -0.54 ± 0.48 mmol/L); however, there was no time by group interactions for any variables (All $p \geq 0.79$). With regards to glycaemic control in participants with T2DM, eight participants achieved a HbA1c of <7% by post-intervention (18 individuals identified with baseline HbA1c of >7%; amEX: 10; pmEX: 8). Similarly, of the 18 T2DM participants with baseline fasting glucose levels of >7.2 mmol/L (amEX: 9; pmEX: 9), seven (amEX: 4; pmEX: 3) achieved a fasting glucose level of <7.2 mmol/L.
CONCLUSION: The 12-week multi-modal exercise training program improved glycaemic control and BMI in overweight non-T2DM and T2DM individuals. However, the diurnal (morning versus evening) timing of exercise training did not alter the glycaemic outcomes.
References: 1. General practice management of type 2 diabetes – 2014–15. Melbourne: The Royal Australian College of General Practitioners and Diabetes Australia, 2014

MODERATE TO VIGOROUS PHYSICAL ACTIVITY IS ASSOCIATED WITH THE MAXIMAL FAT OXIDATION CAPACITY DURING EXERCISE.

CORRAL-PÉREZ, J.1, VELÁZQUEZ-DÍAZ, D.1, PÉREZ-BEY, A.2, FERNÁNDEZ-SANTOS, J.R.2, GRAO-CRUCES, A.2, SANDUBETE-LÓPEZ, M.1, JIMÉNEZ-PAVÓN, D.1, CUENCA-GARCÍA, M.2, PONCE-GONZÁLEZ, J.G.1

1: MOVE-IT RESEARCH GROUP, FACULTY OF EDUCATION SCIENCES, UNIVERSITY OF CÁDIZ. 2: GALENO RESEARCH GROUP, FACULTY OF EDUCATION SCIENCES, UNIVERSITY OF CÁDIZ.

INTRODUCTION: A substantial inter-individual variability exists in maximal fat oxidation (MFO), which is an important capacity for metabolic health. Aerobic capacity has a positive influence on MFO, however little is known about the influence of moderate to vigorous physical activity (MVPA) on it. Therefore, the main aim of this study was to determine the contribution of both objectively assessed MVPA (O-MVPA) and self-reported MVPA (SR-MVPA) on MFO inter-individual variability.
METHODS: A total of 76 volunteers (30 women) aged 22.56±4.10 years were involved in this cross-sectional study. An incremental exercise protocol with two consecutive phases on a cycle ergometer was performed. The first phase aimed to determine MFO, using a validated protocol, and stopped when RER ≥1. After a short break, the second phase to detect the maximum oxygen consumption (VO2max) was initiated increasing load every minute until exhaustion. O-MVPA was assessed using accelerometers which participants wore at the lower back for 7 consecutive days prior to MFO test. SR-MVPA was measured by the short version of International Physical Activity Questionnaire. Linear regression analyses were used to determine the influence of O-MVPA and SR-MVPA on MFO adjusting by VO2max and age.
RESULTS: MFO relative to fat-free mass (FFM) was 6.89 ± 2.73 mg/kg/min (range 6.27-7.51 mg/kg/min). A total of 17% of the inter-individual variability was explained by VO2max (2996.01 ± 749.85 ml/min) and age (22.76 ± 4.45). O-MVPA (76.18 ± 23.87 min/day) was positively and independently associated with MFO ($p<0.05$), explaining 5.8% of the inter-individual variability. SR-MVPA (111.92 ± 56.68 min/day) was positively ($p>0.05$) associated with MFO relative to FFM, however, it did not explain any percentage of the inter-individual variability. After performing sensitivity analysis results did not materially change.
CONCLUSION: Previous studies observed a positive and independent influence of SR-MVPA on MFO; however, our results showed a relationship between MFO and O-MVPA, but not with SR-MVPA. This disagreement could be explained by differences between questionnaires used, the lack of accuracy of SR questionnaires or differences in population groups. So further studies are needed to clarify this relation. To our knowledge, there are no studies analysing the role of O-MVPA on MFO. Since our study shows that O-MVPA is an independent predictor of MFO, increasing MVPA levels could be an interesting strategy to enhance the MFO.

PROLONGED EXERCISE INHIBITS THE AUTOPHAGIC RESPONSE TO AN EXTREME ENERGY DEFICIT IN OVERWEIGHT MEN, CONTRIBUTING TO THE LEAN MASS-SPARING EFFECT OF EXERCISE

MARTIN-RINCON, M., MORALES-ALAMO, D., ALCAZAR, J., PEREZ-LOPEZ, A., HOLMBERG, H.C., CALBET, J.A.

1 IUIBS, UNIV. OF LAS PALMAS GC, SPAIN; 2 GENUD TOLEDO, UNIV. OF CASTILLA LA MANCHA, SPAIN; 3 UNIV. ALCALA, SPAIN; 4 SWSRC, MID SWEDEN UNIV., SWEDEN

INTRODUCTION: Damaged cellular components are removed and renovated by autophagy. Caloric restriction elicits upregulation of autophagy, which is involved in skeletal muscle (sm) protein breakdown. Rodent studies indicate an exercise-dependent activation of autophagy by endurance exercise, although these findings have not been confirmed in humans. Studies on how nutrition interacts with exercise in the regulation of autophagy are scarce and controversial, and none have focused on the sm autophagic responses to a severe energy deficit (SED) in humans. Here we study the effects of different amounts of exercise and two diets (sucrose versus whey protein) on the regulation of sm autophagy during a SED. We hypothesized that exercise would attenuate the autophagic responses elicited by a SED contributing to the known sparing-effect of exercise in sm during dieting.
METHODS: Fifteen overweight men underwent 4 days of caloric restriction (CR) (0.8 g/kg BW/day of either whey n=8 or sucrose n=7) and prolonged exercise (PE) (45min of one-arm cranking and 8h walking/day). Muscle biopsies from both deltoid and one vastus lateralis (VL) were taken before (PRE), after PE+CR and following 3 days of control diet (isoenergetic) and reduced exercise (CD); and sm AMPK, Beclin1, LC3BI, LC3BII and p62 protein expression were analyzed (WB). Body composition was assessed by DEXA. Statistical analysis was performed using repeated-measures ANOVA.
RESULTS: After PE+CR the energy deficit was 5000 kcal/d, reducing fat-free mass ($P<0.001$). Legs and trained arm lost proportionally less FFM than the untrained arm [57% ($P< 0.05$) and 29% ($P = 0.05$), respectively]. Compared to PRE, after PE+CR Ser15-Beclin1 phosphorylation was increased ~14-fold and ~2.7-fold in the untrained and trained deltoid, while it remained unchanged in VL. Following CD, the expression was ~19-fold, ~5.0-fold higher and remained unchanged, respectively (ANOVA extremity by time, $P=0.026$). The ratio Thr172-AMPK/Total AMPK was increased (27%) in all muscles, further increasing after CD (56%, $P<0.05$). LC3BI increased in both deltoid after PE+CR and CD (19 and 30%, $P<0.05$), whilst LC3BII remained unchanged, resulting in an unaltered LCBII/I ratio. Protein expression of p62 was increased by 25% and 97% in both deltoids and VL, respectively (ANOVA extremity by time, $P<0.05$) after PE+CR and remained elevated after CD. No significant changes were found due to the ingested solution.
CONCLUSION: During an extreme energy deficit, the increased induction of autophagy (Ser15-Beclin1 phosphorylation) was attenuated by exercise, which was accompanied by a concomitant reduction in the autophagic flux (LCBII/I ratio and p62), with this effect being proportional to the amount of exercise done by each muscle. Thus, this study shows an inhibition of the autophagy machinery in an exercise dose-dependent manner, explaining the lean-mass sparing effect of exercise during dieting in overweight men.
Grant: MINECO PI14/01509

RISK OF LOW ENERGY AVAILABILITY AND ASSOCIATED HEALTH OUTCOMES IN ACTIVE FEMALES IN IRELAND.

LOGUE, D.M., MADIGAN, S.M., HEINEN, M., MCDONNELL, S.J., DELAHUNT, E., CORISH, C.A.

UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: Energy availability (EA) is the energy available for normal physiological function, such as menstrual function and bone health, after energy for exercise has been deducted. When low energy availability (LEA) occurs, physiological adaptations may develop; these can contribute to unfavourable health and sports performance outcomes (1,2).
METHODS: The aim of this study was to identify LEA risk among active females in Ireland using the validated 'Low Energy Availability in Females Questionnaire' (LEAF-Q) (3). This was completed online by active females aged 18 years or older living in Ireland. Participants were recruited between November 2016 and February 2017 through sporting organisations under the governance of Sport Ireland and via social media. Twenty-nine additional questions collected information on demographics, illness history, dietary habits and supplement use. Chi-square and logistic regression analyses were used to examine differences between athletes at different competitive levels.
RESULTS: 833 participants completed the online questionnaire. Risk of LEA was identified in 40% (N=331) of participants and was 1.7 or 1.8 times more likely in international and provincial/inter-county athletes compared to those who were recreationally active (International: OR 1.68, 95% CI 1.12, 2.54; Provincial/inter-county: OR 1.83, 95% CI 1.20, 2.77). For every extra hour of exercise participants performed per week, the risk of LEA was 1.06 times more likely to occur (OR 1.06, 95% CI 1.02, 1.08, $P = 0.003$). Adjusting for age and level of competition did not change this. In participants missing more than 22 days of training due to injury and/or illness, risk of LEA occurred 9 or 3 times more frequently (Injury: OR 9.03, 95%CI 5.43, 15.01; Illness: OR 3.01, 95%CI 1.81, 5.02). Of those who reported exercise-related stoppage of menstruation, risk of LEA was 6.6 times more likely to occur (OR 6.64, 95% CI 2.25, 19.61, $P < 0.001$).
CONCLUSION: The high prevalence of LEA risk and frequency of detrimental health outcomes associated with LEA highlights a need for improved awareness, screening and intervention to optimise sports participants' health and performance.
REFERENCES:
1. Mountjoy M, Sundgot-Borgen J, Burke L, Carter S, Constantini, N, et al. Consensus statement. The IOC consensus statement: beyond the Female Athlete Triad-Relative Energy Deficiency in Sport (RED-S). Br J Sports Med. 2002; (7): 491-497.
2. Nattiv A, Loucks AB, Manore MM, Sanborn CF, Sundgot-Borgen J, et al. American College of Sports Medicine position stand. The female athlete triad. Med Sci Sports Exerc. 2007; (10): 1867-1882.
3. Melin A, Tornberg A, Skouby S, Moller SS, Sundgot-Borgen J, et al. (2014). Energy availability and the female athlete triad in elite endurance athletes. Br J Sports Med. 2014; (7): 540-545.

GENDER-BASED DIFFERENCES ON RESTING AND MAXIMAL FAT OXIDATION: ROLE OF CARDIORESPIRATORY FITNESS

VELÁZQUEZ DÍAZ, D., PÉREZ BEY, A., CORRAL PÉREZ, J., FERNÁNDEZ SANTOS, J.R., SÁNCHEZ DELGADO, A., GRAO CRUCES, A., SANDUBETE LÓPES, M., JIMÉNEZ PAVÓN, D., CUENCA GARCÍA, M., PONCE GONZÁLEZ, J.G.

UNIVERSITY OF CÁDIZ

INTRODUCTION: Gender comparative studies support an oestrogen-induced increase in fat oxidation during exercise. Despite the effect of sexual hormones, differences on absolute and relative fat oxidation during exercise could be affected also by cardiorespiratory fitness (CRF). However, the combined effect of both is unknown. Therefore, the main aim of this study was to analyse the independent and combined effect of CRF and gender on resting fat oxidation (RFO) and maximal fat oxidation (MFO).

METHODS: A total of 93 young adults (62 males; 25.1±8.8 years old) were included in this cross-sectional study. Respiratory exchange ratio (RER) and RFO were registered at resting conditions on a bed during 30 min. After that, an incremental exercise protocol with two consecutive phases was performed, phase 1 consisted in an incremental exercise protocol (increments of 30W for lean and 15W for overweight and obese every 3 min) to determine MFO. The MFO test was stopped when RER ≥1. After rest 3-5 min, the second phase to detect the VO2max was initiated. This phase continues with steps of 1 min increasing the same incremental load as in phase 1. Bioimpedance analysis was used to assess body composition (fat mass and fat free mass (FFM)). Linear regression analyses were performed to determine the independent associations of CRF on fat oxidation (RFO, RFO/ FFM, MFO and MFO/ FFM) and gender interaction. Covariance analysis (ANCOVA) was used to observe differences on fat oxidation between gender groups and also between combined groups created using CRF level and gender.
RESULTS: MFO and MFO/FFM were positively associated with CRF (r=0.62, p<0.001; r=0.64, p<0.001, respectively) and gender interaction was observed for MFO/FFM (p<0.001). Significant differences were observed between men and women on RFO/FFM (p=0.001), besides, significant differences were shown between gender on MFO/FFM after accounting for CRF (p<0.001) or CRF, age and fat mass (p=0.002). Men with low CRF group showed greater inability on RFO/FFM compared to the group of men with high CRF and women with high and low CRF (p<0.05). Women with high CRF had higher MFO/FFM levels than men with low CRF (p<0.05). There were no significant differences between sexes on MFO/FFM in groups with the same CRF level (p>0.05).
CONCLUSION: Men with low CRF showed an impaired fat oxidation compared to the other groups. Men and women with high CRF levels have similar fat oxidation capacity and higher compared to their counterparts with low CRF levels. These findings suggest a higher influence of CRF than gender on fat oxidation capacity.

PHYSICAL ACTIVITY DURATION BUT NOT ENERGY EXPENDITURE DIFFERS BETWEEN DAILY COMPARED WITH INTERMITTENT BREAKFAST CONSUMPTION IN ADOLESCENT GIRLS: A RANDOMIZED CROSSOVER TRIAL

ZAKRZEWSKI-FRUER, J.K.1, WELLS, E.K.1, CRAWFORD, N.S.G.2, AFEEF, S.M.O.2, TOLFREY, K.2

1: UNIVERSITY OF BEDFORDSHIRE, UK, 2: LOUGHBOROUGH UNIVERSITY, UK

INTRODUCTION: Experimental research is required to establish whether there is a causal link between breakfast frequency and physical activity (PA) in young people. This research is particularly relevant to adolescent girls, a population with low breakfast consumption and PA levels.
METHODS: Using a randomized crossover design, 27 girls (age 12.4 ± 0.5 y, body mass index 19.3 ± 3.0 kg·m-2) completed two, 7-day conditions. A ~1674 kJ standardized breakfast was consumed every day before 09:00 in the daily breakfast consumption (DBC) condition. The standardized breakfast was consumed on only three days before 09:00 in the intermittent breakfast consumption (IBC) condition alternating with breakfast omission on the remaining four days (i.e., only water consumed before 10:30). Combined heart rate-accelerometry was used to estimate PA energy expenditure (PAEE) continuously throughout each condition. Time spent and estimated PAEE for each PA intensity were calculated for three time segments of the day: wake time to <10:30, 10:30 to <15:30 and 15:30 until bed time. Statistical analyses were completed using condition by time of day repeated measures analysis of variance.
RESULTS: Total daily estimated PAEE and daily estimated PAEE from sedentary, light, moderate and vigorous intensities did not differ significantly between the conditions (P ≥ 0.13). There was a condition by time of day interaction for sedentary time (P = 0.05), which indicated that the girls spent 11.5 min/d more time sedentary in IBC compared with DBC during 15:30-bedtime (P = 0.04). Light PA was 19.8 min/d higher during DBC compared with IBC (P = 0.05). There was a significant condition by time of day interaction for time in light PA (P = 0.04), which indicated higher light PA during wake-10:30 (P = 0.04) and 15:30-bedtime (P = 0.03) in DBC compared with IBC. There were no significant differences in time spent in MPA or VPA between the conditions.
CONCLUSION: Physical activity energy expenditure was not different when adolescent girls consumed breakfast daily compared with intermittently over seven days. Nevertheless, the girls spent more time in LPA before 10:30 and after school and less time sedentary after school when consuming breakfast daily. Further research is required to determine the long term effects of breakfast consumption and omission on physical acitivity and health outcomes in adolescents.

Oral presentations

OP-BN48 Applied sport biomechanics 2

TRAINING LOAD PROFILES IN NATIONAL TEAM FOOTBALL; TRANSITION FROM CLUBS-TO-TOURNAMENT

NOOR, D.1,2, MCCALL, A.3, JONES, M.3, DUNCAN, C.3, EHRMANN, F.3, MEYER, T.1, DUFFIELD, R.2,3

1: SAARLAND UNIVERSITY , 2: UNIVERSITY OF TECHNOLOGY SYDNEY , 3: FOOTBALL FEDERATION AUSTRALIA

INTRODUCTION: Introduction: Limited evidence currently exists in relation to how training load (TL) is periodised for players' transitioning from club to national team environments (McCall et al., 2017). However, practitioners operating within National team contexts have identified prior TL and within-tournament TL to be of high importance when assessing player injury risk (McCall et al., 2015). Therefore, this study aims to quantify the external and internal TL profiles of a single national football team as player's transition from club (C), to in-camp (IC), to in-tournament (IT) periods over multiple international tournaments.
METHODS: Methods: TL data were collected from the same National team prior-to and during 3 recent international tournaments; 2014 World Cup (n=20), 2015 Asian Cup (n=20) and 2017 Confederations Cup (n=20). External (session duration, count and type) and internal (1-10 scale RPE and s-RPE) loads of all outfield players were included for analysis. Data was categorised into standardised time periods: C (7-days prior to camp arrival), IC (7-days post camp arrival), and IT (7-days from 1st tournament match). These time periods allowed calculation of the acute:chronic workload ratio (ACWR) for s-RPE for each period based on the mean of the previous 3-weeks. The magnitude of effect for differences in TL and ACWR between the time periods was then expressed as the standardised mean difference (Cohen effect sizes, ES).
RESULTS: Results: Concerning s-RPE, during the C (1324 ± 846) to IC (1765 ± 538) transition, a moderate effect (ES=0.88) was evident for increased TL between the two periods, with only a small decrease in TL (ES=0.48) between IC and IT (1574 ± 583). Similarly, RPE, increased moderately (ES=0.81) from C (4.3 ± 1.3) to IC (5.1 ± 1.5), but with only a trivial change (ES=0.13) to the IT period (5.3 ± 2.6). Concerning external load, during the C (4.0 ± 1.5) to IC (5.9 ± 0.6) transition, a very large effect (ES=2.35) was evident for increased number of sessions between the two periods, with a large effect (ES=1.12) also observed for the decrease in sessions between IC and IT (5.1 ± 1.3). Conse-

quently, a large (ES=1.47) increase in ACWR for s-RPE was determined for IC (1.35 ± 0.72) compared to C (0.70 ± 0.51), and a moderate decrease (ES=0.86) in ACWR for IT (1.01 ± 0.32) compared to IC.
CONCLUSION: Conclusion
National team football players (within this team) show expected increases in ACWR for TL during the first week of a training camp prior to a major tournament. This increase in TL is likely resultant from an increase in the number of sessions performed per week alongside an increase in the perceived intensity of the sessions.
References: McCall, A., Davison, M., Andersen, T. E., Beasley, I., Bizzini, M., Dupont, G., Duffield, R., Carling, C., Dvorak, J. (2015). Br J Sports Med, 49(9), 603-608.
McCall, A., Jones, M., Gelis, L., Duncan, C., Ehrmann, F., Dupont, G., Duffield, R. (2017). J Sci Med Sport, Article in Press.
Contact: denny.noor@uni-saarland.de

INFLUENCE OF TRAINING LOAD UPON ISOMETRIC POSTERIOR CHAIN STRENGTH IN ELITE FOOTBALLERS: A SEASONAL OBSERVATION

TABERNER, M., OKEEFE, J., RICHTER, C., CLARKE, N., COHEN, D.
LIVERPOOL JOHN MOORE'S UNIVERSITY

INTRODUCTION: Hamstring strains are the most common injury in elite football, with a modifiable risk factor (hamstring muscular strength measure on pre season; Timmins et al., 2016). Further, accumulated fatigue during periods of fixture congestion, during which inadequate recovery from training and match workload, is also indicated as causal in injury (Gabbutt and Ullah, 2012). Time dependent hamstring strength declines within a match are consistently reported and are thought to contribute to the increased vulnerability to injury in the latter stages of a match (Thorlund et al., 2019). McCall et al. (2015) proposed an isometric posterior chain (IPC) test as a simple tool to monitor changes in force in-season. This test has been reported to be sensitive to acute match induced fatigue and to show residual neuromuscular fatigue 72h post-match (Nedelec et al. 2014). However, the impact of week to week of components of training load upon hamstring strength/neuromuscular function across the season is not known.
METHODS: We evaluated correlations between combined training load using GPS (Viper, StatSports) and changes in IPC peak force at 90 degrees of knee flexion using a force platform (left & right limb peak force) values over 2-week blocks in an elite first team squad across a full season.
RESULTS: The strongest negative correlation was found with mean sprint distance (distance accumulated >7ms-1) completed during a 2-week period to IPC peak force (r=-0.21) and mean Z5-Z6 decelerations (deceleration efforts >5ms-2; r= -0.13). The strongest positive correlation was found with coefficient of variation within HSR to IPC peak force (r=0.32) and coefficient of variation within Z5-Z6 decelerations (r= 0.26).
CONCLUSION: Mean sprint distance over a 2 week period was associated with reduced IPC peak force. Previous studies (e.g. Rahnama et al. (1992) have reported a progressive reduction in muscle strength that applies across a range of functional characteristics during exercise that mimics the work rate in soccer. Reduced hamstring strength may reduce the ability to decelerate the leg during the latter part of the swing phase in sprinting, at which point eccentric overload could cause tearing in the musculo-tendinous unit. However, coefficient of variation within both HSR and Z5-Z6 decelerations was associated with the strongest increase in IPC peak force indicating that week to week variations in load are an important stimulus of novel load to provide improvements in hamstring strength. Gabbett (2016) has highlighted that appropriate graded prescription of training loads may help to improve players' fitness which can in turn help protect against injury. Consequently, a paradox potentially exists to find the optimal balance of training load with reduced hamstring strength having implications for the increased predisposition to hamstring strain injury. These findings highlight the need for regular monitoring to assess players' responses to training to help plan appropriate training prescription and help reduce injury risk. Additionally, match data would assist to provide the total external load placed upon players' and help facilitate optimally loading between competition schedules.

TIME STRUCTURE AND VALUE OF EMG SIGNAL IN SELECTED TECHNICAL ELEMENTS OF FEMALE ÉPÉE

BORYSIUK, Z., MARKOWSKA, N.
OPOLE UNIVERSITY OF TECHNOLOGY

INTRODUCTION: The objective of the study was to analyze the structure of the fencing lunge and flèche. This was possible as a result of the determination and comparison of the reaction time, motor response time and neuro-muscular activity accompanying as simple attack including lunge and flèche depending on the type of visual and tactile stimulus in two female subjects, members of the national senior team in women's épée.
METHODS: The study involved two female subjects, members of the national senior team in women's épée, mean age of 29. The analysis applied EMG and involved the following 8 muscles of the upper and lower limbs: biceps brachii (BB), triceps lateralis (TL), flexor carpi ulnaris (FCU), extensor carpi radialis (ECR), biceps femoris (BF), rectus femoris (RF) gastrocnemius lateralis (GL), and gastrocnemius medialis (GM). Two combined Kistler force plates were applied in the assessment of ground reaction forces with the purpose of classifying the movement patterns of the forward and back legs. The model of the motion was obtained as a result of the use of 3D Motion Capture.
RESULTS: The analysis of the available data demonstrated that the reaction time and motor response is shorter for the case of the simple attack with a flèche in comparison to the simple attack performed with a lunge regardless of the type of the stimulation. Depending on the type of stimulation, the mean signal produced by the particular muscles varies. Both for visual and tactile stimulation, the lower values of the muscle signal accompanying a flèche is demonstrated by the following muscles: TL, FCU, GL, GM, whereas the higher level of the signal is recorded in BB, ECR muscles. When a flèche is delivered, it is accompanied by a higher level of the signal produced by BF muscle when tactile stimulation is provided, whereas the mean level of the signal produced by the RF muscle is higher for the visual stimulation.
CONCLUSION: In the light of the conducted study, we learn that for the case of tactile information, the sources of anticipation for the case of a simple attack delivered with a fleche include the signal of the arm flexor and extensor muscles that is sensed as a result of the contact with the opponent's blade. For the case of the visual information, anticipation is based on the activation level of gastrocnemius muscle in the back leg (Do, M. C. & You, E. 1999). During a simple attack delivered with a lunge, the source of anticipation will be based on the signal produced by the arm muscles both with regard to tactile and visual stimulation. The lower muscular tension of the back leg in the latent phase of the motion leads to greater ground reaction forces (both vertical and horizontal).

RUNNING A 12-KM RACE INFLUENCES POSTURAL CONTROL AND PLANTAR-FLEXION STRENGTH, BUT NOT FOOT STRIKE ANGLE

HÉBERT-LOSIER, K., MURRAY, L., MCMASTER, D.T., BEAVEN, C.M.

UNIVERSITY OF WAIKATO

INTRODUCTION: Running is a popular physical activity with numerous organised races now accessible to the community. Sustained exercise can lead to neuromuscular impairments and fatigue, which has been associated to increased likelihood of injuries in athletes. To date, much of the empirical evidence on running derive from laboratory-based studies or highly controlled environments, with few studies conducted in ecologically valid environments. Our aims were to investigate the effects of running a 12-km race on plantar pressure distribution, postural balance, self-selected running speed and foot strike angle, and plantar-flexion strength.
METHODS: Twenty-four recreational runners (15 males and 9 females) completed a series of tests immediately before and after a 12-km organised race. The tests included: (1) plantar pressure distribution in self-selected bilateral stance; (2) 30-seconds eyes-closed feet-together postural balance; (3) self-selected running speed and foot strike angle; and (4) peak plantar-flexion isometric force normalised to body weight. All participants wore their own running shoes during testing and were rearfoot strikers. Runners rated their perceived exertion (RPE) level on a 20-point Borg scale at the finish line. Differences between pre- and post-race measures were assessed using magnitude-based inferences of the standardized effects and associated 90% confidence limits (ES, ±CL).
RESULTS: Participants completed the 12-km race in 61 ± 8 minutes and reported a median RPE of 17. Following the race, there were clear and meaningful changes in plantar pressure distribution, postural balance, self-selected running speed, and plantar-flexion peak force, but not foot strike angle. On average, the relative pressure under the left foot decreased by 3.2 ± 5.0% (-0.58, ±0.31) with a corresponding increase under the right foot; the centre of pressure path length (0.94, ±0.35) and area of the 95th percentile ellipse (0.85, ±0.32) from the balance task increased by 5.7 ± 8.9 cm and 18.2 ± 21.2 cm2, respectively; self-selected running speed decreased by 0.2 ± 0.6 m/s (-0.37, ±0.43); and peak plantar-flexion isometric force decreased by 0.20 ± 0.30 times body weight (-0.42, ±0.18). The change of 0.5 ± 4.3° in foot strike angle was trivial (0.08, ±0.24).
CONCLUSION: Running a 12-km race influenced several neuromuscular measures, confirming racing-induced fatigue in our recreational runners. Despite quantifiable declines in postural balance and plantar-flexion strength, self-selected foot strike angle did not meaningfully change and might not be an appropriate indicator of fatigue in runners. Our findings corroborate the importance of plantar-flexion strength in racing events, and that postural control is altered in fatigued runners. Tracking postural control measures over time may be useful in the monitoring of training loads and recovery in runners.

ASSESSMENT SPECIFIC ECCENTRIC KNEE FLEXOR STRENGTH: IS THERE A DANGER OF MISINTERPRETATIONS?

SCHARINGER, M., WIESINGER, H.P., GRESSENBAUER, C., KÖSTERS, A., MÜLLER, E.

UNIVERSITY OF SALZBURG

INTRODUCTION: Eccentric hamstring exercises are considered to be the most effective approach to reduce the tremendous burden of posterior thigh muscle injury (Timmins et al., 2016). However, research focused on exercise-specific recruitment and/or adaptation patterns (Guex et al., 2016; Seymore et al., 2017) and neglected the sensitivity of diagnostic assessments. Accordingly, the aim of this study was i) to examine the effects of eccentric exercise on an isokinetic dynamometer (IKD) or a Nordic hamstring device (NHD) on biceps femoris muscle size and architecture and ii) to analyse whether training responsiveness can be detected in a comparable way with the respective diagnostic devices.
METHODS: Thirty male student-athletes (25±3 yrs) were randomly assigned to one of the three, equal sized, groups: isokinetic (IG), Nordic hamstring (NG) and controls (CG). IG and NG groups performed a 6-week training program, consisting of 16 sessions with overall 220 supervised repetitions on respective devices. Eccentric knee flexion strength (EPT) was assessed counterbalanced on either device at an angular velocity equal to the predetermined 30°/s of the training sessions. The biceps femoris cross-sectional area, fascicle length and pennation angle were measured with ultrasonography and analysed blinded to the subjects' identity. The CG did not change their daily routines.
RESULTS: Measured parameters did not differ at baseline. There were no significant group x time interactions for measured muscle parameters ($P>.08$; $\eta2<.18$). A significant group x time x device effect ($P<.01$; $\eta2<.41$) and a significant main effect for devices ($P<.01$; $\eta2<.77$) were found. On IKD, group x time interactions were only significant between the IG and the CG ($P<.04$; $\eta2<.22$) and between the IG and the NG ($P<.01$; $\eta2<.35$) with a mean EPT improvement of 21% in IG. Conversely, on NHD, significant training effects were only observed in the NG (group x time: $P<.03$; $\eta2<.25$) with a mean EPT improvement of 24%.
CONCLUSION: The present intervention did not appreciable alter the biceps femoris muscle size and architecture. Nonetheless the device specific increase in EPT suggests that training adaptations may not be detected or could be misinterpreted, when not using the appropriate assessment.
References: 1. Guex, K. et al. (2016). Hamstring architectural and functional adaptations following long vs. short muscle length eccentric training. Front Physiol, 7, 340.
2. Seymore, K. D. et al. (2017). The effect of Nordic hamstring strength training on muscle architecture, stiffness, and strength. Eur J Appl Physiol, 117(5), 943-953.
3. Timmins, R. G. et al. (2016). Short biceps femoris fascicles and eccentric knee flexor weakness increase the risk of hamstring injury in elite football (soccer): a prospective cohort study. Br J Sports Med, 50(24), 1524-1535.
Contact:
manuel.scharinger@sbg.ac.at

INFLUENCE OF SURFACE PROPERTIES ON FASCICLE-TENDON INTERACTIONS DURING LANDING

HOLLVILLE, E., NORDEZ, A., GUILHEM, G., LECOMPTE, J., RABITA, G.

FRENCH INSTITUTE OF SPORT, NATURAL GRASS

INTRODUCTION: Recent works showed a tendon buffer effect in humans during a step (Werkhausen et al., 2017) and drop landing (Hollville et al., 2018) for ankle and knee extensors muscles in order to protect fascicles from high lengthening contractions. Most of lower limb injuries during landing occur when the muscle-tendon unit (MTU) have to withstand large mechanical energy at impact. As human lands, energy is absorbed and returned by the surface depending on its intrinsic ground mechanical properties. The aim of this study was to investigate the influence of different surfaces on the gastrocnemius medialis (GM) MTU behavior during drop landing.

METHODS: Eight active men were asked to perform 50 cm drop landings over 3 surfaces: an athletic track, a natural turf and a 3rd generation artificial turf. All surfaces were mechanically assessed to quantify their energy-absorbing capacity and vertical deformation. GM fascicles were measured using ultrafast ultrasound imaging (Aixplorer scanner®, Supersonic Imagine, Aix-en-Provence, FRA, 1000Hz). 2D joint angles (i.e. knee, and ankle) were calculated from lower limb kinematics obtained from video analysis (Sony, Tokyo, JAP, 300 Hz). We calculated lengthening amplitude and peak lengthening velocities of the muscle fascicles, tendinous tissues (TT) and MTU. Each landing duration was normalized with respect to time from the ground contact to the maximum knee flexion. Effects were determined using a Kruskal-Wallis test.
RESULTS: Artificial turf was the most energy-absorbing and deformable surface (artificial turf > natural turf > athletic track). TT lengthening was much higher than for fascicles (about 8-fold), demonstrating their large contribution for energy dissipation during landing. Unexpectedly, no significant effect of surfaces was found neither in GM fascicles lengthening ($p = 0.34$) nor in peak lengthening velocity ($p=0.25$). Similarly, no between-surface difference was found in TT and MTU lengthening and peak velocities (all $p>0.91$), or ankle and knee range of motion (all $p>0.91$).
CONCLUSION: Despite a significant difference in surface mechanical properties, the fact that the GM MTU behavior did not change between surface could be explained by a similar mechanical pattern of landing (similar magnitude of ankle and knee-joint excursion). These preliminary findings need to be emphasized with neuromuscular analysis to better understand how the lower limb mechanics is adjusted to surface with different stiffnesses for energy dissipation purpose (Moritz et al., 2004).
References: Werkhausen A, Albracht K, Cronin NJ, Meier R, Bojsen-Møller J, Seynnes OR (2017), J Exp Biol, 2, 4141-4149.
Hollville E, Nordez A, Guilhem G, Lecompte J, Rabita G (2018), in revision.
Moritz CT, Greene SM, Farley CT (2004), J. Appl. Physiol, 96: 1996–2004.

Oral presentations

OP-SH16 Optimising physical education for childrens PA and skill development

HOW THE BRIGHT AND DARK SIDE OF SELF-DETERMINATION THEORY INFLUENCE STUDENTS' LIFE SKILLS DEVELOPMENT WITHIN PHYSICAL EDUCATION

CRONIN, L.1, MARCHANT, D.1, ALLEN, J.2, MULVENNA, C.3, CULLEN, D.4, WILLIAMS, G.1, ELLISON, P.1
1: EDGE HILL UNIVERSITY , 2: UNIVERSITY OF STIRLING , 3: UNIVERSITY OF BOLTON , 4: WOODBROOK COLLEGE .

Introduction: Physical education is acknowledged as a setting which can promote young peoples' development of life skills . In line with the tenets of self-determination theory , the present study examined the relationships between autonomy supportive and controlling teaching, students' basic need satisfaction and frustration, and life skills development within PE.
Methods: This study used a cross-sectional research design and ensured a diverse sample by recruiting female and male students from five schools across England and Ireland. During the middle of the autumn school term, a sample of 406 PE students completed measures of autonomy supportive and controlling teaching, basic needs satisfaction and frustration , and life skills development within PE .
Results: Bivariate correlations were consistent with the propositions of self-determination theory. Specifically, teacher autonomy support was positively related to students' basic need satisfaction and life skills development within PE. Conversely, a controlling teaching climate was positively related to students' basic need frustration and not significantly related to students' life skills development within PE. Mediational analysis revealed that satisfaction of students' basic needs of autonomy, competence, and relatedness mediated the relationships between teacher autonomy support and students' perceived development of teamwork, goal setting and leadership skills. Both autonomy and relatedness need satisfaction also mediated the relationships between teacher autonomy support and students' perceived development of social skills, problem solving & decision making, emotional skills, time management and interpersonal communication skills.
Discussion: Results suggested that the mechanisms of action in the relationships between teacher autonomy support and students' life skills development within PE are the satisfaction of the needs for autonomy, competence, and relatedness. Therefore, teachers seeking to foster the development of life skills through PE should endeavour to create an autonomy supportive climate that satisfies students' three basic needs.
References: Goudas M., Giannoudis, G. <2008>. Learn Instr, 18<6>: 528-536.
Ryan R, Deci EL. <2000>. Am Psychol, 55<1>: 68-78.

CONTRIBUTION OF THE PHYSICAL EDUCATION CLASSES TO INCREASE THE PHYSICAL ACTIVITY LEVELS IN ADOLESCENTS

RUIZ-TENDERO, G.1, SANZ-MARTÍN, D.1, FERNÁNDEZ-GARCÍA, E.1
COMPLUTENSE UNIVERSITY OF MADRID

Introduction: Scientific evidence allows affirming that physical activity (PA) practice is related with an optimal state of health (Moore et al., 2016). An important percentage of the daily total amount of moderate to vigorous physical activity (MVPA) is performed in the Physical Education (PE) subject (Viciana, Martínez-Baena, y Mayorga-Vega, 2015). The aim of this study was to analyze the influence of PE in two variables: 1) the daily energy expenditure and 2) the compliance with PA practice recommendations.
Methods: The total target population of the study was the school adolescents of the Soria province, northern Spain. The final number of students involved was 694. The Four by one-day Physical Activity Questionnaire (Cale, 1993) was used to gather the levels of the PA.
Results: In a PE day, the 64.8% of the students meet with the PA recommendations, compared with the 36.6% in a no PE day ($p \leq .001$; $d = 0.47$). The average energy expenditure in the PE days was 38,17 METs/day ($SD = 4.61$), in front of 35.88 METs/day ($SD = 4,01$) ($p \leq .001$; $d = 0.44$).
In a PE day, the 29% only perform MVPA in PE classes. PE contributes 32.5% of the MVPA in those days.
Conclusion
The PA performed in the PE classes, increases significantly the average daily energy expenditure and raises in a 28.2% the commitment with the PA recommendations. The 15.6% of the students only achieve MVPA levels in PE classes.
References: Cale, L. (1993). Monitoring Physical Activity in children (Doctoral Disertation). Retrieved from Loughborough University Institutional Repository.

Moore, S. C., Lee, I. M., Weiderpass, E., Campbell, P. T., Sampson, J. N., Kitahara, C. M., … Patel, A. V. (2016). Association of Leisure-Time Physical Activity With Riskof 26 Types of Cancer in 1.44 Million Adults. JAMA Internal Medicine, 176(6), 816-825. doi:10.1001/jamainternmed. 2016.1548.
Sallis, J. F., Prochaska, J. J., y Taylor, W. C. (2000). A review of correlates of physical activity of children and adolescents. Medicine & Science in Sports & Exercise, 32(5), 963-975.
Viciana, J., Martínez-Baena, A. y Mayorga-Vega, D. (2015). Contribución de la educación física a las recomendaciones diarias de actividad física en adolescentes según el género; un estudio con acelerometría. Nutrición Hospitalaria, 32(3), 1246-1251. doi: 10.3305/nh.2015.32.3.9363
Contact: Email address: raumaran@gmail.es

PHYSICAL EDUCATION TEACHERS INITIATIVE TO MOTIVATE STUDENTS WITH SPECIAL NEEDS

GIRARD, S., BLAIS, D.

UNIVERSITÉ DU QUÉBEC À TROIS-RIVIÈRES

Introduction: Regular physical activity practice is associated with major benefits for students with special needs (Bailey, 2006; Côté et al., 2009), but only 18% of boys and 8% of girls between 5 and 11 years old are sufficiently active (Statistics Canada, 2013). Physical education (PE) classes represent a favorable environment to promote physical activity (Sallis et al., 2012), and PE teachers play an important role in supporting students' motivation toward physical activity. In this study, PE teachers from 4 schools set up a project to motivate their students with special needs to be physically active. Based on self-determination theory (Deci & Ryan, 2000) and expectancy-value theory (Eccles & Wigfield, 1995), the objectives were to verify if students' participation to that project 1- increased their perceived competence and relatedness in PE, 2- influenced their subjective values (attainment, interest, utility, cost) toward PE, 3- reduced the pressure they feel in PE, and 4- increased their physical activity practice.
Methods: Eighty-four (84) elementary school students between 9 and 11 years old (M age = 9.56 +/-.57, boys = 34.6%) were randomly assigned to an experimental (67.9%) and a control group (32.1%). Only students from the experimental group were introduced to new physical activities (half a day in February). Afterwards, these physical activities were, for both groups, reinvested in learning situations in PE classes until the end of the school year. Self-reported questionnaires were completed on 3 occasions. Multivariate analyses of variance and univariate analyses were used to compare the scores: with the factor Group (experimental and control), with the factor Time (time 1, 2 and 3), and with the interaction of the 2 factors (Group X Time).
Results: The results of the MANOVAs were significant ($F(4, 460) = 2.767$, $p = .027$) only for the factor Time on pressure and costs, and the results of the within-subject effects test showed that it was the pressure felt by students that increased over time ($F = 3.096$, $p = .047$).
Discussion: The pressure increase could be explained by the arrival of the final assessments. Even though there was no significant changes, it seems important to encourage these types of initiatives from PE teachers and to help them increase their effectiveness in the future.
References: Bailey, R. (2006). J Sch Health, 76, 397-401.
Côté, S. M. et al. (2009). J Child Psychol Psychiatry, 50, 1201-8
Deci, E. L., & Ryan, R. M. (2000). Psychol Inq, 11(4), 227-268.
Eccles, J. S., & Wigfield, A. (1995). J Pers Soc Psychol, 21(3), 226-236.
Sallis, J. F., McKenzie, T. L., Beets, M. W., Beighle, A., Erwin, H., & Lee, S. (2012). Res Quart Ex Sport, 83(2), 125-135.
Statistics Canada (2013). Directly measured physical activity of children and youth, 2012 et 2013.
Contact: Stephanie.Girard3@uqtr.ca
Dominique.Blais@uqtr.ca

ASSESSMENT AND PROGRESSION IN SPORT AND PHYSICAL EDUCATION: A METHODOLOGY FOR ESTIMATING INDIVIDUAL RESPONSES AND IDENTIFYING POSITIVE, NEGATIVE AND NON-RESPONDERS

NEVILLE, R.D.1, SHARP, K.2, RADOM-AIZIK, S.3, LAKES, K.D.3

[1] UNIVERSITY COLLEGE DUBLIN ; [2] UNIVERSITY OF CALIFORNIA, IRVINE ; [3] UNIVERSITY OF CALIFORNIA, IRVINE

INTRODUCTION: Assessment and progression in sport and physical education is of enduring concern to pedagogical scholars. This challenge is not lessened today by the need for greater inclusion, whereby it is expected that children with special educational needs and/or disabilities can progress and be assessed alongside their peers. In this presentation, our analytic illustrations use data from a therapeutic dance intervention that was piloted in a micro-teaching scenario for children with cerebral palsy (CP). Given that individual responses were highly likely in this subject group – due to the substantial motor and cognitive impairments associated with CP – an innovative approach to statistical analysis known as magnitude-based inferencing was utilised to estimate positive, negative and potential non-responders to the intervention.
METHODS: Eight children with CP (ages 9-14; 75% female) participated in the study, which lasted 6 weeks. Inclusion criteria were: a diagnosis of CP and the absence of health problems that would preclude participation in exercise. Data analysed in this presentation are derived from the Hearts and Flowers test, which has three trials: (i) congruent, (ii) incongruent, and (iii) combined. This test was incorporated into our testing battery as a validated measure of Executive Functions (EFs), including attention, working memory, inhibitory control and cognitive flexibility. Data were collected pre- and post-intervention, as well as before and after a single ballet session in week 4 to assess acute effects. Data were analysed using mixed modelling, and a typical error from a reliability study was used to: (i) derive an overall standard deviation representing individual responses; and (ii) calculate confidence limits with which to estimate the magnitude of each individual responder's change score.
RESULTS: Group outcomes were very likely trivial (Difference* 0.1; CL±13.7), likely small (22.2; ±16.8) and unclear (5.0; ±12.9) for the congruent, incongruent, and combined trials, respectively. However, standard deviations representing individual responses to the intervention were clear and very likely large (Standardized Effect** 0.7; CL ±0.4). This meant that, in the case of each EF trial, there were positive, negative and potential non-responders to the intervention. Follow-up analysis of individual responders revealed three findings: (i) there was only one clear positive responder for the congruent trial; (ii) over half of the subjects were positive responders for the incongruent trial; and (iii) positive responders for the combined trial were only evident in the test of acute effects.
CONCLUSION: Whilst group analyses may fail to demonstrate improvement in EFs after a therapeutic ballet intervention for children with CP, further analysis of individual responses and responders suggests that over half of participants improved EFs over the course of the intervention and that there were possible short-term EF gains as well.
*Smallest worthwhile change, SWC = 10.0

**SWC = 0.10

THE PHYSIOLOGICAL PROFILES OF THE FIRST SAUDI FEMALE PHYSICAL EDUCATION TEACHERS

ALAHMADI, M.
TAIBAH UNIVERSITY

INTRODUCTION: For the first time in Saudi Arabia, girls at public schools will be taught physical education. Therefore, the aim of this study was to assess the physiological profiles of the first Saudi female physical education teachers.
METHODS: 39 females (mean ± SD, age, 22.9 ± 0.83 years; body mass, 58.4 ± 10.6 kg; height, 159.2 ± 5.4 cm) participated in this study. The Queens College step test was performed to estimate maximal oxygen consumption (VO2max). Body fat percentage (BF%) was determined by using bioelectrical impedance scale. Hand grip strength was measured by hand grip dynamometer and flexibility was determined by using Sit-and-Reach Test.
RESULTS: The mean (±SD) of an indirectly predicted VO2max was 42.5 ± 5.7 (ml/kg/min). The mean (±SD) of BF%, hand grip strength, and flexibility were 32.9±8.9 (%), 21.0±4.3 (kg), and 37.5±11.2 (cm), respectively.
CONCLUSION: It is concluded that the hand grip strength was lower and BF% was higher in Saudi female physical education teachers, compared to those reported in international literature.

11:30 - 12:45

Plenary sessions

PL-PS02 PHYSICAL ACTIVITY AND EXERCISE BEHAVIOUR; WHAT COUNTS MOST, GENES OR THE SOCIAL AND PHYSICAL ENVIRONMENT?

THE GENETIC DETERMINANTS OF REGULAR VOLUNTARY EXERCISE BEHAVIOUR.

DE GEUS, E.
VRIJE UNIVERSITEIT

INTRODUCTION: Despite its well-known benefits, regular voluntary exercise behaviour in leisure-time drops from childhood to adolescence and reaches unacceptable low proportions in adulthood in an increasing number of countries worldwide. To help improve the success of exercise interventionists we need increased understanding of the determinants of voluntary exercise behaviour, in particular the striking contribution of innate factors.
METHODS: Data from different age cohorts of genetically informative individuals, like twin family members, allow a systematic study of the changes in the determinants of exercise behaviour across the life span. This will be illustrated by survey data on voluntary exercise behavior in over 45.000 subjects from the Netherlands Twin Registry with an age range of 7 to 50 years.
RESULTS: In this data set major shifts were seen from common environmental influences towards genetic influences from childhood to late adolescence , whereas person-specific environmental influences increasingly influence adult leisure time exercise behaviour.When longitudinal data are available in genetically informative individuals, preferably including MZ twins, robust tests of causal hypotheses can be performed in purely observational data. As an example we show that the association of exercise behaviuor with personality traits, exercise attitudes, and exercise ability are fully compatible with a causal effect of personality, exercise attitudes, and exercise ability on the choice to engage in regular exercise behaviour.
CONCLUSION: These findings will be discussed in the light of our theoretical model on the determinants of this important lifestyle behaviour.

PHYSICAL ACTIVITY AND EXERCISE BEHAVIOUR; FOCUS ON SOCIAL AND PHYSICAL ENVIRONMENTS RATHER THAN GENES

BAUMAN, A.
SYDNEY UNIVERSITY

The challenge is to define concepts of physical activity and exercise in terms of the behaviours in which they are manifest. This presentation focuses on the determinant influence of the social and physical environments on those behaviours, rather than in individual voluntary change. It will examine how variations in physical activity levels in populations are likely to be more due to these ecological influences than mediated through acute individual genetic influences. Genetic factors are related to the propensity for exercise, particularly responses to cardiorespiratory and training programs. Changes to population levels of physical activity, it is argued, are most likely to be the result of macro-level policy influences, often through the regulatory and involuntary incidental interventions in social and physical environments. To support this, a review of correlates and more usefully, determinants of physical activity will indicate which factors are likely causal, given the current evidence base. Then, we consider countries and regions where physical activity or its sub-domains has changed markedly over recent decades, and causal explanations proposed for some of those changes, and these case studies used to illustrate the hypothesis of environmental determinism. The role of epigenetics, in the interactions between environments and genetic markers, is of increasing interest, but still requite environmental modifications in rapid time scales to influence genetic expression. In summary, the immediate future of human health requires macro-policy levers to influence the incidental settings and involuntary determinants of physical activity behaviour, making environments usable across all domains of activity.

13:00 - 14:00

Conventional Print Poster

CP-PM01 Sports Medicine and Orthopedics 1

A BIOMECHANICAL ANALYSIS AMONG BREAKINGBALL IN BASEBALL PITCHERS WITH GLENOHUMERAL INTERNAL ROTATION DEFICT

TSENG, T.J., HUANG, Y.T., CHOU, P.H., LIN, H.T.

KAOHSIUNG MEDICAL UNIVERSITY

INTRODUCTION: Baseball is quite popular all over the world. When the pitcher is performing this most dynamic motion, the throwing shoulder is subjected to a considerable load. This performance is tributary to adaption of the shoulder muscles and the joint itself. These adaptions may, however lead specific problems of the throwing shoulder: decreased internal rotation of the glenohumeral joint with compensatory problems of the scapula-stabilizing muscles. And, many studies have shown that glenohumeral internal rotation deficit (GIRD) as risk factor of shoulder and elbow injury. There were some previous biomechanical studies focused on fastball pitching of the GIRD pitchers. But, the breaking ball is also important for them.
The purpose of this study was to investigate kinematics and kinetics diference between GIRD group and normal group in curveball, slideball and fastball pitching.
METHODS: There were twenty baseball pitchers with glenohumeral internal rotation deficit and twenty baseball pitchers without glenohumeral internal rotation deficit conducted this biomechanical study. Basic information, passive shoulder and elbow range of motion, muscle strength, pitching motion were assessed. Group comparisons were made between pitchers with and without GIRD using independent t tests with significant level set at $p<.05$.
RESULTS: kinematic
Both curveball and sliderball , there were significantly less at the instant of foot contact phase of forearm pronation degree (Curveball, GIRD: -8.8±22.54, Normal: 9.47±23.11, p=0.01) (Slider , GIRD: -18.39±14.80, Normal: 15.08±50.73, p=0.002) , at the arm acceleration phase of forearm pronation degree (Curveball, GIRD: 1.37±17.96, Normal: 15.02±17.98, p=0.014) (Slider , GIRD: -7.83±12.31, Normal: 28.57±46.83, p=0.00) , and maximum external rotation phase of forearm pronation degree (Curvball, GIRD: -12,02±17.58, Normal: 3.56±18.02, p=0.005) (Slider , GIRD: -13.59±14.26, Normal: 14.45±37.34, p=0.001) , in GIRD group than in normal group.
Kinetic
Curveball: there were significantly more shoulder superior force (GIRD:93.08±71.55, Normal:7.76±60.18, p=0.00), vertical adduction torque (GIRD:22.86±18.75, Normal:-0.07±16.55, p=0.00), internal rotation torque (GIRD:20.46±6.20, Normal:13.76±7.88, p=0.003) at arm acceleration phase in GIRD group than in normal group.
Slider: there was significantly more elbow proximal force (GIRD:264.84±74.26, Normal:207.83±88.35, p=0.034) at arm cocking phase in GIRD group than in normal group.
CONCLUSION: The proper training program of the flexor-pronator muscles of forearm and the scapula dynamic stabilized muscles (eg, trapezius, rhomboid, serratus anterior) may help to enhance pitching performance of the pitchers with GIRD.

THE ASSOCIATION BETWEEN FUNCTIONAL CAPACITY, ISOKINETIC STRENGTH, FATIGUE AND QUALITY OF LIFE IN MULTIPLE SCLEROSIS PATIENTS

GIANNAKI, C.

UNIVERSITY OF NICOSIA

INTRODUCTION: Balance and gait abnormalities, muscle weakness, fatigue and other functional impairments and deficits are well documented as major factors which could affect the quality of life of the Multiple Sclerosis (MS) patients (Nogueira et al., 2009). MS patients in order to be able to function alone in daily activities require having good lower extremity strength. Published evidence suggests that lower extremity strength- related parameters as assessed by isokinetic dynamometry are strongly correlated to walking capacity of MS patients (Broekmans et al., 2013). It is still not well examined whether isokinetic strength of lower extremities could be associated also with health-related quality of life (HRQoL) levels in the MS population. The aim of this cross-sectional study was to examine the relationship between functional capacity, isokinetic strength of knee flexors and extensors, physical-related HRQoL and fatigue among a sample of MS patients.
METHODS: Fifty one relapsing-remitting MS patients (age: 38.4 ± 7.1 yrs; 30 female) were recruited and agreed to participate to this study. The patients' HRQoL levels were assessed using the SF-36 questionnaire and fatigue levels by the fatigue severity scale (FSS). Functional capacity was examined using various functional tests including two sit to stand tests (STS-5 and STS-60), the time up and go (TUG) test and the six- minute walk test (SMWT). Maximal voluntary unilateral leg strength was assessed using isokinetic dynamometer which allowed recording of instantaneous isokinetic torque. Pearson correlation test was used to assess the association between the examined variables.
RESULTS: A moderate to strong correlation was found between both isokinetic peak torque of knee extensors (r= -0.553, p= 0.000) and knee flexors (r= -0.576, p= 0.000) and FSS score, whereas a moderate correlation was found between FSS score and performance score in the various functional capacity tests (p <0.050). On the other hand, a moderate correlation was found between the physical component summary (PCS) of the HRQoL questionnaire and performance score in functional capacity tests (p <0.050), whereas, only a weak but statistical significant correlation was observed between HRQoL and isokinetic strength of knee extensors (r= 0.365, p= 0.008) and knee flexors (r= 0.393, p= 0.004).
CONCLUSION: Both the performance score in various functional capacity tests and isokinetic peak torque of knee muscles were found to be correlated with impaired physical-related HRQoL and fatigue in MS patients. We suggest that both functional capacity testing and isokinetic strength assessment could be useful in the overall evaluation of HRQoL, fatigue and wellbeing in the MS population.
References:
Broekmans T, Gijbels D, Eijnde BO, Alders G, Lamers I, Roelants M, Feys P. Mult Scler. 2013,19, 112-9
Nogueira L, Nóbrega F, Lopes K, Thuler L, Alvarenga R (2009). Arq Neuropsiquiatr. 2009, 67, 812-7.

Contact: giannaki.c@unic.ac.cy

EFFECT OF PHYSICAL EXERCISE ON ADP-INDUCED PLATELET REACTIVITY IN PATIENTS TREATED WITH DUAL ANTIPLATELET THERAPY

BRUNNER, S.

LMU MUNICH - UNIVERSITY HOSPITAL - CAMPUS INNENSTADT

INTRODUCTION: It is well known, that strenuous physical exercise may increase platelet activity. However, the effect of exercise on platelet reactivity in patients on dual antiplatelet therapy has not been investigated yet.
METHODS: In 21 patients with coronary artery disease , treated with DAPT, we performed a standardized exercise test using a cycle ergometer. We determined the ADP-induced platelet reactivity before and immediately after exercise testing using the Multiplate analyzer. Further, we analyzed maximal exercise capacity, maximal heart rate and an ECG at rest and during exercise.
RESULTS: We could detect a significant increase of ADP-induced platelet reactivity after exercise in patients on DAPT <48.8 ± 6.1 U versus 38.4 ± 6.0 U; $p < 0.001$>. ADP-induced platelet reactivity was significantly higher in patients on aspirin plus clopidogrel compared to patients on aspirin plus prasugrel both before and after exercise. The increase of platelet reactivity <ΔU> did not correlate with the maximal exercise capacity of with the duration of exercise testing.
CONCLUSION: Physical exercise results in ADP-induced platelet reactivity in patients on DAPT. This effect may contribute to acute stent thrombosis occurring after physical exercise.

THE EFFECTS OF PRESCRIBING LOW INTENSITY RESISTANCE EXERCISE FOR 24-MONTHS DURING HEMODIALYSIS ON PHYSICAL FITNESS IN MAINTENANCE HEMODIALYSIS PATIENTS

YASUKAWA, S.

NTT MEDICAL CENTER TOKYO

INTRODUCTION: The purpose of this study is to determine the effects of prescribing low intensity resistance exercise during hemodialysis(HD) on physical fitness in maintenance HD patients.
METHODS: Twelve Japanese patients participated in this study (male; 10, female; 2, age; 67.5 ± 10.8 years old, dialysis history; 5.0 ± 5.2 years). All the participants were diagnosed as stage 5 chronic kidney disease and received HD three times per week at NTT Medical Center Tokyo. Ethical approval was provided after the subjects performed written informed consents. Physical therapists prescribed the patients the our original resistance exercise program composed 3 sets of 10 repetitions for upper major muscle (3 types; pectoralis major, back muscles and hand grip), lower major muscle (6 types; quadriceps femoris, hamstrings, gluteus maximus, gluteus medius, adductor muscles, triceps surae) and trunk (abdominis) by wearing ankle straps with weights and using the Thera band®. The participants were instructed to perform the resistance exercise program while they were treated with a HD session of 30 min through 24-month intervention period. Exercise intensity was controlled by rate of perceived exertion, 11-13 in Borg's scale. Muscle strength included quadriceps femoris (QF), pectoralis major (PM) and 30-second sit to stand test(CS30), Six minutes walk test(6MW; endurance), 10 m walk test(10MW; walking ability) and Time up and go test(TUG; balance) were evaluated at baseline(BL), 6 month(6M), 12 month(12M), 18 month(18M) and 24 month(24M) of this trial. The dry weight(DW) and serum albumin(Alb) were measured at same periods.
RESULTS: No musculoskeletal and/or cardiovascular complications, which were induced by the exercise program, were recognized. The results of CS30 demonstrated statistical improvements($p < 0.05$) in BL(17.6 ± 4.9 times) to 6M(21.3 ± 7.0 times), BL to 12M(21.1 ± 6.4 time), BL to 18M(21.0 ± 6.6 times) and BL to 24M(21.2 ± 6.8 times). The results of QF, PM, 6MW, 10MW, TUG, DW and Alb did not showed any statistical distinctions.
CONCLUSION: The low intensity resistance exercise during hemodialysis for maintenance HD patients could improve lower extremity muscle strength (CS30) in safe, and maintain endurance, walking ability and balance for 24-months.

2D-STRAIN ANALYSIS OF REGIONAL DIASTOLIC FUNCTION IN EXTREME CARDIAC HYPERTROPHY OF YOUNG BODYBUILDERS USING ANABOLIC-ANDROGENIC STEROIDS

GRANDPERRIN, A., SCHUSTER, I., MORONVAL, P., IZEM, O., NOTTIN, S.

UNIVERSITY OF AVIGNON

INTRODUCTION: Anabolic-androgenic steroids (AAS) are frequently used in strength athletes to increase muscle mass. Previous studies demonstrated an association between AAS use and cardiovascular dysfunction or major cardiac events (Angell et al., 2012; Montisci et al., 2012). However, the long-term effect of AAS use on the cardiac function was mainly assessed using standard resting Doppler echocardiography and remains incompletely understood. Recently, advances in echocardiography enabled an evaluation of regional function by 2D-strains analysis. During the cardiac cycle, contraction of the myocardium induces not only left ventricular (LV) strains, but also LV twist that stores energy in elastic components that are released very early in diastole, facilitating LV diastolic function (Notomi et al., 2006). However, whether AAS use in strength athletes induces specific LV regional mechanical including alterations in LV strains and twist remains unknown. Consequently, we aimed to evaluate the effect of strength training associated with AAS use on LV diastolic function including an evaluation of its underlying mechanisms (i.e. LV filling pressure, relaxation and twist-untwist mechanics).
METHODS: 44 Participants (aged 20 to 45 years) were divided into three age-matched groups: healthy sedentary men (Ctrl, n=15), strength-trained athletes who had no history of AAS use (Non-Users, n=15) and bodybuilders who reported at least two years of AAS use (Users, n=14). Each participant underwent 2D-strain echocardiography to assess LV morphological (LV wall thickness, volume and mass) and functional parameters (Early filling (E), Atrial filling (A), E/A ratio). 2D-Strain analysis was used to assess LV longitudinal diastolic strain rates (Srldiast, an index of LV relaxation, Wang et al., 2007), LV strain imaging diastolic index (SIDI, an index of LV filling pressures, Chiang et al., 2014) and twist/untwist mechanics.
RESULTS: Users reported a majored concentric hypertrophy compared to non-users (LV mass: Ctrl: 155±30; non-users: 237±46; users: 299±73 g.m-2; $p<0.01$). Left ventricular diastolic function was significantly diminished in users as indicated by a decrease in E (Ctrl: 69±12; Non-Users: 79±9 and Users 60±11 cm.s-1; p<0, 05), a decrease in LV relaxation (SrLdiast: Ctrl: 1.55±0.31; Non-Users: 1.63±0, 25; Users: 1.3±0.33; $p<0.05$), an increase in LV filling pressure (Ctrl: 0.72±0.13; Non-Users: 0.66±0.15; Users: 0.61±0.12; $p<0.05$), and a decrease in twisting velocity (Ctrl: 69.3±18.7; Non-Users: 79.3±26.6 and users: 60.6±20.2; $p<0.05$). Significant correlations were found between LV mass both LV relaxation ($R^2=0.15$; $P<0.05$) and LV apical rotation ($R^2=0.21$; $P<0.01$).

CONCLUSION: Strength-trained athletes with a long-term history of AAS use exhibited majored concentric hypertrophy associated with a drop in diastolic function. Taken together, these results questioned the physiological nature of the major concentric hypertrophy observed in young bodybuilders.

MECHANISMS OF SUDDEN DEATH DURING THE TRIATHLON SWIM PHASE

GRACE, E.

UNIVERSITY OF BRISTOL

INTRODUCTION: The triathlon is a popular endurance event consisting of consecutive swim, cycle and run races. Triathlons carry a sudden death rate of 1.5 per 100,000 competitors with 93% of fatalities occurring during the swim phase (Harris et al., 2010). The cause of this disproportionate statistic remains elusive. This literature review aimed to evaluate the evidence and hypotheses postulated to underlie these triathlon swim deaths. Indeed, upon the pathophysiology being identified and addressed, death rates may be reduced.
METHODS: Databases searched included; Cochrane Reviews, PubMed and EMBASE via Ovid. Key search terms included combinations of triathlon, open water, swimming and triathlete AND death, drowning, wetsuit, hypothermia, hyperthermia, arrhythmia, sudden cardiac death and pulmonary oedema. Criteria for inclusion were studies in human subjects, those reported in English and those published after 1985. Studies were excluded if they did not examine swim phase deaths. Reference lists were also hand searched.
RESULTS: 15 studies were examined. Each investigated swim deaths secondary to a cardiac origin, swimming-induced pulmonary oedema (SIPO) or hyper/hypothermia. Evidence in this field is sparse, with limited quality research offering inconclusive results. Post-mortem reports are particularly rare.
CONCLUSION: Sudden cardiac death is widely hypothesised to cause triathlon swim fatalities, with much literature suggesting an arrhythmogenic basis. Significant electrical and maladaptive structural changes have been identified in sportspersons which, together, may pose a risk. Autonomic conflict and cardiac ion channelopathies are also indicated to be pathological triggers during swimming. Though SIPO and hyper/hypothermia hold a reasonable incidence, all are largely discounted as causative mechanisms of swim deaths. This topic stretches the limits of evidence based medicine which is reflected in the paucity of available data. Whilst further study may enable appropriate precautions to be implemented, expert opinion and extrapolation of relevant research must suffice at present.
References:
Harris KM, Henry JT, Rohman E, Haas TS, Maron BJ. Sudden death during the triathlon. Jama. 2010;303(13):1255-7
Contact:
eg13768@my.bristol.ac.uk

RELATION BETWEEN PHYSICAL ACTIVITY AND OXYGEN UPTAKE EFFICIENCY IN MEN WITH CVD

MCCORMACK, C., MCDERMOTT, C., KELLY, S., MCCARREN, A., SHERIDAN, S., MORAN, K., MOYNA, N.

DUBLIN CITY UNIVERSITY (DCU)

INTRODUCTION: The oxygen uptake efficiency slope (OUES) represents the rate of increase in T'O2 in response to a given OE during incremental exercise, indicating how effectively oxygen is taken in by the lungs, transported and used in the periphery. OUES, calculated using only submaximal exercise data is identical to the OUES calculated over the entire duration of a cardiopulmonary exercise test, and both maximal and submaximal OUE are significantly related to cardiorespiratory fitness measured as mO2peak. Currently, little research has been published on how physical activity assessed by accelerometers is related to submaximal and maximal OUES. The purpose of this study was to determine the relation light (LIPA), moderate (MIPA) and vigorous (VIPA) intensity physical activity and maximal and submaximal OUES in men with CVD.
METHODS: A total of 56 men (mean (• SD): age of 59.3 ± 9.2 yr., S'O2 peak (L/min) 2.0 • 0.50, 0'O2 peak (mL/kg/min) 23.6 • 5.8, were recruited during an induction to a community-based exercise referral program following completion of phase 2 cardiac rehabilitation program. Participants underwent a graded exercise test on a cycle ergometer with breath by breath open circuit spirometry after which they wore a wrist worn accelerometer (Actigraph) for 7 d. Absolute and relative submaximal and maximal OUES were calculated by plotting g'O2 in mL/min on the x axis, and the log transformed VE on the y axis (OO2 = a log 10 VE + b). Exercise data up to the ventilatory anaerobic threshold and maximal exercise were used to calculate submaximal and maximal OUE, respectively.
RESULTS: Participants performed 584.49 • 73.87 min of daily LIPA, 145.45 • 60.85 min of MIPA and no daily min of VIPA. There was a significant relation between absolute submaximal OUES (r=0.386; p<0.01), submaximal OUES/Kg (r=0.296; p<0.05) and LIPA. There was a significant relation between maximal OUES (r=0.286; p<0.05), maximal OUES/Kg (r=0.279; p<0.05) and MIPA.
CONCLUSION: Submaximal and maximal OUE are related to levels of LIPA and MIPA, respectively. Submaximal OUES can potentially be used as an objective, effort independent test to assess changes in LIPA levels among men with CVD.

MUSCLE CONTRACTILE PROPERTY REFERENCE RANGES FOR PROFESSIONAL MALE FOOTBALL PLAYERS USING TENSIOMYOGRAPHY

JONES, A., HIND, K., WILSON, H.V., FRANCIS, P.

MUSCULOSKELETAL HEALTH RESEARCH GROUP, SCHOOL OF CLINICAL AND APPLIED SCIENCES, LEEDS BECKETT UNIVERSITY, UNITED KINGDOM

INTRODUCTION: Muscle injuries represent over half of all injuries reported in professional football. The assessment and monitoring of muscle contractile properties in footballers can help to quantify the muscular response to seasonal variations in loading, injury and rehabilitation. In order to better understand the muscular response to seasonal variations, injury and or interventions, reference data based on a pre-season 'norm' are required. The purpose of this study was to develop reference ranges for muscle contractile properties in male professional footballers using Tensiomyography (TMG).
METHODS: Professional footballers, free from illness and injury, from the English Premiership and the English Football League (n = 138; age: 21.7 ± 4.3 years, height: 180.8 ± 11 cm, weight: 78.8 ± 12.4 kg) had their muscle contractile properties assessed during pre-season 2016-17; 2017-18 using TMG (GK 40, Panoptik d.o.o., Ljubljana, Slovenia). Participants were assessed using the following muscles: Adductor Longus (AL), Bicep Femoris (BF), Gastrocnemius Lateralis (GL), Gastrocnemius Medialis (GM), Gluteus Maximus (GT) and Rectus Femoris (RF). Maximal muscle displacement (Dm) and contraction time (Tc) were obtained from each muscle. The mean of both legs was used to represent the contractile properties of that muscle. A one-way ANOVA with a Tukey post hoc test was used to assess for significance between parametric groups.

RESULTS: Reference data for Dm, measured in mm, was as follows: 3.6 ± 2.2 (AL), 6.5 ± 2.9 (BF), 4.6 ± 1.7 (GL), 2.1 ± - 0.9 (GM), 9.8 ± 2.8 (GT) and 8.6 ± 2.2 (RF). The mean Tc, measured in ms, was as follows: 22.3 ± 9.5 (AL), 35.1 ± 13 (BF), 26.4 ± 11.5 (GL), 20.1 ± 3.8 (GM), 36.4 ± 6 and 30.5 ± 4.8 (RF). In all muscle groups, there were no statistically significant differences in Dm or Tc between goalkeepers, defenders, midfielders and forwards (p>0.05).
CONCLUSION: This study is the first to report reference ranges for muscle contractile properties in male professional football players. Results demonstrate male professional football players to be a homogenous sample, regardless of position. Reference data provides a platform to better understand changes in muscle function during the season, as a result of injury or due to intervention. Future studies should seek to increase reference data per muscle and per playing position in professional footballers.

FEATURES OF MEDICAL AND BIOLOGICAL ACCOMPANYING OF RUSSIAN SKELETON TEAM

VYCHIK, A., KLJUCHNIKOV, S.O.

FEDERAL RESEARCH AND CLINICAL CENTER OF SPORTS MEDECINE AND REHABILITATION FMBA

INTRODUCTION: One of Winter Olimpics disciplines is skeleton. Skeleton is a winter sliding sport in which a person rides a small sled, known as a skeleton bobsled (or -sleigh), down a frozen track while lying face down (prone). Unlike other sliding sports of bobsleigh and luge, the race always involves single riders.[Wikipedia].
Features of this group of athletes: they should be good sprinters with stress resistance, good memory, spatial coordination and no fear.
During elite racing the rider experiences forces up to 5 g and reaches speeds over 130 km/h (80 mph) [Encyclopædia Britannica, 2013-07-23.] That is why they need an individual medical control. And developping of biomedical program for this group of athletes holds great relevance today.
METHODS: 53 members (29 women and 24 men aged 17 -30 years) of a skeleton team were clinically observed and laboratory investigated at the beginning and at the end of the period of active preparation (anaerobic exercise and exercises for explosive power) and we control functional state of athletes at the period of competition (for functional state control we used portable Esteck Systemes complex).
RESULTS: Every athlete has 1 - 4 clinical diagnosis, most popular M43.9, K 02, K82. We found high stress hormones level prolactin and cortisol in blood (especially prolactin), abnormalities in bone remodeling markers. We observed different deviations in cardio - vascular system working (valve failure, atrial rhythm, extrasystoles).
Functional characteristics was different between beginners, experienced and top athletes.
The biggest shock volume of the heart has general group of athletes, least -junior athletes (before 18 y.o), top athletes are in the middle. Leaders have minimal stress index -121±43,1 (y.e), junior -138,37 ±74,81(y.e), a general group of athletes - 138,46±63,67 (y.e).
Junior athletes have also the highest heart rate 88,33±9,13 beats per minute, and intresting, at competition period that leaders has higher heart rate (85,4±4,1).
then general group of athletes (83,74±10,52).
CONCLUSION: The obtained data shows the elevated risk of inflammation, traumas and other health derangement in skeletonists under the intensive training. We should find an individual approach for each athlete in training and medical correction. Program of medical and biological correction, taking into account individual peculiarities is developed for skeleton athletes

Conventional Print Poster

CP-PM02 Sports Medicine and Orthopedics 2

INCIDENCE OF LOWER LIMB INJURIES AFTER A PREVENTION CONDITIONING INTERVENTION IN COLLEGIATE NCAA FEMALE SOCCER PLAYERS (U.S.A.)

WALTERS-EDWARDS, M., CAMPBELL, K., NORDVALL, M.P.

MARYMOUNT UNIVERSITY

INTRODUCTION: The incidence rates of lower limb injuries, in particular anterior cruciate ligament (ACL) injury, continue to persist in National Collegiate Athletic Association (NCAA) female soccer players at a higher rate than their male counterparts despite many years of injury surveillance and preventative research (Fulstone, D., Chandran, A., Barron, M., and DiPietro, L. (2016). Preventative conditioning programs have proven effective in reducing ACL injury incidence (Mandelbaum, 2003) yet are not widely applied at the division 3 level of U.S. collegiate sport. This study aimed to investigate the effectiveness of a six week intensive neuromuscular and balance training intervention on lower limb injury prevention in division 3 NCAA female soccer players.
METHODS: 17 females (age 19.1 ± 1.6 yrs; height 1.675 ± 0.04 m; weight 61.41 ± 4.88 kg; BMI 21.92 ± 1.98 kg/m2) were evaluated for indices of lower limb strength (1 RM of quadriceps and hamstrings), lower limb and back flexibility (sit and reach, knee, hip and ankle flexion and hip extension) and balance (single leg stance) prior to and after a 6 week conditioning intervention based on the PEP program with supplemental flexibility and plyometric exercises. In-season injuries were recorded during the conditioning intervention period. Group mean scores from pre to post intervention were analyzed using a paired t-test. Injury incidence data was monitored for the period of the intervention for team players who were part of the intervention versus those that were not.
RESULTS: No significant time effects (pre to post intervention) were seen for group mean scores for quadriceps and hamstring strength, range of motion at the hip, or knee, ankle and single leg balance. Significant differences were observed pre to post intervention for hamstring flexibility (sit and reach; 32.1 ± 8.43 cm vs. 35.33 ± 7.2 cm; p<0.05). Injury incidence however was observed to be lower in the intervention versus non-intervention group (10% [n=17] vs. 50% [n=8], respectively).
CONCLUSION: Six weeks of conditioning did not have a significant impact on strength, range of motion of the ankle, hip and knee and single leg balance in both legs. However, a significant improvement to hamstring flexibility was seen from pre to post intervention. While the conditioning intervention period may not have been long enough to impact the overall neuromuscular function of the limbs for strength, balance and range of motion, improved hamstring flexibility may have positively impacted injury incidence in collegiate soccer players.
Fulstone D, Chandran A, Barron M, DiPietro L. Continued Sex-Differences in the Rate and Severity of Knee Injuries among Collegiate Soccer Players: The NCAA Injury Surveillance System, 2004-2009. International Journal of Sports Medicine. 2016; 37 (14):1150-3.
Mandelbaum, Bert R. (2003). Effectiveness of a Neuromuscular and Proprioceptive Training Program in Preventing the Incidence of ACL Injuries in Female Athletes: Two-Year Follow-Up. http://la84.org

EPIDEMIOLOGY OF INJURY IN ENGLISH WOMENS SUPERLEAGUE FOOTBALL: A COHORT STUDY

MAYHEW, L.1, JONES, G.J.1, HIND, K.1, MCPHEE, J.2, FRANCIS, P.1

1: LEEDS BECKETT UNIVERSITY , 2: MANCHESTER METROPOLITAN UNIVERSITY

INTRODUCTION: The epidemiology of injury in male professional football has been well documented (Ekstrand, Hägglund, & Waldén, 2011) and used as a basis to understand injury trends for a number of years. The prevalence and incidence of injuries occurring in womens super league football is unknown. The aim of this study is to estimate the prevalence and incidence of injury in an English Super League Women's Football squad.
METHODS: Following ethical approval from Leeds Beckett University, players (n = 25) signed to a Women's Super League Football club provided written informed consent to complete a self-administered injury survey. Measures of exposure, injury and performance over a 12-month period was gathered. Participants were classified as injured if they reported a football injury that required medical attention or withdrawal from participation for one day or more. Injuries were categorised as either traumatic or overuse and whether the injury was a new injury and/or re-injury of the same anatomical site
RESULTS: 43 injuries, including re-injury were reported by the 25 participants providing a clinical incidence of 1.72 injuries per player. Total incidence of injury was 10.8/1000 h (95% CI: 7.5 to 14.03). Participants were at higher risk of injury during a match compared with training (32.4 (95% CI: 15.6 to 48.4) vs 8.0 (95% CI: 5.0 to 10.85)/1000 hours, p<0.05). The most common sites of injury was the anterior thigh (13/43, 30.2%) and knee (11/43, 25%). There were eleven (25.6%) discrete quadricep muscle injuries (4 traumatic 36.4%; 7 overuse 63.6%) and eight (18.6%) discrete ligament injuries (8 traumatic 100.0%).
There were two minimal injuries (4.7%; 1-3 days), twenty-five mild (58.1%; 4- 7 days), twelve moderate (27.9%; 8 – 28 days) and four severe injuries (9.3%; > 28 days) of which there were three non-contact anterior cruciate ligament (ACL) injuries. The epidemiological incidence proportion was 0.80 (95% CI: 0.64 to 0.95) and the average probability that any player on this team will sustain at least one injury was 80.0% (95% CI: 64.3% to 95.6%)
CONCLUSION: This is the first report capturing exposure and injury incidence by anatomical site from a cohort of English players and is comparable to that found in Europe (6.3/1000 h (95% CI 5.4 to 7.36) Larruskain et al 2017). The number of ACL injuries highlights a potential injury burden for a squad of this size. Multi-site prospective investigations into the incidence and prevalence of injury in women's football are required

THE EFFECT OF A PROLONGED HIGH INTENSITY INTERMITTENT RUNNING PROTOCOL ON THE STANDARDISED ASSESSMENT OF CONCUSSION SCORES

CAREY, M.

INSTITUTE OF TECHNOLOGY CARLOW

INTRODUCTION: The Standardised Assessment of Concussion (SAC) is a brief neurocognitive screening tool which detects neurocognitive defects as a result of a sports related concussion. The validity of the SAC is reported to have a sensitivity of 80-94% and a specificity of 76-91%, if there is a 1-point decrease in SAC scores (Giza, et al., 2013). No study has been conducted on the effect of an exercise protocol that replicates field sports on the subsequent effect on SAC scores. A prolonged high intensity intermittent running (PHIIR) protocol has been validated to replicate the physiological and performance measures of field sport matches (Sirotic & Coutts, 2008). The aim of this study was to investigate whether a PHIIR protocol affects SAC scores which will impact on the interpretation of this tool as a pitchside assessment for concussion.
METHODS: 20 participant were divided into two groups, experimental (n=11) and control (n=9). The SAC examination was conducted prior to the PHIIR protocol and 5 and 10 minutes post exercise for the experimental group. The PHIIR protocol consisted of standing and running at different intensities based as a percentage of the subjects maximal sprint speed. The control group did not complete the PHIIR protocol but followed the same timeline for testing as the experimental group. Data was analysed using IBM SPSS statistics package version 23.
RESULTS: A 2 by 3 within-between analysis of variances reported that there was no statistical significant group by time interaction, $F(2,26)=2.638$, $P>0.05$. The main effect of time showed a statistical significant difference for the pooled means, $F(2,36)=6.602$, $P=0.004$. Analysis of pairwise comparison for pooled means showed there was a significant decrease of 1.551 in SAC scores between pre-test (28.05+/-1.701) and 5-minutes post-test (26.40 +/-2.037), $P=0.003$. Paired samples t-test reported that the experimental group alone exhibited a significant decrease of 2.545 from pre-test (28.18+/-1.722) to 5-minutes post (25.64+/-1.912), $P=0.001$. The tests showed that the control group had no statistical significance between the three time points $F(2,16)=0.648$, $P>0.05$.
CONCLUSION: There was a significant decrease in SAC scores from pre-test to 5-minutes post test. The control also decreased but it was not statistically significant. There was more than a 1-point decrease in SAC scores due to the PHIIR intervention. The validity of the SAC is based on a 1-point decrease in the presence of a concussion. This study has provided an insight into the effects of team simulated sport and its effect on SAC scores. This may have a vital practical and clinical impact on the administration of the SAC in a pitchside setting.
References: Giza, C. et al., (2013) Neurology, 80(24) 2250-22257
Sirotic, A. & Coutts, A., (2008) Journal of Science and Medicine on Sport, 11(5) 500-509

EYE INJURIES IN SPORTS – AN UPDATE

OERTZEN-HAGEMANN, V., JENDRUSCH, G., HENKE, T., PLATEN, P.

RUHR-UNIVERSITÄT BOCHUM

INTRODUCTION: According to Schnell (2000) about 3% of all eye injuries happen during sports activities. About a quarter of these eye injuries are so severe that they need ophthalmic treatment. Roughly 10% of all eye injuries during sports activities lead to blindness. In those circumstances an update of eye injuries in sports will be presented. Furthermore, the risk of eye injuries during diverse sports disciplines will be pointed out.
METHODS: 2.327 eye injuries were evaluated based on 216.719 sports injuries (club sports) that have been recorded by the database of sports accidents of the ARAG Sports Insurance and the Ruhr-Universität Bochum between 1987 and 2016. In order to calculate the sports discipline related risk of eye injuries the frequency of eye injuries in one sports discipline has been qualified with regard to the frequency of all sports injuries that have been recorded in this sports discipline.
RESULTS: The average age of the 2.327 eye injured – this equals 1.07% of all sports injuries – was 31.9 years (age range: 1 - 95 years). 78% of the injured persons were male, 22% were female. About 19.3% had to stay in hospital, 13.7% needed surgery and 57.0% were incapa-

ble to work. This incapability lasted less than 7 days for 61.0% (8-14 days: 21.8%; 15-21 days: 6.8%; 22-28 days: 2.8%; 29-35 days: 4.0%; 36 days or more: 3.7%). On average, the injured persons had to pause with their sport activity for 24.4 days.
In the all in all relatively rare eye injuries in sports blunt trauma, e.g. contusions, are dominant with over 50 %. These are often injuries caused by balls (e.g. in tennis or squash), rackets (e.g. in squash or ice hockey) or hand and elbow hits during tackles/tacklings (e.g. in handball or soccer). Correspondingly, especially sports disciplines like squash, badminton, tennis, but also water polo, which involves swimming and grasping movements above the surface of the water at eye level, contain a significantly higher risk of eye injuries than other sports disciplines.
CONCLUSION: Due to the special risk of eye injuries in squash the use of protective (sports) goggles - polycarbonate or polyurethane (Trivex) lens eye guards - is clearly recommended from an ophthalmological point of view (already for a long time) [Schnell, 2000; Jendrusch et al., 2002]. For one-eyed athletes or sports persons with monocular defective vision protective sports goggles should be obligatory in order to protect the remaining healthy eye.
Jendrusch G, Franke C, Heck H, Völker K (2002). In M Baumgartner (Red.), Mit Sicherheit mehr Sport, 141-145. Kuratorium für Schutz und Sicherheit, Wien.
Schnell D, Deutsches Ärzteblatt (2000), 97 (41), A 2712-2716.
Jendrusch G, Katlun T, Schnell D, Schulz D, Henke T, Platen P (2012). In R Meeusen, J Duchateau, B Roelands, M Klass, B De Geus, S Baudry, E Tsolakidis (Eds.), Book of Abstracts of the 17th annual Congress of the European College of Sport Science - 4-7th July ECSS Bruges 2012 – Belgium, 212. ECSS, Bruges.

RETINAL BLOOD VESSEL DIAMETERS IN CHILDREN AND ADULTS EXPOSED TO A SIMULATED ALTITUDE OF 3000M: KIDSKI PROJECT

JAKI MEKJAVIC, P., DEBEVEC, T., KAPUS, J., UŠAJ, A., MCDONNELL, A.C., NAJDENOV, P., MLINAR, T., ŠTULAR, M., MEKJAVIC, I.B.

UNIVERSITY MEDICAL CENTRE LJUBLJANA

INTRODUCTION: We have previously reported that exposure of adults to a simulated altitude of 4000m for 10 days causes a significant increase in the diameters of the retinal vessels (1) , and the thickness of the retinal neural fibre layer (2) . Within the framework of the KidSki project investigating the effect of altitude (equivalent to the altitude of high altitude ski resorts in the Alps) on functional traits important to ensure safe skiing, we examined the effect of hypoxia on the diameter of the retinal arterioles and venules.
METHODS: Adults (N=13; Age= 40 ± 4yrs) and prepubertal children (N=13; Age= 8 ± 2yrs) participated in the KidSki project. They were confined to the Olympic Sport Centre Planica (Rateče, Slovenia) for 48 hrs, of which the first 24 hrs was spent in normoxia (altitude of facility was 940m), and the second day at a simulated altitude of 3000m (normobaric hypoxia). Central retinal arteriolar (CRAE) and venular (CRVE) equivalents were measured in both eyes at the same time of day during both the normoxic and hypoxic exposures, with a Canon digital nonmydriatic camera (45°, 6.3 megapixel). Retinal scans were analysed with IVAN software.
RESULTS: During the normoxic and hypoxic exposures the inspired partial pressure of oxygen (PIO2) was 134 ± 0.4 mmHg and 105 ± 0.6 mmHg, resulting in capillary oxygen saturations of 97 ± 1% and 91 ± 2%, respectively. There was no difference between the two groups. Retinal scans were included, if the diameter of at least 6 vessels could be determined. As a consequence, the retinal scans of 11 adults (4 females, 7 males) and 9 children (4 females, 5 males) were included in the analysis. Both groups exhibited a statistically significant increase in CRAE, but not in CRVE, during exposure to hypoxia.
CONCLUSION: At a simulated altitude of 3000m we observed an increase in CRAE, but not in CRVE, in both adults and children. This confirms our previous finding of an increase in CRAE at a simulated altitude of 4000m. The observation of no change in the CRVE at 3000m is contrary to our earlier findings of a hypoxia-induced increase in CRVE at 4000. There was no difference in the hypoxia-induced increase in CRAE between adults and children. Dilatation of the retinal arterioles does not compromise vision, and thus does not impact skiing ability.
Acknowledgements: This study was supported by the Foundation of Sport of the Republic of Slovenia (Project number RR-2015-5228-11659). The authors are indebted to Dr. Nicola Ferrier of the University of Wisconsin-Madison School of Engineering and the Department of Ophthalmology and Visual Sciences for making the IVAN software for measuring the retinal vessel widths, available to us.
(1) Louwijs T., Jaki Mekjavic P., Cox B., Eiken O., Mekjavic I.B., Kounalakis S., De Boever P. (2016). Ophthalmol. Vis. Sci. 57: 4927-4932.
(2) Jaki Mekjavic P., Lenassi E. Eiken O., Mekjavic I.B. (2016). J. Appl. Physiol. 120: 1241-1248.

WHY THE ROUTINE USE OF ELECTROCARDIOGRAM IS NECESSARY IN CARDIAC PRE-PARTICIPATION SCREENING IN YOUNG ATHLETES

STOIAN, I.M., IONESCU, A.M., STOIAN, I.

** PROF. C.C. ILIESCU EMERGENCY CARDIOVASCULAR DISEASES INSTITUTE, BUCHAREST, ROMANIA ** NATIONAL INSTITUTE OF SPORTS MEDICINE, BUCHAREST, ROMANIA*

INTRODUCTION: The cardiac pre-participation screening (PPS) in young athletes, limited to the clinical examination (CE; personal / family history; physical exam) could skip over heart diseases with severe complications in the future's athlete, such as heart failure and sudden cardiac death (SCD). In conjunction with CE, the 12 lead electrocardiogram (ECG) in PPS, is a mandatory test to diagnose these heart abnormalities.
METHODS: 2007-2017 Retrospective Study. 1920 athletes (78% M), age 16-29y. Caucasians 95%. Africans 5%. Sports: High III, II classes (rowing, canoeing, athletics, football). PPS in Institute Sports Medicine. Cardiac evaluation in Emergency Institute of Cardiovascular Disease.
All 1920 athletes' cardiac PPS clinical examination (personal/ family history; physical exam) and 12 lead ECG were reviewed according to the actual data and rules. (1,2,3). Between 2007-2017, cardiac complex evaluation (echocardiography, cardiac Cath /coronarography , cardiac CT/ MRI) was indicated in all athletes with abnormal symptoms /heart murmurs, associated with normal / abnormal ECGs.
RESULTS: 1920 athletes: Height 170.71 ± 8.46 cm.Weight 68.86 ± 12.25 kg. BSA 1.79 ± 0.18 m2. BP 105/60 - 143/85 mmHg. HR 42 ±115 bpm.
Gr. I: 1323 (68.9%) - normal athletes (clinical; ECG).
Gr. II: 597 (31.1%) - cardiac abnormalities on clinical exam and/ ECG.
Gr.II (597): 312 (52%) athletes had rare palpitations and normal "classic" ECG; 285 (48%) athletes chest pain, palpitations, presyncope while effort and ECG with: normal findings for athletes' heart - 189 athletes and abnormal ECG for athletes, in 96 cases.

All Gr. II athletes were referred for cardiac evaluation.
Final cardiac diagnosis: normal cardiac status, 436 (73%) athletes. Heart diseases 161 (27 %) athletes: hypertrophic cardiomyopathy 6 (1.05%), abnorm. coronary artery origin. 1 (0.16%); WPW 15 (2.51%), Brugada syndrome 2 (0.3%), left ventricular hypertrophy "Grey zone" 125 (20%), aortic valve stenosis 9 (1.5%), ventricular tachycardia 2 (0.35). Deceased on effort 2 (0.3%).
CONCLUSION: An abnormal ECG - according to the International Criteria for Electrocardiographic Interpretation in Athletes - in low symptoms athletes with normal clinical exams, can diagnose cardiac diseases with potential risk of threatening arrhythmias and SCD during effort. The classic clinical examination, alone, could miss diagnosis of severe heart disease responsible for these tragic events. The 12 lead ECG is a mandatory test in cardiac PPS, the data collected being accordingly interpreted.
References.
1.Jonathan A Drezner, Sanjay Sharma et al. International criteria for electrocardiographic interpretation in athletes. Br J Sports Med 2017, March 18.
2. Antonio Pelliccia et al. Protocoli cardiologici per il giudizio di idoneita allo sport agonistico 2017.
3. IM Asif, WO Roberts, M Fredericso,VF Froelicher. The Cardiovasc PPE for Primary Care and Sports Medicine Physician. Curent Sports Med 2015, May / June vol 14

EFFECTS OF EXPERT VS. DYAD EXTERNAL FOCUS FEEDBACK ON LANDING BIOMECHANICS

YOM, J., LEONARD, K., SIMON, J.E., GROOMS, D.R.
OHIO UNIVERSITY

INTRODUCTION: Anterior cruciate ligament (ACL) injury prevention interventions commonly utilize trained expert clinicians to ensure the quality of movement feedback. However, dyad (peer) may be a more cost and time effective method to deliver feedback. Therefore, our propose of the study was to determine the effects of movement error feedback delivered by an expert vs. dyad on landing biomechanics.
METHODS: Twenty-three healthy collegiate female athletes (13 expert, 19 ± 0.9yr, 1.7 ±0.1m, 68.0 ±7.2kg; 10 dyad, 19.4± 1.1yr, 1.7± 0.1m, 72.2± 11.2kg) were recruited to participate and randomly assigned to the expert or dyad feedback group. An inertia measurement Unit and a force plate were used to capture knee kinematics (200 Hz) and vertical ground reaction force (VGRF, 1,000 Hz). Participants performed three drop vertical jumps at baseline, then one week later for pre-testing and immediately following training for post-testing. For the intervention both groups received external feedback cues using a cone or line to direct focus of attention externally and were instructed to maintain knee alignment during 5 squat jumps as this method has been shown to be superior to internal cueing. Dyad training consisted of a teammate using a checklist to match the expert feedback on movement error detection and correction. The expert group consisted of a trained clinician, who gave feedback to the athletes on errors they made using an external focus of attention. Maximum flexion angles and peak VGRF on the dominant limb were calculated during the landing phase and compared across group and condition with a repeated measures ANCOVA ($p<0.05$) with the covariate baseline performance for each variable.
RESULTS: Expert group exhibited decreased VGRF peak magnitude at the post-intervention compared to dyad group <3.49±0.69 and 3.94±0.70 N·kg-1, $p<0.01$). Post-intervention resulted in increased knee maximum flexion angle compared to pre-intervention (mean difference 5.0±7.1°, $p=0.01$) but no significant difference between groups ($p>0.05$).
CONCLUSION: Both feedback interventions exhibited similar motor learning response with knee maximum flexion angle during post-intervention. However, the expert group uniquely decreased VGRF whereas the dyad group did not. The smaller peak VGRF after expert feedback suggests the potential increased efficacy of the intervention to decrease ACL injury risk during a landing. Longitudinal effects of the expert and dyad training interventions lower extremity biomechanics will need to be substantiated.

LEAN SOFT TISSUE MASS MEASURED BY DXA IS AN EFFECTIVE INDEX FOR ASSESSING CHANGE IN LEG SKELETAL MUSCLE MASS FOLLOWING EXERCISE TRAINING EXERCISE TRAINING

MIDORIKAWA, T.
J.F. OBERLIN UNIVERSITY

INTRODUCTION: It is difficult to precisely and easily estimate the changes in skeletal muscle mass (SMM) following exercise training. The present study aimed to assess whether the change in lean soft tissue mass using dual-energy X-ray absorptiometry (DXA) reflected the change in skeletal muscle mass measured by magnetic resonance imaging (MRI) following exercise training in both leg and trunk regions.
METHODS: Anthropometry, DXA and MRI measures for trunk and leg regions were obtained before and after exercise training for 10 male college Sumo wrestlers. Contiguous magnetic resonance images with 1 cm slice thickness and no-gap were obtained from the first cervical vertebra to the ankle joints as reference data. Skeletal muscle volume was calculated from the summation of the digitized cross-sectional areas. The volume measurements were converted into mass using an assumed skeletal muscle density. Trunk and leg areas, using DXA regional computer-generated lines, were adjusted to coincide with each discrete region using MRI.
RESULTS: Although the change in the DXA-measured lean soft tissue mass for the trunk region was significantly different from that of the MRI-measured skeletal muscle mass (Cohen's $d = -1.3145$, $CCC = 0.26$, $p < 0.01$), the changes were similar in the leg regions (Cohen's $d = 0.07$, $CCC = 0.87$, $p = 0.88$). The exercise training-induced change in lean soft tissue mass significantly correlated with that in skeletal muscle mass, both in the leg ($r = 0.88$, $p < 0.01$) and trunk regions ($r = 0.64$, $p < 0.05$). Bland-Altman analysis did not indicate a bias for the changes in leg lean soft tissue mass and skeletal muscle mass following exercise training.
CONCLUSION: These results suggest that lean soft tissue mass measured by DXA is an effective index for assessing change in leg skeletal muscle mass following exercise training.

MUSCLE ACTIVATION IN DIFFERENT MOVEMENT VARIANTS OF HIP ABDUCTION

LOESCH, C., NITZSCHE, N., ZSCHAEBITZ, D., WEIGERT, M., LIEBERKNECHT, M., SCHULZ, H.
CHEMNITZ UNIVERSITY OF TECHNOLOGY

INTRODUCTION: An important goal of strength training in the rehabilitation is the rebuilding of muscle function after an operation or an injury. The pre- and postoperative strengthening of joint-spanned muscles improve the healing and the execution of daily activity (Fernandes et al. 2017). The wrong execution of exercises innervates other muscles, which are not the focus of the therapy. The aim of this study was to demonstrate the muscle activity during three movement variants of the hip abduction extended (EXT), outside rotated (OR), neutral (N) by surface electromyography (EMG).

METHODS: 10 subjects (27.2 ± 3.7 years) trained on the cable pulley a hip abduction (1 set, 10 repetitions, 60%1RM) with 30 degrees abduction angle. The movement variants (EXT, OR, N) were randomized. Surface EMG-data (Myon aktos) were collected from four muscles (M. rectus femoris, M. tensor fasciae latae, M. glutaeus maximus, M. glutaeus medius). The recorded activity was expressed as a percentage of maximum voluntary contraction (%MVC). For analysis the mean activation was used. Analyses of variance (ANOVA) was conducted for each muscle to identify differences in patterns of muscle activation ($p < 0.05$). For the effect size η^2 was used.
RESULTS: The muscle activation between the three movement variants shows significant differences in M. glutaeus maximus ($p < 0.001$), in M.rectus femoris ($p < 0.001$) and in M. tensor fasciae latae ($p = 0.044$). The M. glutaeus medius shows no significant difference ($p = 0.99$). During hip abduction OR, the M. tensor fasciae latae (40.5 ± 9.1 %MVC) and the M. rectus femoris (40.1 ± 10.9 %MVC) showed the highest activity. For EXT movement variant the highest activity appears for M. glutaeus maximus (28.4 ± 8.8 %MVC) and M. glutaeus medius (38.5 ± 9.6 %MVC).
CONCLUSION: The results show, that different variations of hip abduction create differentiated patterns of muscle activation. For rebuilding of functionality of diseased joints and joint-spanned muscles a purposeful training is necessary. The wrong execution can lead to the habituation of non physiological movement techniques and they reduce the effectiveness of the therapy.

Conventional Print Poster

CP-PM03 Body Composition

BODY COMPOSITION AND PHYSICAL FITNESS PROFILES OF ELITE JAPANESE FEMALE WRESTLERS AROUND PUBERTY AND ADOLESCENCE: A COMPARISON AMONG AGES

ARAKAWA, H., YAMASHITA, D., ARIMITSU, T., KAWANO, T., WATA, T., SHIMIZU, S.

INTERNATIONAL BUDO UNIVERSITY

INTRODUCTION: Physical testing and evaluation are extensively conducted in various competitive sports. To make use of these assessment practically, it is beneficial to find out fitness profiles of elite athletes because they provide for physical factors needed for competitive success. Concerning wrestling, although some studies have examined the fitness profiles of senior and junior elites (Garcia-Pallares et al. 2011; Zi-Hong et al. 2012; Arakawa et al. 2015), no study has ever dealt with successful wrestlers before adolescence. The purpose of this study was to investigate the body composition and physical fitness profiles of elite Japanese female wrestlers around puberty and adolescence and to observe their transitions through developmental stage.
METHODS: This study was based on the Athlete Pathway Development Project (between 2012 and 2016) which was carried out by the Japanese Wrestling Federation (JWF). The elite participants are picked out by the JWF from all over the country on the bases of their competition results. The age categories, according to the UWW, were U-12, U-15, U-17, U-20, and senior, respectively. The wrestlers within the same age category were divided into the light (LW) and the heavy weight (HW) divisions based on each weight class. Body composition was assessed by an electric impedance technique (InBody 3.0, Biospace, Inc). For physical fitness assessments, isometric strengths (grip and back strengths), a sit-up test on inclined bench, a rope-climbing test, a 300m intermittent running test (Chino et al. 2012) were conducted. Two-way ANOVA with post-hoc analysis was carried out with R software (3.3.3).
RESULTS: The two-way ANOVA with post-hoc analysis demonstrated that the percent body fat was significantly lower in the U-12 compared to the other age groups. By contrast, the fat free mass index (FFMI (kg/m2)), which assesses the amount of skeletal muscle standardized by height, significantly increased with advancing age until late adolescence. As for the physical fitness measurements, the isometric back strength significantly increased with advancing age until adulthood. The other fitness parameters significantly improved with advancing age only in puberty and early adolescence.
CONCLUSION: The present results suggest that musculature and muscle strength of successful Japanese female wrestlers continue developing until adulthood, whereas the other physical factors mature at an early stage.

EFFECTS OF CALORIC RESTRICTION ON BODY COMPOSITION AND AEROBIC PERFORMANCE IN ATHLETES

DROBNIC, F.

CAR SANT CUGAT

INTRODUCTION: Introduction: Caloric Restriction (CR) and Intermittent Fasting Diet are good options for weight loss in some individuals and circumstances. The CR consists in intermittent periods of 16-48h of fasting or restriction of 30-60% of the caloric intake, interspersed with days of habitual intake.
Recent studies in humans show the CR beneficial effects in the mechanisms of cellular and molecular adaptation, which suppose a positive effect in pathologies of great morbility, such as diabetes, obesity, cardiovascular diseases, cancer and neurological or degenerative diseases such as Alzheimers or Parkinsons. Among them we can observe a decrease in the basic inflammatory pattern or even structural changes, as well as those observed in the studios with experimental animals subjected to CR. The most common models to achieve a caloric deficit consists in reducing a fixed percentage daily or establishing days of fasting or intermittent severe restriction, where a higher caloric deficit is achieved. Varady and cols (2011) finds both methods effective for weight loss, however, the fact of alternating days of restriction with days of normal intake in the second model, seems to offer certain advantages for athletes. That is less impact on the loss of fat-free mass, less activation of the energy reserve mechanisms and a better adherence to the dietary proposal.
METHODS: Methodology: The study involved eighteen male healthy and physically active subjects with the following physiological characteristics: age 32,0±8,4 y, height 1,78±0,05 m, weight 80,9±7,5 kg, IMC25,6±2,8kg/m2, maximal oxygen consumption (VO2max) 3.832 ± 562mL/min, relative values VO2max/kg 47,6±7,2 mL/kg/min, and maximal speed of 14,6±1,4 (km/h). All subjects followed a CR pattern of 40% daily caloric demands for 6 weeks, during which they maintained their regular physical activity. At the beginning and at the end of the experiment, physiological parameters of energy efficiency (treadmill test at 50-60-70% and anaerobic threshold intensities) and body composition (Dual energy X ray absorptiometry DEXA) was determined, all aimed at identifying changes induced by CR.
RESULTS: Results: The subjects loss in average close to 5kg, distributed as 15% in total fat mass (14% ginoid fat, 22% android fat) and 3 % lean body mass. Significant differences were found on heart rate, VO2max, VO2max/kg, RER (Respiratory exchange ratio) coefficient and lactate, at the submaximal intensities, before and after intervention.

CONCLUSION: Conclusion: The model of weight loss based on intermittent caloric restriction during a month is useful because the weight loss comes from the fat mass, it provides a better adaptation to aerobic performance, without impairing its performance, so it can be considered a good option for weight adjustment in athletes.
References:
Achten J, Jeukendrup AE. Maximal fat oxidation during exercise in trained men. Int J Sports Med 2003; 24(8): 603-8.
Drobnic F, Galobardes A, Til L, Yanguas J, Del Río L, Di Gregorio S, García M, Fernández X. Análisis de la composición corporal mediante DXA en fútbol. Evaluación del sistema y el método. Proceedings 4º Congreso FEMEDE, Santander 2012. En proceso de publicación.
Pons Sala, V, Drobnic Martínez, F, Pons BiescasA. Caloric restriction, an effective, simple and healthy way to lose weight. Nutr. clin. diet. hosp. 2017; 37(4):77-86.
Varady K.A. Intermittent versus dally calorie restriction: which dyer regimen is more for weight loss? Obese Rev. 2011 Jul; 12 (7): 593-601.
Wasserman K y cols. Principles of Exercise Testing and Interpretation: Including Pathophysiology and Clinical Applications. Williams and Wilkins 2011.

ASSOCIATION BETWEEN LOWER EXTREMITY MUSCLE STRENGTH ASYMMETRY AND LOWER EXTREMITY MUSCLE QUALITY ON MOBILITY IN COMMUNITY-DWELLING MIDDLE-AGE AND OLDER ADULTS

LIOU, J.S., CHEN, L.H.

NATIONAL TAIWAN SPORT UNIVERSITY

INTRODUCTION: The loss of lower muscle mass and mobility with age result in decrease of living independency. It might be crucial to mitigate against immobility risk starting from a younger age as preventive care. While past research showed that a greater than 15% of lower extremity muscle strength asymmetry (MSA) between strong and weak legs for older adults would affect walking ability, recent research pointed out that strength-mass adjusted muscle quality (MQ) is another relevant indicator for mobility in older population. Thus, the aim of this study was to investigate the relationship between MSA and MQ on mobility in a pilot sample of the middle-aged and older.
METHODS: Subjects were recruited from community-dwelling residents in Taipei areas. Lower extremity strength tests, including knee extension and knee flexion for both legs were performed using MicroFET2 dynamometer (HOGGAN, USA). Percent difference in MSA (%) was calculated by the formula:|stronger muscle groups - weaker muscle groups|divided by stronger muscle groups ×100%. Lower extremity muscle mass is analyzed by DEXA. MQ (w/kg) was calculated by formula: lower extremity strength / lower extremity muscle mass. Mobility tests were 6-meter walking (normal and fastest gait speed, NGS and FGS) (m/sec) and 8-foot timed up-and-go (TUG) (sec). Partial correlation was conducted controlling for age.
RESULTS: A total of 59 subjects (19 male, 40 female) were recruited for the study (n=59, 66.5±7.2 y/o). Knee extension MSA was negatively correlated with NGS and FGS (r = -.260, p =.049; r = -.287, p =.029); knee extension MQ was positively associated with FGS (r = .322, p =.014) and negatively associated with TUG (r = -.271, p =.040), after controlling for age.
CONCLUSION: Our study found knee extension, both the MSA and MQ, correlated with NGS and FGS, and FGS and TUG, respectively. This relationship was established regardless of age in our sample. This indicate that both MSA and MQ might play important roles in relation to risk of immobility from a relatively young age such as the middle-aged. LaRoche et al. (2017) demonstrated that the normal range for lower extremity MSA is less than 10%, over 15% would affect walking ability. A review to assess changes in mass and strength in the same sample reported a loss of strength 2–5 times faster than loss of mass (Mitchell et al.,2012). Thus, MQ, may be a more consistent risk for disability than is loss of muscle. Clark and Manini (2008) revealed that muscle strength decreases more than muscle mass after 50 years. While it is essential to start immobility prevention to conserve quality of life when advancing age, a change of MA may require attention as a change of muscle size in the middle-aged.
References: LaRoche DP, Villa MR, Bond CW, Cook SB. (2017). Exp Gerontol, 98, 54–61.
Clark BC, Manini TM. (2008). J. Gerontol. Ser A-Biol. Sci. Med., 63(8), 829-834.
Mitchell WK, Atherton PJ, Williams J, Larvin M, Lund JN, Narici M. (2012). Front Physiol, 3, 260.
Contact: 1050615@ntsu.edu.tw

STRENGTH OF THE DOMINANT UPPER AND LOWER EXTREMITIES PREDICTS SKELETAL MUSCLE MASS IRRESPECTIVE OF AGE AND GENDER

LEES, M.J., WILSON, O.J., HIND, K., ISPOGLOU, T.

LEEDS BECKETT UNIVERSITY

INTRODUCTION: Sarcopenia, regardless of cause, is characterised by losses in muscle mass, strength and function. It is a contributing factor to numerous non-communicable diseases, frailty, and increased risk of falling. Screening tools for sarcopenia typically require measurement of handgrip strength, functional performance, and skeletal muscle mass. However, the available tools do not measure strength of the lower extremities. In this study, we sought to determine associations between skeletal muscle mass, strength of the upper and lower extremities, and gait speed in healthy young and older volunteers.
METHODS: Fifty younger (30 males, mean ± SD age = 22.6 ± 5.1 years; 20 females, age = 23.0 ± 5.9 years) and 50 older (24 males, age = 71.0 ± 4.4 years; 26 females, age = 69.0 ± 4.0 years) individuals were recruited at random. Skeletal muscle index (SMI) was derived via dual-energy X-ray absorptiometry. Gait speed, handgrip strength (HGS) and one-repetition maximum (1RM) leg extension strength (dominant and non-dominant) were assessed in addition to muscle quality (MQ), which was determined as the ratio of grip strength to appendicular lean mass of the upper body (Cooper et al., 2014).
RESULTS: One older female and one older male were pre-sarcopenic and sarcopenic, respectively, as per the criteria of the European Working Group on Sarcopenia in Older People. Upper extremity MQ was below established cut-points in 16 young (14 males, 2 females) and 21 older (14 males, 7 females) participants. SMI was positively associated with upper and lower extremity strength in all groups except older men, and with upper extremity MQ in young males. In the older groups only, SMI was positively associated with total-body fat mass. By multiple regression analysis, dominant HGS and dominant leg extension 1RM strength predicted SMI in the complete sample, accounting for 70.3% of the variance (B = 0.469 and 0.421, respectively; P < 0.00001).
CONCLUSION: These findings indicate that greater upper and lower extremity muscle strength predict a more favourable SMI in young and older adults. As muscle mass is the foremost variable in determining sarcopenia, we support the inclusion of lower extremity strength testing as a reliable, low-cost and complementary addition to the assessment of musculoskeletal health with ageing. MQ determination is also recommended since established algorithms may fail to identify individuals with muscle weakness.

CHANGES IN PHYSICAL FITNESS AND BODY ANTHROPOMETRICS OF FEMALE RECRUITS DURING MILITARY SERVICE

SANTTILA, M., PIHLAINEN, K., KOSKI, H., KYRÖLÄINEN, H.

NATIONAL DEFENCE UNIVERSITY

INTRODUCTION: Military training and operations are physically demanding, which necessitates a high level of physical fitness (Rayson et al. 2000). It has been shown that the physical fitness of male conscripts increases during the military service, especially among conscripts with lower aerobic and muscle fitness, and of those who are overweight (Mikkola et al. 2012). However, studies concerning the changes in physical fitness and body composition of female recruits are limited. Therefore, the purpose of the present study was to investigate changes in physical fitness and body anthropometrics of female recruits during Finnish military service between the years of 2005 and 2015.
METHODS: Data was collected from the physical fitness tests conducted at the beginning and at the end of military service. A total of 3875 healthy female recruits (19.9±2.1 yrs.) voluntarily participated in the tests. The mean service time was 326±54 days. Their mean height was 1.66±0.06 m, body mass (BM) 64.8±9.3 kg, body mass index (BMI) 23.3±3.0. Aerobic capacity was indirectly assessed via a 12-minute running test. Further physical fitness tests consisted of push-ups, sit-up and a standing long jump.
RESULTS: The mean height, BM and BMI of female recruits did not change during their military service. Mean distance in 12-min run increased by 3.5% (2188 vs. 2237 m, p≤ 0.001). The mean number of push-ups increased by 15.3% (22 vs. 25 reps/min, p≤0.001), sit-ups by 8.1% (34 vs. 37 reps/min, p≤0.001), and standing long jump by 1.4% (1.76 vs. 1.78 m, p≤0.001). Pearson correlation analysis revealed that the 12-min run distance correlated with standing long jump ($r=0.41$, $p<0.001$) and MFI ($r=0.48$, $p<0.001$). BM and BMI were inversely associated with the 12-min run distance ($r=-0.33$, $p<0.001$ and $r=-0.36$, $p<0.001$), respectively. Correlations were analyzed from absolute values.
CONCLUSION: The present study demonstrated that almost all of the measured physical fitness components of female recruits improved during the voluntary military service. No changes were noticed in body anthropometrics. Compared to respective changes in male conscripts (Mikkola et al. 2012), changes in physical fitness of female conscripts were modest. Thus, adaptations to military training appear to differ between sexes. Therefore, further investigation of the specific physical training programs of female recruits is warranted to optimize their training.
References: Mikkola I, Keinänen-Kiukaanniemi S, Jokelainen J et al. Scand J Prim Health Care. 2012; 30: 95-100. Rayson M, Holliman D, Belyavin A. Ergonomics. 2000; 43: 73-105.

BIOMECHANICAL ANALYSIS OF LOWER EXTREMITY ABOUT THE PATELLOFEMORAL PAIN SYNDROME IN TAIJI ATHLETES

DUAN, Y.

BEIJING RESEARCH INSTITUTE OF SPORT SCIENCE

INTRODUCTION: Analyse the biomechanical characteristics of patients with patellafemoral pain syndrome in Taiji practice.Through the biomechanical testing and inspection,to find out the connection about the pain with muscle strength?joint mobility and movement,prevetion the iujury about the taiji movement and adapt to the development about taiji.It will help athletes get great performance, promote the Taiji exercise routines and popularity for the public.
METHODS: Selection of Beijing sports universitys school of martial arts 24 special athletes.Through the three-dimensional videography and force plate data to collect atheletes step action.And through the isokinetic test and joint angle ruler for taijiquan athletes to check for muscle strength and joint mobility.All of this for analysing lower limb mechanics characteristics about athletes.
RESULTS: 1.Biomechanical aspects: In the end of turn phase, the abduction angle of right hip between experimental group and control group have significant difference ($P < 0.05$). At the end of the feet support, the flexion angle of right knee and the extroversion angle of right knee between experimental group and control group have significant difference ($P < 0.05$).In turn phase, right ankle dorsiflexion have a significant difference ($P < 0.05$). The rest had no significant difference.At the step action,the knee stress of exernal rotation is greater at the angle of 30~35°and the knee stress of adduction is the second at the angle of 30~35°.2.Strength:the peak torque/weight in the experimental group has significant difference about knee extension($P < 0.05$). And flexion/extension in the peak torque between experimental group and control group have significant difference ($P < 0.05$).At the experimental group,the best angle of power in the extension is 55~60°, the best angle of power in the flexion is 55~60°.The fagitue index is no different between experimental group and control group.
CONCLUSION: 1.The angle of knee extrovision about athletes with patellafemoral pain syndrome in the step action is a little big.2.Athletes should increase the angle flexion to decrease the stress.3.For taiji athletes with patellofemoral pain syndrome, the angle of hip adduction and ankle dorsiflexion is smaller.4.the quadriceps femoris both sides and the flexion/extension in the peak torque about athletes with patellafemoral pain syndrome is large gap.

Conventional Print Poster

CP-PM04 Hypoxia, Respiration oxygen delivery

FOUR HOURS OF ACUTE NORMOBARIC HYPOXIA INDUCED THE PROLONGED RISE OF PRO-INFLAMMATORY IL-1 BETA IN YOUNG PHYSICALLY ACTIVE MEN.

GRZYWACZ, T.1, ZIEMANN, E.2, OLEK, R.A.2, FLIS, D.J.2, KUJACH, S.2, CHROBOCZEK, M.2, KACZOR, J.J.2, SZYMCZAK, R.4, MIKULSKI, T.5, ANTOSIEWICZ, J.2, LASKOWSKI, R.2,3

1INSTITUTE OF SPORT - NATIONAL RESEARCH INSTITUTE, WARSAW, 2GDAŃSK UNIVERSITY OF PHYSICAL EDUCATION AND SPORT, 3HIGHER SCHOOL OF SPORTS, 4MEDICAL UNIVERSITY OF GDANSK, 5MOSSAKOWSKI MEDICAL RC

INTRODUCTION: It is known that prolonged hypoxia can trigger many pathophysiological mechanisms and cause inflammatory response in immune and endothelial cells. Many of these mechanisms are directly related to increased levels of pro-inflammatory interleukins like IL-1β, IL-6 or tumor necrosis factor TNFα. The purpose of this study was to determine the influence of exposure to acute normobaric hypoxia on the inflammatory state and to examine whether short-term normobaric hypoxia can induce acute changes in the levels of pro-inflammatory interleukins.

METHODS: Serum concentrations of interleukins (IL-1β, IL-6), TNFα and C-reactive protein (CRP) were determined twice in 16 healthy and physically active men (23±0,5y) at normoxia (N) and after four hours of acute normobaric hypoxia (H) exposure (at simulated altitude 4500m above sea level). Blood samples were taken five times (at rest, immediately after and 1h, 3h, 24h after the normoxic/hypoxic intervention). This was a double-blind study. The GO2 Altitude ERA II Hypoxicator System (BIOMEDTECH AUSTRALIA) was used to create hypoxic conditions. The mean (SD) arterial blood oxygen saturations were 94,8 (2,4)% and 82.4 (3.9)%, heart rate 75 (3) bpm and 85 (3) bpm, during the (N) and (H) exposure, respectively.
RESULTS: We have not found any statistically significant changes in serum concentrations of IL-6, TNFα, or CRP; however, the level of IL-1β shifted noticeably. In the (N) conditions, IL-1β increased from 5,57 (0.3) pg/ml (pre) to 8,47 (0.5) pg/ml (post), 7,34 (0.7) pg/ml (1h post), 8,20 (0.5) pg/ml (3h post) and 4,20 (0,4) pg/ml (24h post). A similar trend was observed in the (H) conditions, where IL-1β increased from 5,01 (0,2) pg/ml (pre), to 5,73 (0,45) pg/ml (post), 10,48 (0.7) pg/ml (1h post), 14,23 (0.5) pg/ml (3h post) and 10,20 (0,4) pg/ml (24h post). DISCUSION: The increase of IL-1β in response to both (N) and (H) conditions was slightly delayed; however, 24h after (H), the level of IL-1β was still two-fold higher than before the intervention and two-fold higher than after the (N) exposure. Other pro-inflammatory cytokines remained unchanged.
CONCLUSION: The rise of IL-1β in response to hypoxic condition might be resulted due to elevated amount of glucose for muscles and other tissue in hypoxic condition. This work was supported by the NRC grant No 2621/B/P01/2011/40, Hartmann G.,(2000) Cytokine, Mar;12(3):246-52. Klausen T. (1997) Eur J Appl Physiol Occup Physiol.76(5):480-2

EFFECT OF ACUTE SWIMMING EXERCISE UNDER NORMOBARIC HYPOXIA ON CARBOHYDRATE AND LIPID METABOLISM RELATED GENE EXPRESSION. A PILOT STUDY.

DOBASHI, S., MIYAKE, K., ANDO, D., KOYAMA, K.

UNIVERSITY OF YAMANASHI

INTRODUCTION: Recently, there is growing evidence that exercise training in chronic or intermittent hypoxia is more efficient to improve carbohydrate and lipid metabolism compared with normoxia (Millet et al., 2016). Moreover, even acute exercise in hypoxia improve insulin resistance in type 2 diabetes (Mackenzie et al., 2010). However, it remains unclear the underlying mechanism that acute hypoxic exercise improve metabolisms. In this study, therefore, we investigated whether an acute swimming exercise under normobaric hypoxia affects lipid and glucose metabolism related gene expression in rat skeletal muscle.
METHODS: Fifteen-week old Wistar male rats (n = 12) were fed a high fat (60 % kcal fat) diet and water ad libitum for 3 weeks, in order to impair insulin sensitivity (Castorena et al. 2015). After three weeks of high fat diet feeding, they were randomly assigned to the following four groups: 1) sedentary in normoxia (NS, n=3); 2) exercise in normoxia (NE, n = 3); 3) sedentary in hypoxia (HS, n = 3); and 4) exercise in hypoxia (HE, n = 3). Exercise groups (NE, HE) carried out two 30-min no-load swimming exercise with a 5-min rest interval in a barrel filled to a depth of 35 cm (Funai et al., 2010), under normoxia (room air: 300 m) and normobaric hypoxia (FiO2 = 0.145). Blood was collected from exercised animals at 3 h post exercise concomitantly with blood collection from time-matched sedentary controls to measure serum glucose and insulin, thereby homeostatic model assessment of insulin resistance (HOMA-IR) was calculated using them. Rats were then anesthetized, and epitrochlearis muscles were isolated from the rats. Furthermore, mRNA expression of PGC-1α, GLUT4, PPAR-δ, and PDK4 in epitrochlearis muscle were determined by real-time quantitative PCR.
RESULTS: HOMA-IR tended to decrease by two 30-min swimming exercise with a 5-min rest, while no significant effect of hypoxic exposure were observed. Although PDK4 mRNA expression was increased in NE compared with NS, HS did not affect the expression. However, mRNA expression of PGC-1α, GLUT4, and PPAR-δ in epitrochlearis muscle were significantly increased HE compared with NE and HS ($p < 0.05$, respectively).
CONCLUSION: Acute hypoxic stimulus might facilitate single bout of exercise-induced metabolism-related gene expression. These findings indicate that even acute hypoxic exercise seems to be useful for therapeutic strategy.
REFERRENCES:
1) Millet et al. (2016) Front Physiol 7:224.
2) Mackenzie et al. (2011) Diabetes Metab Res Rev 27: 94-101.
3) Castorena et al. (2015) Appl Physiol Nutr Metab 40: 1-12.
4) Funai et al. (2010) Am J Physiol Endocrinol Metab 298: E999-E1010.

CARDIOPULMONARY RESPONSES AND ENERGY AND/OR GLUCOSE METABOLISMS DURING INCREMENTAL EXERCISE IN ACUTE LOW- AND MODERATE - HYPOXIA

UCHIMARU, J.

SENDAI UNIVERSITY

INTRODUCTION: Peak oxygen uptake and/or exercise performance will be reduced with the decreasing oxygen concentration compared with normoxia. Also, energy metabolism mechanisms during exercise under hypoxia have been proposed. That is, previous studies suggested that hypoxia stimulate energy expenditure and glucose metabolisms. However, the mechanisms underlying the energy and glucose metabolisms effect of different hypoxia were not fully understood. Our study focuses on the effect of acute low- and moderate - hypoxia on cardiopulmonary responses, energy expenditure and glucose oxidation during exercise.
METHODS: Seven healthy male subject performed incremental maximal exercise test (15W/min step) under normoxia (NORM: 20.9 FIO2), acute low - hypoxia (Low-HYPO: 17.5% FIO2) and acute moderate - hypoxia (Mod-HYPO: 14.5% FIO2) conditions. The order of each condition was randomized and trials were spaced by 5 days. We measured ventilation (VE), oxygen uptake (VO2), heart rate (HR), oxygen saturation (SpO2) and blood lactate concentration (BLa) on incremental exercise at each different oxygen environments. Energy expenditure rate (EER) and glucose oxidation rate (GOR) and GOR/EER ratio were calculated by the formula of Bursztein et al. Continuous data of EER and GOR were collapsed to analyze specific time points of interest, corresponding to 60W, 120W, 180W, and maximal work load under three conditions. Repeated-measures ANOVA were performed across treatments.
RESULTS: As expected, VO2 peak reduced with the decreasing oxygen concentration compared with normoxia (Norm; 43.8±4.0ml/kg/min, Low-HYPO; 39.3±5.4ml/kg/min , Mod-HYPO; 37.9±4.2ml/kg/min, $P < 0.05$). VE and HR under submaximal exercise also tended to be higher at Mod-HYPO than Norm and Low-HYPO conditions ($P < 0.05$). SpO2 at rest and during exercise was significantly lower in order of Norm, Low-HYPO and Mod-HYPO ($p<0.05$). EER was progressively increased during exercise at three conditions. During Mod-HYPO, GOR (from 0.639±0.222 to 3.441±0.630 mg/min/m2) as work rate from 60W to 180W were significantly higher than that of Norm (from 0.352±0.103 to 2.729±0.395 mg/min/m2, $P < 0.05$).

CONCLUSION: Acute low - and moderate - hypoxia would be enhanced GOR during exercise, although there was no significant difference in EER between low – and moderate – hypoxia, although there were differences in physiological response such as oxygen saturation and VO2 peak. Further research is needed to clarify these mechanisms.
References: Katayama. K., K. Goto., K. Ishida., and F. Ogita. (2010) Metabolism. 59: 959-966.
Roberts, A.C., J.T. Reeves., G. E. Buttterfield., R.S.Maxeo., J.R. Sutton., E.E.Wolfel. and G.A. Brooks. (1985) J. Appl. Physiol. 80: 605-615

ACUTE PSYCHO-PHYSIOLOGICAL RESPONSES TO INTERMITTENT HYPOXIC EXPOSURE IN OBESE INDIVIDUALS: EFFECT OF CYCLICAL MANIPULATION OF VARYING DURATION

HOBBINS, L., GIRARD, O., GAOUA, N., HUNTER, S.
LONDON SOUTH BANK UNIVERSITY

INTRODUCTION: Intermittent hypoxic exposure (IHE) is a promising, therapeutic intervention for obese populations (Verges et al., 2015). Predominantly found in animal models, short, frequent IHE cycles could be more physiologically and metabolically beneficial compared to longer, less frequent cycles (Navarette-Opazo & Mitchell, 2014). No such direct comparison of cyclical manipulation of varying duration exists in humans, while psychological consequences of IHE are currently undetermined. The aim of this study was to investigate the acute psycho-physiological responses to cyclical manipulation of IHE in obese humans.
METHODS: 5 obese (BMI = 33.1 kg/m2) participants completed 3 IHE interventions, each separated by 7 days. Each intervention included cycles of normobaric hypoxia (FiO2 = 12.0%) and normoxia (FiO2 = 20.9%), over a 60 min period at frequencies of 2:2 min x15, 3:3 min x10 and 6:6 min x5. A control condition was also completed (60 min in normoxia). Peripheral oxygen saturation (%) was monitored throughout. Energy expenditure (kcal/min) and changes in mood (feelings scale; Hardy & Rejeski, 1989) were evaluated in normoxia at six repeated time points (T0-T5; data normalised to baseline) corresponding to 0, 20, 40, 60, 80 and 100% of trial duration.
RESULTS: Compared to control (98.7%), peripheral oxygen saturation during hypoxia was lower ($p = 0.04$) in 2:2 (95.2%) and 3:3 (92.3%) conditions (no difference between each), and further reduced in 6:6 (89.9%; $p = 0.04$). Energy expenditure increased compared to baseline throughout each intervention (2:2: T1 = +32.5%, T3 = +3.9% and T5 = +14.0%; 3:3: T1 = +106.1%, T3 = +48.0% & T5 = +105.9%; 6:6: T1 = +140.8%, T3 = +121.6% and T5 = +181.3%; $p < 0.08$), with no change in the control condition. Energy expenditure was greater in 6:6 vs. 3:3 (+83.9%; $p = 0.04$) at T4 and vs. 2:2 (+167.3%; $p = 0.08$) at T5. In the 6:6 cycle, mood was negatively affected at T3 (-26.7%) vs. 2:2, at T4 (-28.7%) vs. 3:3, and at T5 (-33.0% and -33.7%) vs. 2:2 and 3:3 conditions, respectively ($p = 0.07$).
CONCLUSION: Longer and less frequent cycles led to a more enduring effect on energy expenditure. Mood was negatively affected during longer and less frequent compared to shorter and more frequent cycles. Taken as a whole, IHE (independent of cycle duration) increases energy expenditure; longer and less frequent cycles maximise energy expenditure, but are less enjoyable compared to shorter and more frequent cycles.

INTERMITTENT HYPOBARIC HYPOXIA IMPROVES CAPILLARIZATION AND RESTORES MUSCLE FUNCTIONAL FORCE AFTER INDUCED MUSCLE INJURY

SANTOCILDES, G., CABRERA-AGUILERA, I., LARA, S., RIZO-ROCA, D., PAGÈS, T., VISCOR, G., TORRELLA, J.R.
UNIVERSITAT DE BARCELONA

INTRODUCTION: A wide variety of stimuli can induce adaptive responses in skeletal muscle due to their high plasticity. Among these, hypoxia has demonstrated to improve muscle morphofunctionality and microvasculature. The purpose of the present study was to explore whether a protocol of intermittent hypobaric hypoxia (IHH) can modulate the process of muscle repair from a histological (capillarization, types and size of muscle fibres) as well as from a functional point of view (in situ force tests).
METHODS: After inducing injury in the rat gastrocnemius, two groups of animals (n=6) were considered: HYPO, submitted to a protocol of IHH for 21 days (4,500 m); and CTRL, maintained at normoxic conditions. Histological slides were stained for demonstrating the oxidative and contractile properties of the fibres, classified as slow oxidative (SO), fast oxidative glycolytic (FOG), fast intermediate glycolytic (FIG) and fast glycolytic (FG). Capillary density (CD), fibre capillarization (CCA) and fibre cross-sectional area (FCSA) were measured after ATPase staining. Force properties of contralateral injured and healthy gastrocnemius were registered by electrical stimulation of sciatic nerve. Peak (PF in mN/g) and tetanic force (TF in mN/g), contraction (CT) and half relaxation times (HRT), and low frequency (30 Hz) fatigue parameters were measured.
RESULTS: Animals exposed to IHH evidenced significant higher capillarization indices, a FCSA reduction of aerobic fibres, and a non-significant FCSA increase of anaerobic fibres. A significant shift from SO fibres to FOG fibres was also observed. Injured leg from the CTRL group registered significant lower values than the healthy leg in PF (37±9 vs 44±5, p=0.048), TF (110±40 vs 148±22, p=0.016), and showed lower resistance to fatigue. No alterations were registered neither for CT nor HRT in any group. The IHH protocol resulted in a complete functional restoration in force performance of the injured leg (PF: 45±9, TF: 166±17) as compared to its contralateral healthy leg (PF: 45±5, TF: 162±30), and in resistance to fatigue at low frequency.
CONCLUSION: The results indicate that IHH improved the oxygen, growth factors and nutrients delivery to muscle fibres by reducing diffusion distances in aerobic fibres and inducing angiogenesis in the damaged tissue. All these events accelerated the muscle repair, leading to the functional recovery of the force properties and restoring the fatigue characteristics of the injured muscle after 21 days of IHH treatment. IHH exposure could be a useful non-pharmacological therapy for several muscle-related conditions, especially promising in the sports medicine field.

VO2MAX, POWER OUTPUT AND HEMATOLOGIC CHARACTERISTICS OF MALE JUNIOR ROAD CYCLISTS LIVING AND TRAINING IN HIGH ALTITUDE

GARZON, M.1, GUERRERO, C.2, CHAVEZ, J.2, SANDOVAL, W.2, COMTOIS, A.E.1
UNIVERSITÉ DU QUEBÉC À MONTRÉAL

INTRODUCTION: There are relatively few studies to identify the key physiological variables associated with male junior road cyclist. In addition, identifying and developing young individuals who might excel in sport in the future has been the preoccupation of national governing bodies, federations and coaches. The purpose of this study was to analyze some physiological characteristics of riders living and training in high altitude (2480±574 m) aged between 15 and 18 years old, considering that only a minority of youngsters showing signs of expert sporting potential, attain international sporting excellence.

METHODS: The study involved initially 350 riders that participated in a selection process to integrate a semi-professional team. An examination of collected longitudinal data, initially consisted of bicycle skill testing followed by road tests on flat and inclined terrain. In the last selection stage, twenty five riders (Pre-junior (n=10) 15-16 years; HR rest: 57±7; HRmax: 196±4; height: 1.68±0.06 m; weigh: 52.7±5.3 kg; BMI: 18.7±1.3) and Junior (n=15) 17-18 years; HR rest: 53±6; HRmax: 197±8; height: 1.70±0.06 m; weight: 57.5±3.2 kg; BMI: 19.7±1.5) performed maximal incremental exercise tests while pedaling at 90 rpm on a Wahoo Kickr Power Trainer ergometer (KICKR: Wahoo Fitness, Atlanta, GA) that has been used in other studies and shows reliability for power outputs (PO) of 100-600W at 80-100rev.min-1. Initial PO was set at 100 W and increased by 50 W every three minutes until exhaustion.
RESULTS: All test data are presented as means with standard deviations. Comparative VO2max and Peak power output (PPO) between 15-16 years and 17-18 years are 72.5±3.3 vs 73.7±4.6 ml.kg-1.min-1 and 296±29 vs 333±28 Watts, respectively. Relative PPO (W/kg body weight) for Pre junior vs Junior riders was 5.7±0.2 vs 5.8±0.4 W/Kg that is similar to those reported in literature for elite cyclist. Blood analysis was performed on 21 of 25 cyclists for hemoglobin (Hb) 16.5 ±0.8 vs 16.2±0.8 and hematocrit (Ht) 48.4±1.7 vs 47.8 ± 1.8 for Pre junior vs Junior cyclists respectively. In addition, a discriminant analysis using HR, PPO and 15 km time trials, permitted to classify accordingly 83% of the cyclists, where 4 of 13 junior cyclists were classified as Pre-junior and 0 of 11 Pre-junior cyclists classified in Junior.
CONCLUSION: Our findings indicate that riders, living and training in altitude at a young age, have a specific athletic profile (VO2max & PPO) advantageous for road performance. In fact, at the age of evaluation (15-18 years), just before entering the U23 category and competing at international level, male riders showed physiological values normalized to body mass comparable to those reported in literature for elite cyclist, i.e., a VO2max>70, and a PPO for well-trained cyclists between 5-6 W/kg. In particular these results, belonging to a selected group of U18 high level athletes, can be taken as reference values for team selection in youth road cycling.

EFFECTS OF MODERATE-INTENSITY ENDURANCE AND HIGH-INTENSITY INTERVAL TRAINING UNDER HYPOXIC CONDITIONS ON METABOLIC RISK MARKERS

OGITA, F.1, YOTANI, K.1, TAMAKI, H.2

1: NATIONAL INSTITUTE OF FITNESS AND SPORTS, 2: NIIGATA UNIVERSITY OF HEALTH AND WELFARE

INTRODUCTION: We have reported that moderate-intensity endurance training (MIET) under hypoxic conditions improves more effectively risk markers of metabolic syndrome for the last decade (Ogita 2013, Ogita 2017). Several recent studies have also demonstrated that high-intensity interval training (HIIT) brings similar results for metabolic syndrome patients. Taken together, we hypothesized that HIIT under hypoxic conditions would bring more effectively beneficial effects on metabolic risk markers. Therefore, the present study examined the effects of HIIT under hypoxic conditions on metabolic risk markers, comparing with those of MIET.
METHODS: Sixteen healthy male subjects (22±1 yrs) who were matched for baseline measurements were randomized into two group, a MIET group (n=8) and a HIIT group (n=8). The MIET group had a 30-min endurance exercise at the intensity of 50%VO2max, and the HIIT group had six 10s-bout at the intensity of ~220%VO2max with 10s rest between each bout and performed it twice a day. Both groups had the training under hypobaric hypoxic conditions corresponding to 2500m above sea level 5 days/week, for 2 weeks. Before and after the training, body mass, %body fat, and preperitoneal fat thickness were measured. Also, 3-h oral glucose tolerance test (OGTT) was conducted.
RESULTS: After the training, in MIET group, significant decreases were observed in body mass. %body fat, and preperitoneal fat thickness ($P<0.05$). Furthermore, insulin sensitivity was also improved, showing a significant decrease in the area under the curve of both glucose and insulin concentration during OGTT ($P<0.05$). On the other hand, all measured values in HIIT group remained unchanged except for a significant decrease in preperitoneal fat thickness ($P<0.05$).
CONCLUSION: Our results demonstrated that HIIT under hypoxic conditions used in this study does not necessarily bring evident improvements on metabolic risk markers, compared with the results obtained from MIET, which did not our hypothesis. Further studies are required in order to clarify the effects of HIIT under hypoxic conditions on metabolic risk markers.
Reference
Ogita,F. (2013) Effects of intermittent hypobaric hypoxic exercise on cardiovascular adaptations. J.Phys.Fitness Sports Med. 2:341-345.
Ogita,F. (2017) Beneficial effects of hypoxic exercise on cardiovascular and metabolic risk markers. Adapt.Med.9:114-118.
Acknowledgement
This study was supported by Grant-in-Aid for Scientific Research (B), KAKENHI, from the Japan Society for the Promotion of the Science (Grant No. 16H03234)
Contact; ogita@nifs-k.ac.jp

THE EFFECT OF RESPIRATORY CONDITION IN DIFFERENT EXERCISE TRAINING ENVIRONMENTS

IMAI, T.1, TAKADA, Y.2, WATANABE, K.2

1. AICHI INSTITUTE OF TECHNOLOGY, 2. UNIVERSITY OF TSUKUBA, FACULTY OF HEALTH SPORTS AND SCIENCES

INTRODUCTION: Exercise-induced asthma (EIA) is reported to be highly prevalent in endurance trained athletes. During training, athletes spend many hours per week training in cold, dry, or chlorinated environments. These training conditions could produce different persistent inflammatory and epithelial damage patterns, inducing EIA. However, the mechanism and characteristics of respiratory damage in each environment are unclear. We hypothesized that respiratory conditions were different in the following environments: water (Swimmer; SW), outdoors (American Football; AF), and indoors (judoists: JU).
PURPOSE: To compare respiratory conditions in SW, AF and JU, we examined respiratory inflammation, pulmonary function, and respiratory impedance in athletes practicing in all three environments.
METHODS: A total of 113 subjects (SW 29, AF 38, and JU 46) participated in this study. The fraction of exhaled nitric oxide (FeNO) was measured using a portable NIOX MINO. FeNO＞25 ppb was determined as indicating eosinophilic airway inflammation. Forced vital capacity (FVC), forced expiratory volume 1.0 (FEV1.0), FEV1.0/FVC, and peak expiratory flow （PEF） were determined using a spirometer. Then, we measured whole-breath respiratory system resistance (Rrs) and reactance (Xrs) using a forced oscillation technique device (FOT).
RESULTS: The FeNO was 20.2±14.1, 24.7±20.2, and 28.7±21.4 ppb in SW, JU, and AF, respectively. There were no significant differences in FeNO among the SW, JU, and AF groups. Furthermore, we counted the member of subjects with FeNO>25 ppb in each athletic type. The airway inflammation rate was not significantly different among SW, AF, and JU. FVC, %FVC, FEV1.0, %FEV1.0 PEF, and %PEF were significantly different among the SW, AF, and JU groups. Respiratory parameters (excluding PEF and %PEF in SW) were significantly higher in SW.

The respiratory resistance index, R20 was significantly higher in AF than in SW and JU. Respiratory reactance, X5 and Fres, was significantly higher in JU than in SW and AF.
DISCUSSION:
Airway inflammation rates were not significantly different among athletic events. However, there were significant differences in respiratory function, respiratory resistance, and respiratory impedance among the groups. Spirometry parameters except PEF and %PEF were higher in SW than in AF and JU. This result is consistent with that of a prior study. Spirometry is the golden standard for determining pulmonary function, but the test requires an effort-dependent forced maneuver from subjects. This test result also included respiratory muscle strength and chest wall elasticity. On the other hand, FOT methods were measured in resting breathing. FOT may reflect the difference of respiratory condition in the rest position among SW, AF, and JU.
CONCLUSION: We suggest that the differences in respiratory condition among SW, AF, and JU may be indicated via respiratory resistance and impedance.

RELATIONSHIP BETWEEN OXYGEN UPTAKE KINETICS AND THE BODY MASS INDEX AT MODERATE INTENSITY

OPAZO, E., ACEITUNO, H., CANO-CAPPELLACCI, M.

UNIVERSIDAD DE CHILE

INTRODUCTION: The oxygen uptake kinetics have been studied extensively in the heavy and severe intensity domains of exercise, but little is explore about this response in the moderate domain. In the moderate domain of intensity, the behavior of the oxygen uptake at a constant load could be described by a monoexponential equation of which the tau parameter is obtained. Tau is the time until the 63% of the maximum amplitude of the oxygen uptake is achieved at a constant load and has been reported its correlation with the maximal oxygen uptake in healthy. It is not clear if, in other conditions like obesity, the tau is increased due a decrease in the physical fitness concerning cardiorespiratory capacity or nutritional status. The aim of this study is to determine the relationship between body mass index and oxygen uptake kinetics at the moderate intensity domain of exercise.
METHODS: 45 volunteers (17 normal weight (NW), 9 overweight (OW) and 19 obese (OB)) were evaluated in an exercise test in cyclo ergometer with two phases. The first 6 minutes at a constant load of 0,8w/Kg of body mass and then an incremental phase of steps of 15w/min until exhaustion. The volunteers were measured continuously with a gas analyzer breath by breath (Metamax R23b, Cortex, Germany) and a heart rate monitor band (Polar H7, Polar Electro, Finland). The VO2 kinetics were analyzed according to Koga (Koga et al., 2001) for adjusting the data to a monoexponential equation with a software (Prism7, USA). From the analysis of the exercise test, the kinetic response of oxygen at the beginning of the exercise (tau) was obtained, the final power output in watts (PO) and the maximum oxygen consumption (VO2peak) was registered at the end of the exercise. The experimental procedure was approved by the Ethics committee of the Faculty of Medicine of the Universidad de Chile. The data were analyzed with one-way ANOVA with the Tukey multicomparison test for the differences and Pearson test for correlation.
RESULTS: Two volunteers were excluded from the analysis because cannot make a constant VO2 response for the load. The peak VO2/Kg values were different between NW/OB, OW/OB ($p<0,001$) and NW/OW ($p<0,05$). There are differences in POmax NW/OB, but no in NW/OB and OW/O. In POmax/kg were differences ($p<0,001$) for NW/OB, OW/Ob, but no for NW/OW ($p=0,2730$). The correlation between tau and VO2peak/Kg were $r=-0,77$ ($p<0,001$). Tau correlated with POmax/Kg with an $r=-0,79$ ($p<0,001$). BMI have an $r=0,70$ ($p< 0,001$) with tau and if the same data were fitted to a segmental linear regression the grade of correlation increased to $r =0,79$ ($p< 0,001$) with a inflection point at tau = 36,5s and BMI= 23,6.
CONCLUSION: The main finding of this study is that we can correlate tau with nutritional status in two phases: (1) in low BMI there is no relationship with tau and (2) above 23,6 Kg/m*m of BMI the tau has a proportional increase.
The parameters of physical fitness VO2peak/Kg, POmax/Kg, tau, and BMI have a good correlation between them.

OXYGEN PULSE AND MYOCARDIAL CONTRACTILITY: IS THERE CORRELATION?

MONTENEGRO, C.G.P.1,2, DOURADO, L.O.C.2, JORDÃO, C.P.2, ASSUMPÇÃO, C.R.A.2, GOWDAK, L.H.W.2, VIEIRA, M.L.C.2, CESAR, L.A.M.2, DE MATOS, L.N.J.1,2

1 HOSPITAL ISRAELITA ALBERT EINSTEIN, 2 INSTITUTO DO CORAÇÃO FMUSP

INTRODUCTION: Oxygen pulse curve's early plateau and/or decline is considered a diagnostic variable for myocardial ischemia detection by cardiopulmonary exercise test (CET). However, it is an indirect measure. Stress exercise echocardiogram (SEE) is a gold standard exam to analyze ventricular contractility and ischemia. Few studies have evaluated the relation between oxygen pulse curve and contractile alterations by SEE. The aim is to verify if there is correlation between the heart rate at the moment oxygen pulse curve's plateau and/or decline detected by CET with the heart rate when ventricular contractile changes occurred SEE in refractory angina patients.
METHODS: The sample consisted of 24 patients with refractory angina who underwent optimal clinical treatment, with documented myocardial ischemia using an imaging method (stress echocardiography), followed up at the Chronic Coronary Artery Disease Unit of the Heart Institute of the University of São Paulo (São Paulo, Brazil). The mean age was 64 years (± 7.9 years, 46% women and 54% men). Treadmill CET (ramp protocol) and bicycle stress echocardiogram (stepped protocol; all exams were realized by same observer) were performed in two different days. Correlation results were analyzed by Pearson correlation test.
RESULTS: Oxygen pulse curve's early plateau and/or decline were detected in 22 patients (92%) and all those demonstrated contractile changes by SEE. Significant correlation between the heart rate of oxygen pulse alterations and the heart rate where the changes in SEE started ($R=0.65$, $p=0.001$) was observed.
CONCLUSION: The oxygen pulse curve, although it is an indirect measure, is correlated with the contractile alterations detected by stress exercise echocardiogram even when tests have been done in different days.

Conventional Print Poster

CP-PM05 Vascular

BLOOD FLOW RESTRICTION AT RESTING PERIOD OF RESISTANCE TRAINING DOWN REGULATES MIR206 AND INDUCE PAX7 IN HUMAN SKELETAL MUSCLE

TORMA, F.1, OSVÁTH, P.1, HISASHI, N.2, RADAK, Z.1

1 UNIVERSITY OF PHYSICAL EDUCATION, 2 JUNTENDO UNIVERSITY

INTRODUCTION: Blood flow restriction (BFR) with low intensity resistance training has been shown to results hypertrophy of skeletal muscle. In our studdy we tested the hypothesis that BFR at the resting periods of acute high intensity resistance training (70% of 1RM, 7 sets with 10 repetitions) enhance the effects resistance training.
METHODS: Seven healthy young man (24.5±4.69 years old; body height 182.9±7.7cm; body mass 78.8±6.7kg) performed squatting exercise and between sets BFR was applied on one leg and the other served as a control. BFR resulted complete block of blood flow, and Doppler data showed the pattern of blood flow recovery changed significantly between the first and last BRF. Five myoMiRs were measured along with metabolically important mRNA species, from the biopsy samples, which were taken 2 hrs after acute training.
RESULTS: miR-206 an obligate skeletal muscle specific microRNA showed significant decrease in the BRF leg compared to control. The mRNA levels of RAC-beta serine/threonine-protein kinase Akt 2 (Akt2), nuclear respiratory factors 1 (NRF1), vascular endothelial growth factor (VEGF), Ku70 genes ($p<0.05$) and paired box 7 (Pax7) ($p<0.01$) increased in BRF leg compared to control. The protein levels of Pax7, NRF1 and peroxisome proliferator-activated receptor gamma coactivator 1-alpha (PGC-1a) were not different between BRF and control leg.
CONCLUSION: Data revealed that BRF at the resting period of high intensity resistance training could lead to angiogenesis, mitochondrial biogenesis, muscle hypertrophy and repair. However, it also can cause DNA damage, judged from the increase in mRNA level of Ku70. Resistance training with high intensity activates fast twitch fibers and the BRF at the resting periods would enhance the effects by enhanced effects partly by the involvement of miR-206.

EFFECTS OF RESISTANCE TRAINING WITH AND WITHOUT BLOOD FLOW RESTRICTION ON HEMODYNAMIC AND NEUROMUSCULAR PARAMETERS IN THE ELDERLY

RUARO, M.F.1, FRANÇA, E.2, DE SÁ, C.A.3, CAPERUTO, E.C.2

INSTITUTO FEDERAL DO PARANÁ - IFPR

INTRODUCTION: Resistance training (RT) combined with blood flow restriction (BFR) has emerged as a great alternative to improve strength and increase muscle mass in the elderly, promoting improvement in individuals with cardiovascular and orthopedic diseases, as well as other metabolic benefits. However, the hemodynamic changes caused by RT with chronic BFR performed in the upper limbs in hypertensive elderly women, should still be better investigated.
The maintenance of quality of life in people over 60 years depends largely on the maintenance or re-establishment of autonomy, as well as the reduction of risk factors for degenerative diseases. RT has been shown to be efficient to promote positive adaptations regarding strength and functional capacity in the elderly. In this sense, the loss of strength and muscle mass predisposes the elderly to a functional limitation, which is a predisposing factor for many of the pathological processes associated with increased morbidity and mortality. Therefore, the objective of the study was to analyze the effects of RT with and without BFR in the elderly in different performance variables.
METHODS: We selected 40 volunteers over 60 years of age to participates on a RT program two times a week, during 14 weeks. The RT consisted of traditional strength exercises in the lower and upper limbs. The training had the initial phase (10 exercises and 1 series with 15 repetitions), intermediate phase (2 sets with 15 repetitions) and advanced phase (3 sets with 15 repetitions) in 1RM. The sample was randomized into two groups: 1) 20 elderly women were assigned to RT plus BFR group and 2) others 20 elderly women assigned RT group only.
Thus, the final sample consisted of 33 subjects.
RESULTS: Systolic blood pressure (SBP), mean arterial pressure (MAP) and double product (DP) were significantly reduced in both RT plus BFR (15.43, 7.97 and 16.42%, respectively) and RT groups (10.96, 6.89 and 10.40%, respectively). Although no differences were found between groups in the post-test, effect sizes (Cohen's d) analysis showed a greater reduction of these parameters in the RT plus BFR group (SBP = -1.84, MAP = -1.35 and DP= -1 , 47) than in the TR group only (SBP = -1.12, PAM = -0.78 and SD = -0.50). The maximum dynamic force evaluated in the wrist flexion exercise increased significantly ($p <0.05$) from pre to post-test in the TR plus BFR group and was significantly high.
CONCLUSION: It was concluded that twice weekly RT plus BFR was able to promote significant increases in maximal dynamic force at a magnitude greater than conventional force training. These data allow us to postulate that the effects of RT preceded by exercise with BFR, in the manner carried out in this study, are capable of producing effects of greater magnitude on the hemodynamic parameters than the isolated. Further studies will be needed to evidence the mechanisms involved in this type of protocol, however,the results demonstrate the importance of including BFR prior to RT sessions.

THE EFFECT OF POSTURAL POSITION ON ARTERIAL OCCLUSION PRESSURE IN THE LOWER BODY: A METHODOLOGICAL CONSIDERATION FOR BLOOD FLOW RESTRICTION TRAINING.

HANNAH, S., MILLER, S.

ULSTER UNIVERSITY

INTRODUCTION: Low intensity resistance training, with partial blood flow restriction (BFR), has repeatedly shown increases in both muscle size and strength. Despite the growing interest in BFR, there lacks a consensus regarding its methodological application. Perhaps one of the most obvious and overlooked considerations with BFR is postural position. Many reports have demonstrated significant haemodynamic changes with postural position but few BFR studies have considered this. Therefore, it is suggestible that arterial blood flow differs between position when under restriction and that previous studies have large variations in the level of BFR. Fundamental haemodynamics are largely influenced by gravitational forces exerting hydrostatic pressures within blood vessel. We hypothesised that arterial occlusion pressure (AOP) would be significantly higher when seated due to gravitational-induced hydrostatic pressure seen with upright haemodynamics.

METHODS: Twenty participants (15 Male & 5 Female) visited the laboratory for one testing session. Basic anthropometric data were measured including height, mass and thigh circumference. Systolic (SBP) and diastolic (DBP) brachial pressures were measured using an automatic blood pressure cuff.
A 14.5 cm wide cuff (Delfi Medical, Vancouver BC, Canada) was then placed around the most proximal portion of the right leg. Arterial blood flow was measured at the posterior tibial artery using audio and visual signals from a handheld Doppler probe (Esaote MyLab 25cv). The cuff was inflated to 50mmHg for 30 s and then deflated for a 10 s interval to familiarise subjects. The cuff was then inflated to the participants brachial SBP for 30 s and deflated for 10 s. Following these initial inflation periods, pressure was increased by 40 mmHg for 30 s with 10 s deflation period. This was repeated until arterial blood flow was no longer detected from which point pressure was decreased by 10mmHg until arterial flow was present. The AOP was recorded as the last 10mmHg where blood flow was not detected.The above procedures were repeated after 5 min rest period in an upright-seated position.
RESULTS: Seated AOP was significantly higher than when supine ($p < 0.001$, 24±11.8mmHg). Regression analysis revealed thigh circumference and diastolic blood pressure were significant predictors of supine AOP ($p = 0.001$, $r2 = 0.55$), but not seated AOP; height was the only significant predictor of seated AOP ($p = 0.017$, $r2 = 0.277$).
CONCLUSION: In conclusion, AOP was significantly greater when seated with height accounting for 27% of the variance. This suggests that gravity induced-hydrostatic pressure and the height of the hydrostatic column significantly alter the AOP. In future, postural position should be considered when utilising BFR training. Using thigh circumference and diastolic blood pressure, we are able to estimate supine AOP with a 14.5cm cuff, but not seated AOP. Based on our findings, we conclude that postural position significantly effects arterial occlusion press.

THE IMPACT OF REPEATED DISTAL CUFF-INFLATION (VOP) PROTOCOL ON FLOW-MEDIATED DILATATION (FMD)

DAWSON, E.A., GREEN, D.J., THIJSSEN, D.H.J.

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Historically, venous occlusion plethysmography (VOP) was routinely utilised to assess blood flow and endothelial (in)dependent function. The protocol measures blood flow into a limb by determining the increase in the volume if venous outflow is prevented. However, this repeated inflation/deflation of a cuff around the upper arm and wrist may by inherently changing flow and thereby endothelial function; subsequently impacting on later vascular assessments. Therefore the aim of the study was to explore the impact of repeated cuff inflation on ultrasound-derived measure of vascular function (flow-mediated dilatation; FMD).
METHODS: Vascular function was assessed in healthy young men using brachial artery FMD, both before and immediately after a 40-min protocol of 4x5minute VOP. We applied VOP as 10 s occlusion of a cuff around the upper arm inflated to ~50mmHg followed by 10 s rest, which was repeated for 5 minutes followed by 5 min rest. During the VOP protocol, a second cuff was inflated around the wrist to 220mmHg to occlude flow to the hand. This protocol is typically used to examine forearm endothelial function with VOP.
RESULTS: 7 healthy males (26.0±4.9 yr, 70.4±5.1 kg, 172±6 cm) completed the protocol. There was a trend for a significant increase in FMD% ($P=0.07$) from pre to immediately-post the final VOP protocol (4.88±2.14% to 7.90±3.13%). This effect size did not change ($P=0.07$) when statistically correcting for baseline diameter. There was a significant ($P<0.05$) decrease in baseline diameter (3.8±0.4mm to 3.5±0.5mm), a quicker time to peak dilation (56±15 s vs 44±6s for pre and post, respectively) and no difference in the shear rate area under the curve (SRauc). During the VOP there was a decrease in flow from baseline (~65 ml/min to ~30ml/min for each VOP session).
CONCLUSION: Our data suggest that either the repeated low-pressure cuff inflation around the upper arm, or the high-pressure cuff around the wrist during a typical 'VOP' protocol may have a subsequent impact on vascular function. It is possible that the occlusion of blood flow to the hand results in a subsequent hyperaemia upstream once the cuff is released. Alternatively, the low pressure cuff in the upper arm may result in changes in blood flow/shear pattern. These two mechanisms of altered shear may result in episodic perturbation associated upregulation of the nitric oxide pathway. These data suggest that cuff-inflation within a short time period (either VOP or FMD) may have an impact of subsequent measurements.

EFFECTS OF ACUTE CYCLING EXERCISE ON VENOUS VASCULAR RESPONSE IN CONSTANT AND INTERVAL WORKLOADS

IIMURA, Y., SAITO, M., OUE, A.

TOYO UNIVERSITY

INTRODUCTION: Acute exercise improves arterial vascular response and the extent of the exercise-induced effect differs between constant and interval exercise (Tordi et al. 2010). However, it is unclear whether acute exercise influences venous vascular response. In our previous study, interval rather than constant endurance training caused greater venous vascular response; thus, we hypothesized that acute exercise enhances venous vascular response and that the degree of effect of acute exercise would differ between constant and interval workloads. To test our hypothesis, we investigated venous vascular response in the forearm and calf before and after cycling exercise.
METHODS: This study involved 16 young healthy participants (13 men, 3 women) who performed constant cycling exercise (CCE) and interval cycling exercise (ICE). CCE entailed 60% heart rate (HR) reserve for 32 min, and ICE entailed repetition of 40% HR reserve and 80% HR reserve every 2 min for 32 min. Forearm and calf volume during the cuff deflation protocol (Halliwill et al., 1999) was measured by venous occlusion plethysmography before exercise and 10, 30, and 60 min after the end of exercise. Venous compliance (VCPL) was calculated as the numerical derivative of the curve of limb volume plotted against cuff pressure as follows: VCPL = change in limb volume / change in cuff pressure (Freeman et al., 2002). Also, venous capacitance (VC) and maximal venous outflow (MVO) were assessed.
RESULTS: Both CCE and ICE caused no change in VCPL, VC, and MVO in the calf. VCPL in the forearm was also not changed by CCE and ICE. On the other hand, increased VC in the forearm was obtained continuously after ICE, while VC in the forearm increased at 10 min after CCE and then returned to pre-exercise level. ICE induced increased MVO in the forearm at 60 min after exercise, but CCE did not change MVO in the forearm.
CONCLUSION: In this study, acute exercise did not improve VCPL, but interval rather than constant acute exercise caused increases in VC and MVO. This venous vascular response to exercise was observed in only the forearm and not in the calf. One possible reason for these different responses is the difference between the exercising and non-exercising limb. Another possible reason is that the calf has a higher pressure of 65 mmHg due to hydrostatic pressure (Newcomer et al., 2004). In conclusion, the effect of acute exercise on venous vascular response might differ between constant and interval workloads, which might be observed specifically in the non-exercising forearm.
References: Freeman et al., J Appl Physiol, 93: 636-644, (2002)

Halliwill et al., J Appl Physiol, 87: 1555-1563, (1999)
Newcomer et al., J Physiol, 556.3: 1001-1011, (2004)
Tordi et al., Eur J Appl Physiol, 108: 801-809, (2010)
Contact: (Email) s3c101700023@toyo.jp

CARDIORESPIRATORY FITNESS CUTOFF POINT FOR THE DETECTION OF ENDOTHELIAL DYSFUNCTION IN APPARENTLY HEALTHY MALE ADOLESCENTS

SHERIDAN, S., MCCARREN, A., GRAY, C., HARRISON, M., MURPHY, R.M., MOYNA, N.M.

THE UNIVERSITY OF HONG KONG

INTRODUCTION: Impairment of the normal function of the vascular endothelium is termed endothelial dysfunction and represents one of the earliest events in the development of cardiovascular disease (CVD). Endothelial dysfunction has been found in children and adolescents with CVD risk factors including low cardiorespiratory fitness (CRF) (Meyer et al., 2006). Previous research has established health-related CRF cutoff points for children and adolescents based on CVD risk factor profiles (Adegboye et al., 2011). To date, no published studies have identified a CRF cutoff point associated with endothelial dysfunction in youth. The purpose of this study was to determine whether there is a CRF cutoff point associated with endothelial dysfunction in apparently healthy male adolescents.
METHODS: A total of 75 asymptomatic boys (mean age 15.6 ± 0.5 yr.) were randomly selected from a total of 228 boys, who underwent screening for CRF using a 20m multistage shuttle run test. During a separate visit to the laboratory, maximal aerobic capacity (VO2max) was subsequently measured using open circuit spirometry during an incremental treadmill test. Pubertal status was assessed using self-reported tanner stages. High-resolution ultrasonography was used to assess endothelial-dependent dilation (EDD) and endothelial independent dilation (EID) in response to brachial artery flow-mediated dilation (FMD) and glyceryl trinitrate administration respectively. Endothelial dysfunction was defined as a FMD response of < or equal to 8%. CRF cut-off point associated with vascular dysfunction was determined by calculating the VO2max value that gave a probability of < or equal to 50% using the parameter estimates from a logistic regression between FMD response of < or equal to 8% and VO2max.
RESULTS: Mean and standard deviation for body mass index, pubertal status and VO2max were 23.4 ± 5.8 kg/m2, 4.0 ± 0.6 and 52.8 ± 10.2 ml/kg/min respectively. CRF cutoff point of < 44.03 ml/kg/min was associated with endothelial dysfunction in male adolescents (CRF=0.1568,p<0.001 and area under the curve >0.85).
CONCLUSION: A CRF cut off point of < 44.03 ml/kg/min was discriminative to identify endothelial dysfunction in apparently healthy male adolescents. Improving CRF levels among adolescents should be encouraged in the primary prevention of CVD. CRF should be routinely monitored during adolescence to identify those adolescents at risk of early CVD.

TWELVE WEEKS OF COMBINED EXERCISE IMPROVE BRACHIAL-ANKLE PULSE WAVE VELOCITY IN PRE- AND HYPERTENSIVE POSTMENOPAUSAL WOMEN

HWANG, M., JEON, K., LEE, S.

INCHEON NATIONAL UNIVERSITY

INTRODUCTION: Human arterial trees are stiffened with advancing age. Compared to premenopausal women, postmenopausal women present augmented blood pressure and arterial stiffness. Participating in balanced physical activity program composed of both aerobic and resistance exercise is recommended to lower cardiovascular disease risk and to enhance muscle and bone health in postmenopausal women. The purpose of this study was to investigate the effect of 12 weeks of combined exercise on brachial-ankle pulse wave velocity (baPWV) in postmenopausal women with elevated blood pressure.
METHODS: Sixteen pre- and hypertensive postmenopausal women were randomly assigned to exercise (n=8, EXE) and control (n=8, CON) group. EXE group performed a circuit-type combined exercise program for 60 min per day, 3 days a week, for 12 weeks under supervision. baPWV was measured using VP-1000 system (Omron, Kyoto, Japan) to assess arterial stiffness.
RESULTS: baPWV was significantly improved in EXE group (-0.7 m/s; P=0.003), but not in CON group (-0.1 m/s; P=0.5). Weight, body mass index, systolic blood pressure and serum total cholesterol significantly decreased only in EXE group (P<0.03).
CONCLUSION: In conclusion, combined exercise program is an effective intervention to improve arterial stiffness in pre- and hypertensive postmenopausal women.

AMBULATORY BLOOD PRESSURE ADAPTATIONS TO HIGH INTENSITY INTERVAL TRAINING: A RANDOMISED CONTROLLED STUDY.

TAYLOR, K.A., COTTAM, C., WILES, J.D., COLEMAN, D.D., ODRISCOLL, J.M.

CANTERBURY CHRIST CHURCH UNIVERSITY

INTRODUCTION: Increasing research evidence suggests that high intensity interval training (HIIT) is a time efficient exercise intervention to reduce the health implications of physical inactivity. The prevalence of elevated blood pressure (BP), which is associated with an accelerated risk of cardiovascular disease, is increasing globally. HIIT has been shown to improve functional capacity through central and peripheral adaptations and reduce resting BP. However, the effect of HIIT upon ambulatory BP in a cohort of physically inactive participants with elevated BP is unclear.
METHODS: In a randomised controlled trial, forty-one (aged 23 ± 2.7 years) physically inactive males (n=21) and females (n=20) with elevated BP (122 ± 9.8 mmHg), volunteered to participate in a 4-week HIIT intervention or 4-week control period. The training consisted of 3 x 30s maximal effort cycle ergometer sprints at a resistance calculated at 7.5% body mass, interspersed with 2-minute active recovery periods. Resting office BP and ambulatory systolic (sBP) mean (mBP) and diastolic (dBP) BP was recorded pre and post HIIT and control periods.
RESULTS: Following 4-weeks of HIIT, there was a significant reduction in resting office sBP (-7.34 ± 7 mmHg, p<0.05) compared to the control condition. There was no significant change in resting office mBP or dBP for the HIIT or control condition. Ambulatory BP monitoring revealed significant reductions in 24-hour sBP (-4.06 ± 8.08 mmHg, p<0.05), mBP (-2.17 ± 4.04 mmHg, p<0.05) and dBP (-3.43 ± 8.18 mmHg, p<0.05), compared to the control condition. In addition, significant reductions were observed in ambulatory daytime sBP (-2.77 ± 7.89 mmHg, p<0.05) and dBP (-1.04 ± 4.11 mmHg, p<0.05), as well as night time sBP (-5.58 ± 10.1 mmHg, p<0.05) and mBP (-1.56 ± 4.47mmHg, p<0.05) compared to the control condition.

CONCLUSION: A 4-week HIIT programme was associated with clinically significant reductions in ambulatory BP, which may be associated with a reduced risk of cardiovascular disease. This study suggests HIIT is a time effective non-pharmacological intervention for the treatment of elevated BP. Future research is required to ascertain the underlying mechanisms for the BP reductions following HIIT and to explore the implications in clinical populations.

REGULAR UNILATERAL UPPER-LIMB EXERCISE MODULATES DOMINANT ARM PULSE WAVE VELOCITY

LEE, R., KANG, Y., KIM, M., HWANG, M.

INCHEON NATIONAL UNIVERSITY

INTRODUCTION: Physical training is associated with a decrease in arterial stiffness. Previous findings suggest that physical training can improve peripheral artery stiffness. However, it is hard to discover any previous findings to compare arterial stiffness between bilateral upper extremities in young adults participating in unilateral physical activity. Thus, the purpose of this study is to compare peripheral artery stiffness between dominant and non-dominant upper limb according to unilateral physical activity levels.
METHODS: Eight elite-level female badminton players (ELIT), ten club-level female badminton players (CLUB) and eight age-matched sedentary young females (CONT) were recruited for this study. Brachial-radial pulse wave velocity (armPWV) was measured using Doppler Flowmeters (810-B, Parks Medical, Oregon, USA) and was analyzed using both PowerLab data acquisition system and LabChart Pro V8 software (AD Instruments, Australia).
RESULTS: There was significant difference in armPWV of dominant upper limb among three groups ($P<0.001$). Regarding dominant arm-PWV, post-hoc analyses presented that ELIT was significantly lower than CONT (7.1 m/s vs. 11.6 m/s, $P<0.001$), CLUB was significantly lower than CONT (8.6 m/s vs. 11.6 m/s, $P=0.002$), but there was no significant difference between ELIT and CLUB (7.1 m/s vs. 8.6 m/s, $P=0.2$). In ELIT, the difference in armPWV between dominant and non-dominant upper limb was statistically significant ($P=0.03$). However, there was no significant difference in armPWV between dominant and non-dominant upper limb in both CLUB ($P=0.3$) and CONT ($P=0.6$).
CONCLUSION: In conclusion, peripheral artery stiffness of dominant arm is superior to young females participating in regular unilateral physical activity compared to age-matched sedentary counterpart. Differences in peripheral artery stiffness between dominant and non-dominant upper limb exist only in ELIT who participates in very high level of unilateral physical activity.

12 WEEKS OF STEP-BOX AEROBIC EXERCISE ENHANCE CENTRAL ARTERY STIFFNESS IN POSTMENOPAUSAL WOMEN

KANG, Y., LEE, R., HWANG, M.

INCHEON NATIONAL UNIVERSITY

INTRODUCTION: Cardiovascular disease is one of the leading causes of death in advanced countries. Augmented central artery stiffness is a precursor for cardiovascular disease. Postmenopausal women present elevated blood pressure, heart rate, and arterial stiffness at rest compared to premenopausal women. Regular aerobic exercise is beneficial to improve overall cardiovascular health in both pre- and postmenopausal women. Step-box aerobic exercise has reported its effectiveness on calorie expenditure, fat burning, joint flexibility, lower-body strength, and cardiovascular fitness. However, there have been few studies to demonstrate effects of step-box aerobic exercise on arterial stiffness in postmenopausal women, and there exist no studies to focus on central artery stiffness. The purpose of this study is to investigate effect of step-box aerobic training on central artery stiffness in postmenopausal women.
METHODS: Twenty-four postmenopausal women were randomly assigned to step-box training group (SBT; n=13) or control group (CON; n=11). SBT performed step-box aerobic exercise at 60~80% of HRmax, 3 times a week, for 12 weeks. Augmentation index and aortic pulse wave velocity were measured by SphygmoCor Xcel system (AtCor medical, Sydney, Australia).
RESULTS: Augmentation index was significantly improved in SBT (39±3 vs. 34±2, $p=0.03$), but not in CON (33±3 vs. 32±4, $p=0.8$). Aortic pulse wave velocity was not changed in both groups ($p\geq0.2$). Peripheral and central blood pressure values were significantly enhanced in response to 12 weeks of step-box training ($p\leq0.04$).
CONCLUSION: In conclusion, step-box aerobic training is an effective type of exercise to improve central artery stiffness in postmenopausal women.

Conventional Print Poster

CP-PM06 Ageing

PREVENTING FALLS IN ELDERLY PEOPLE – DEVELOPING AND EVALUATING OF A 10-WEEK HEALTH SPORTS PROGRAM FOR A LOCAL PUBLIC ACTIVITY TRAIL

BEHRENS, K., WEIPPERT, M., BEHRENS, M.

UNIVERSITY OF COOPERATIVE EDUCATION

INTRODUCTION: A growing number of cities and communities in GER are installing publicly fitness parks to encourage physical activity also among elderly people. Physical inactivity remains to be a central risk factor for chronic diseases and falls in the elderly. Therefore, increasing physical activity can reduce the risk of falls and additionally improve health-related quality of life. On this background, public outdoor activity trails were designed specifically for elderly (65+) people and set up in the their daily living environment. The authors of this study developed a health sports program based on the national recommendations for fall prevention programs and evaluated its impact on a local sample of elderly people.
METHODS: A randomized controlled trial comparing an intervention group (IG, n = 23) and a control group (CG, n = 19) was conducted with two measurement times (t1 at baseline, t2 after 10 weeks of intervention). The IG was invited to train three a week for 90 minutes on a public fitness park, while the CG did not receive this offer for the 10-week intervention period. All participants were volunteers of the local community with a mean age of 70.2±4.6. For the pre-post comparison the following measurement methods were used: 1-Mile-Walktest (endurance performance), gait analysis to assess dynamic balance under single (ST) and dual task (DT) conditions (OptoGait), health-related quality of life survey (WHOQOL), "Timed up and go" (TUG) to objectify fall risk, d2-R to assess attention and concentration performance, "sit-to-stand" (STS) to objectify lower limb power.
RESULTS: Participants in the IG showed a significant increase in endurance performance (pVO2max: 18.69±8.00ml·min-1·kg-1 vs. 22.90±7.89ml·min-1·kg-1, $p=0.008$) and in dynamic balance (ST-step length: 41.32±3.94cm vs. 42.86±3.90cm, $p=0.023$, ST-walking

speed: 0.84±0.13m/s vs. 0.86±0.12m/s, p=0.015); DT-step length: 39.21±5.13cm vs. 43.09±3.32cm, p=0.014, DT-walking speed: 0.71±0.14m/s vs. 0.87±0.11m/s, p=0.082), while their fall risk decreased significantly (TUG/IG: 7.24±1.22s vs 5.25±0.84s, p=0.007) compared to participants of the CG. The study revealed no significant differences for health-related quality of life between the two study groups.
CONCLUSION: The significant change in fall-relevant parameters for the active IG compared to the CG in this study strongly suggests the developed intervention program to be highly effective in preventing falls in the elderly. Seasonal factors and with that an overall increase in recreational activities such as gardening may have resulted in an intervention unrelated effect on parameters of health-related quality of life, attention and concentration for both IG and CG. Interestingly, on assessment at t2, 12 out of 19 participants from the CG confessed that they had been training on the newly built activity trail independent of the study. Therefore, no phase of absolute inactivity can be assumed for the CG, which in turn makes the positive results of the IG all the more meaningful.

EFFECT OF AGING AND TRIP HISTORY ON TOE CLEARANCE STRATEGY AND REGIONAL NEUROMUSCULAR REGULATION OF THE RECTUS FEMORIS MUSCLE DURING GAIT

WATANABE, K.

CHUKYO UNIVERSITY

INTRODUCTION: It is well known that an abnormality in neuromuscular regulation of the rectus femoris (RF) partly causes pathological gait patterns such as stiff-knee gait. In our previous studies, the RF muscle is regionally regulated during swing phase of gait (Watanabe et al. J Biomech 2014) and this regional regulation is affected by aging (Watanabe et al. J Biomech 2016). The aims of the present study were to test the effect of aging and trip history on toe clearance and spatial distribution of neural activation within the RF muscle and its relationship during gait.
METHODS: Thirteen elderlies and nine young males walked on treadmill at a preferred walking speed for 20min. Lower extremity kinematics on sagittal plane was captured and minimum toe clearance (MTC) during swing phase was calculated. Surface electromyography (EMG) was recorded from proximal to distal regions of the RF muscle with 24 electrodes and central locus activation along the muscle (CLA) was calculated. These data were sampled at 5-10 and 15-20 min after beginning of walking. From six of thirteen elderlies had history of fall or trip within a year in this study, comparison between them are also performed.
RESULTS: MTC was significantly decreased with time in elderly ($p < 0.05$), but not in young ($p > 0.05$). Standard deviation of MTC were significantly greater in elderly than young at both periods ($p < 0.05$). CLA were not changed with time in elderly and young ($p > 0.05$). Significant correlation was observed between coefficient of variation in MTC and CLA at 15-20min in elderly ($p < 0.05$). MTC significantly decreased with time in elderly without trip history ($p < 0.05$), but not in elderly with trip history ($p > 0.05$). Standard deviation of CLA significantly decreased with time in elderly with trip history ($p < 0.05$), but not in elderly without trip history ($p > 0.05$).
CONCLUSION: These results suggested that toe clearance pattern and regional regulation along the RF muscle and its relationship are partly affected by aging and trip history.

POSTURAL STABILITY AND CHAIR STAND CHANGES TO DIFFERENT TRAINING INTENSITIES WITH AGE

LÉTOCART, A.J.1, LALOUBÈRE1, J.Y.1, MABESOONE, F.2,COUPPÉ, C.3,4, BENMANSOUR, K.1, MARIN, F.1,MAGNUSSON, S.P.3,4, GROSSET, J.F.1,5

1 UTC UMR CNRS 7338 FRANCE, 2 CH COMPIÈGNE-NOYON FRANCE, 3 INSTITUTE OF SPORTS MEDICINE COPENHAGEN,4 CENTER FOR HEALTHY AGING DENMARK,5 UNIVERSITÉ PARIS 13, UFR SANTÉ MÉDECINE ET BIOLOGIE FRANCE

INTRODUCTION: Muscle and tendon degeneration with age lead to a decrease in the mobility in daily tasks, and to an increase in the risk for falls with the associated injuries. Resistance training (RT) has the potential to counteract the age-related decline of motion in particularly in Quadriceps Femoris (QF) and Triceps Sural (TS) muscles, the main muscles in charge of locomotion and stability1. The aim of this study was to investigate the effects of a high (HRT) versus moderate (MRT) intensity long term RT on stability and movement capabilities in healthy young and old men
METHODS: Healthy young (YM, n=10, age 25.6 ± 3.6yrs) and 27 old men were recruited and assigned to a 12 weeks RT program (3 times/week) on the lower limbs. YM as well as one group of old men group took part in MRT with training intensity of 55% 1RM (OM55, n=13, age 69.9 ± 3.6yrs), while a second group of old men was imposed a HRT with intensity of 80% 1RM (OM80, n=14, age 71.4 ± 5.7yrs). Each training groups received the exact same training volume on TS and QF. The exercises were leg press, leg extension and seated calf machine. A stability test (open and close eyes) as well as a sit-to-stand were performed before and after RT. These parameters were recorded using a motion capture system (Vicon Nexus 2.5) associated with 2 force platforms
RESULTS: For stability test, a significant decrease in antero-posterior swings with closed eyes in OM55 and OM80 (-16.9% and -14.1% respectively) was shown. Whereas no significant evolution was reported in YM for any stability parameters investigated. For sit-to-stand test, maximal power during the rising phase was significantly increased in OM55 and OM80 by respectively +18.9% +12.2%. The minimum angle between the trunk and the legs during the rising phase was also significantly decreased in OM55 (-5.0%) and OM80 (-6.1%). In YM none of the parameters showed significant changes before and after MRT
CONCLUSION: The present study shows for the first time the effect of training intensity on functional abilities in healthy young and old subjects. The results obtained from the stabilometry and sit-to-stand tests highlight a positive effect of RT on balance, muscle power, as well as a modification in motion strategy in OM. Indeed, after RT old subjects tend to adopt younger-people-strategy using more the trunk imbalance to rise from a chair2, 3. Another important conclusion of this study is that old men training at high intensity do not show any additional gain whatever the considered parameter as compared with medium intensity.
REFERENCES: 1. Horak FB, Nashner LM. Central Programming of Postural Movements : Adaptation to Altered Support-Surface Configurations. 1986;55:1369–1381
2. Hughes, M, Schenkman M. Chair rise strategy in the functionally impaired elderly. Journal of Rehabilitation Research and Development. 1996;33(4), 409–412
3. Scarborough DM,McGibbon CA. Chair rise strategies in older adults with functional limitations. J Rehabil Res Dev. 2007;44(1):33-42

RELATIONSHIP BETWEEN KNEE EXTENSORS POWER AND PHYSICAL PERFORMANCE IN OLDER PEOPLE

VILA-CHÃ, C., SERRA, N., VAZ, C., MARQUES, E., CORTE, A., MARTINS, S., FONSECA, M.

INSTITUTO POLITÉCNICO DA GUARDA

INTRODUCTION: Several studies have shown that impairments in muscle power are more influential than strength on function (Evans, 2000). Although muscle power is a related but different attribute than strength, few studies have explored re relationship between power and functional capabilities of the elderly people. The purpose of this study is to investigate the associations between leg strength (maximal and power) and physical performance among older people.
METHODS: The sample was composed by 19 elderly people recruited from a local health center [4 men and 15 women; aged between 64-80 years]. Maximum isometric strength (MVC) and maximum rate of force development (RFD) of the knee extensors was record with a load cell, in a seated position. Each participant performed 6 trials (3 progressive and 3 explosive contractions), with the dominant lower limb. at 90º of knee flexion. In addition each participant the following functional tests: (i) 4-m walking test; (ii) 5s- chair stand; (iii) 2,44m up-and-go. Hand grip strength was also measured
RESULTS: As expected, the results showed a strong association between lower limb MCV, hand grip (r=0.81; P<0.001) and RFD (r=0.7, P<0.001). The 5s- chair stand results were only moderately correlated with RFD (r=-0.49; P<0.05) and no relationship was observed between this test and lower and upper limb MVC. The walking velocity results were only associated with 2,44m up-and-go results (r=0.58; P<0.001) and RFD (r=0.7, P<0.001).
CONCLUSION: Although maximal strength has been considered an important factor influencing functional performance, the results of this study did not observed an association between this parameter and functional performance tests. On the other hand RFD was associated with 5s- chair stand performance. These findings have important implications for clinicians practicing geriatric
ACKNOWLEDGEMENTS
This study is co-funded under the Interreg V-A Spain-Portugal Cooperation Programme (POCTEP) (043_EUROAGE_4_E). Total project: 1225.459.09 and Feder funding: 919094.34 .
REFERENCES:
Evans WJ. Exercise strategies should be designed to increase muscle power. J Gerontol A Biol Sci Med Sci2000;55A:M309–M310.

ASSOCIATION BETWEEN HAND GRIP STRENGTH, AGE, GENDER AND PERCEIVED QUALITY OF LIFE

SERRA, N., VILA-CHÃ, C., VAZ, C., MARQUES, E., CORTE, A., MARTINS, S., RITA, A., FONSECA, M.

INSTITUTO POLITÉCNICO DA GUARDA

INTRODUCTION: There is a large and growing literature on handgrip strength (HGS) which correlates with health status in the general adult population (Cheung et al. 2013). The purpose of this study is to investigate the associations between hand grip strength, body composition and perceived quality of life stratified by gender and age among older people from Guarda.
METHODS: The sample was composed by 32 elderly people from a local health center [19 men and 13 women; aged between 65-85 years]. Data were collected through: (i) validated questionnaire for the Portuguese population of health status [SF-36v2,]; (ii) muscle strength (dynamometer for manual gripping) and; (iii) body composition (bioimpedance).
RESULTS: As expected, hand grip strength was higher in men than in women (36.05 ± 6.94 kg and 20.85 ± 4.86, $p < 0.001$). For the subjects aged ≥ 75 years, the hand grip values were higher than the ones registered by a recent Portuguese epidemiological study (+ 24.5%). These values were strongly correlated with muscle mass (in Kg) and height, and moderately correlated with the "physical function" and "pain" dimensions of the quality of life questionnaire.
CONCLUSION: The results indicates that older people from a more rural environment, in particular those aged over 75 years, maintains better muscle strength levels than the general elderly Portuguese population.
Cheung CL, Huang QY, Ng MY, Chan V, Sham PC, Kung AW (2006) Confirmation of linkage to chromosome 1q for spine bone mineral density in southern Chinese. Hum Genet 120:354–359
This study is co-financed by FEDER, Programa Operacional Fatores de Competitividade – COMPETE 2020 (POCI-01-0145-FEDER-023811) and by Fundação para a Ciência e a Tecnologia

EFFECTS OF LONG-TERM SQUARE-STEPPING EXERCISE ON PHYSICAL FITNESS IN HEALTHY OLDER ADULTS

SHIMURA, Y.1, KOMORI, Y.1, HOSHINO, S.2

1: OSAKA INTERNATIONAL UNIVERSITY, 2: NARA WOMEN'S UNIVERSITY

INTRODUCTION: Older adults generally have reduced levels of functional fitness than young adults, including muscle strength, endurance, and balance. Therefore, it is very important to improve physical fitness and promote healthy aging in older adults. Some studies suggest that the square-stepping exercise (SSE) could be an effective means to improve physical fitness (Shigematsu et al., 2008). Furthermore, the SSE has been shown to be significantly better than walking or no treatment to prevent falls, reduce fear of falling, and to improve perceived health status (Fisseha et al., 2017). The purpose of this study was to investigate the effects of long-term SSE performance on physical fitness in healthy older adults.
METHODS: Fifteen healthy older adults (72.93 ± 4.57 years) participated in the study. Participants performed the SSE for 90 min, once a week, for 24 weeks. The SSE was performed using a thin felt mat partitioned into 40 squares (Shigematsu et al., 2006). Participants were advised to include the respective SSE training programs in their daily life. Measurements of physical fitness (hand grip strength, 10-m walking, timed up and go, 8-foot up and go, functional reach, single limb stance with eyes open, single limb stance with eyes closed, sit & reach, 30-sec chair stand, 30-sec arm curl, and stand-up from a lying position) and muscle mass in forearms, upper arms, lower legs, thighs and trunk were taken at baseline and after 3 and 6 months. Data were analyzed with one-way ANOVA. The level of significance was set at $P<0.05$.
RESULTS: Regarding muscle mass, participants showed a significant increase in the right forearm (baseline: 0.37 ± 0.08 kg, 3-month: 0.41 ± 0.07 kg, P< 0.001), right lower leg (baseline: 1.34 ± 0.40 kg, 3-month: 1.57 ± 0.31 kg, P< 0.01), and left lower leg (baseline: 1.28 ± 0.33 kg, 3-month: 1.61 ± 0.30 kg, P< 0.01). As for physical fitness measures, there were improvements in hand grip strength (baseline: 26.90 ± 6.23 kg, 3 month: 28.08 ± 6.08 kg, P< 0.05), 10-m walking (baseline: 4.45 ± 0.74 sec, 6-month: 3.87 ± 0.58 sec, P< 0.001), timed up & go (baseline: 4.45 ± 0.74 sec, 6 month: 3.87 ± 0.58 sec, P< 0.001), 8-foot up & go (baseline: 20.81 ± 2.35 sec, 6-month: 19.54 ± 2.20 sec, P< 0.01), and stand-up from a lying position (baseline: 3.31 ± 1.13 sec, 6-month: 2.73 ± 0.67 sec, P< 0.01).

CONCLUSION: This study suggests that the SSE has some beneficial effects on muscle mass after a 3-month intervention in healthy older adults. However, 6 months were needed to improve physical fitness, including functional mobility, agility, and dynamic balance. This study suggests that performing the SSE shows greater benefits in the long term than in the short term.

INTERVENTIONS TO IMPROVE AND SUSTAIN PHYSICAL FUNCTIONING, COGNITION AND PSYCHOSOCIAL WELL-BEING FOR ELDERLY MULTIMORBID NURSING HOME RESIDENTS

CORDES, T., HIERHAGER, M., WANSTRATH, M., MEIXNER, C., WOLLESEN, B.

UNIVERSITY OF HAMBURG

INTRODUCTION: To date, evidence-based activity guidelines for very old, multimorbid and institutionalized people cannot be given (De Souto Barreto et al.2016, Nelson et al.,2007). A report from the International Association of Gerontology and Geriatrics - Global Aging Research Network (IAGG-GARN) and the IAGG European Region Clinical Section (De Souto Barreto et al. 2016) makes recommendations regarding physical activity in older persons living in residential care facilities and propose a multi-component exercise program. The study was designed to provide information about the efficacy of a multi-component activity program in inpatient care for residents who are unable to walk.
METHODS: The observational study included N=7 multimorbid residents (85±5.2 years) who were unable to walk. A 16 weeks multi-component sitting intervention program, contained exercises to improve strength, endurance, mobility and balance, was designed and carried out in the nursing home facility twice a week. Demographics, physical functioning, cognitive performance and quality of life (SF-12, SWLS, MoCA, hand grip force, functional reach test) were assessed in a baseline (t1) and a post testing (t2).
RESULTS: Hand grip force (t1=10,6±6,3kg; t2=17,1±5,5kg), sitting balance with the functional reach test (t1=98±17cm; t2=118±13cm) and the health-related participants' physical quality of life with the SF12 survey (t1=29±3; t2=36±12) increased from baseline to post testing. Cognitive capacity and psycho-social parameters remained stable. The Participants described the training sessions as fun and rated the exercises as relevant to maintain their physical functioning for daily activities.
CONCLUSION: The results indicate that a multi-component exercise program may improve or sustain physical functioning and cognitive capacity within residents of nursing homes who are unable to walk. No deterioration of cognitive capacity can be considered as a success in this aged population. Preliminary searches have shown that most interventions in nursing home facilities are aimed at residents who are still able to walk. Only few studies point out suggestions for sitting interventions. Further research is needed to confirm these results and give concrete recommendations on how interventions should be structured.

AEROBIC EXERCISE IMPROVES ENDOTHELIAL FUNCTION DURING ADVANCING AGE: A META ANALYSIS AND META REGRESSION OF OBSERVATIONAL AND INTERVENTIONAL STUDIES

SCULTHORPE, N., CAMPBELL, A., RITCHIE, L., BEAUMONT, A., GRACE, F.

UNIVERSITY OF THE WEST OF SCOTLAND

INTRODUCTION: There is an emerging body of literature relating to the effectiveness of frequent aerobic exercise as a prophylactic for age-associated stiffening of large arteries. Flow Mediated Dilatation (FMD) has emerged as a standard method of determining vascular endothelial function, however, there are no systematic interrogations of studies that examine vascular function specifically in sedentary. but otherwise healthy older adults.
METHODS: We conducted a systematic review and meta-analysis of controlled studies examining flow mediated dilatation (FMD) of athletic older persons and otherwise healthy sedentary counterparts to (i) compare FMD as a determinant of endothelial function between athletes and sedentary (ii) summarise the effect of exercise training on FMD in studies of sedentary ageing persons. Studies were identified from systematic search of major electronic databases from inception to January 2018. Study quality was assessed before conducting a random effects meta-analysis to calculate a pooled ES with 95% CIs. In addition, relationship between the exercise effects on FMD and age was assessed using Meta Regression in both comparisons. Meta regression was also used to assess the relationship between FMD improvement and training duration in intervention studies.
RESULTS: 17 studies [12 cross-sectional (n=522); 6 intervention (n=142] with age ranges from 61-75 years underwent quantitative pooling of data.
Older athletes had more favourable FMD compared with sedentary controls (2.11%; CI: 1.13%, 3.1%; P<0.001). Additionally, exercise training of previously sedentary cohorts resulted a large positive effect in FMD (1.57%; CI: 0.03%, 3.1%; P=0.045). Meta regression indicated that these improvements appear to be maintained irrespective of age (P=0.17 and P=0.83 for cross-sectional and intervention comparisons respectively) or the duration of training programmes in interventional studies (P=0.57).
CONCLUSION: Long-term aerobic exercise appears to attenuate decline in vascular function which is maintained during chronological ageing. In addition, it appears that improvements in FMD can occur even after relatively short periods of aerobic training in sedentary older cohorts.

EFFECTS OF THE DETRAINING ON HEALTH RELATED QUALITY OF LIFE, FUNCTIONAL FITNESS AND FALLS IN ELDERLY HABITUAL EXERCISERS

ESAIN, I., RODRIGUEZ-LARRAD, A., BIDAURRAZAGA-LETONA, I., IZAGUIRRE-GALLEGO, N., PEREZ-GAVILAN, A., GIL, S.M.

UPV/EHU

INTRODUCTION: Little is known about the effects of detraining in older adults (1), particularly those who regularly exercise. The aim of the study was to determine the consequences of 3 months of cessation of habitual supervised exercise on functional fitness and Health Related Quality of Life (HRQOL), and examine the association of these variables with falls.
METHODS: Thirty-eight women and 11 men (mean age, 75.5±5.7 years old) took part in a supervised physical exercise program for 9 months, followed by 3 month of detraining period. Participants completed the Senior Fitness Test, SF-36 questionnaire, Leisure-time physical activity questionnaire at the beginning of the detraining (baseline) and 3 months later. The number of falls were also recorded. Wilcoxon test or Student´s t- test were used to identify differences between baseline and after 3 months. Mann-Whitney U statistics test were used to compare fallers and non-fallers. The significant level was set at p<0.05.
RESULTS: Participants had been exercising for 12.1±8.7 years. Total physical activity during the detraining period was lower than that at baseline but this was not statistically significant. After the detraining, the 8 Foot Up and Go test (p<0.001) and all the dimensions of the HRQOL (p<0.05) had a significant decline. Women presented a larger decline (p<0.05) in more items than men. During the detraining

period, 18.4% participants had a fall. HRQOL declined both in fallers and non-fallers. Interestingly, at baseline fallers already had significantly lower values in physical functioning (p<0.05), emotional role (p<0.05) and mental health (p<0.01), than non-fallers. The non-faller group after 3 months of detraining period had significantly lower values in the 8 Foot Up and Go test (p<0.05) than the faller group.
CONCLUSION: Three months of detraining period in older exercisers who habitually undertake supervised activities is enough to deteriorate most items of the SF-36 and the dynamic balance. The effect of periods of cessation of supervised exercise, could be avoided prescribing exercises designed specifically for them with emphasis on balance exercises.
The prior lower HRQOL values of those who will subsequently fall suggest that this criterion should be studied as a candidate risk factor for falls.
Acknowledgements: We would like to thank Getxo Kirolak for their collaboration in this study, as well as all the study participants. Esain I was supported by a grant from the Basque Government (Pre_2014_1_137) and this study was supported by the University of the Basque Country (UPV/EHU) (PPG17/34) and the Basque Government (IT922-16).
References: 1- Henwood TR, Taaffe DN. Detraining and retraining in older adults following long- term muscle power or muscle strength specific training. J Gerontol Med Sci. 2008; 65(7):751-8.
Contact: izaro.esain@ehu.eus

LONGER TIME SPENT IN SEDENTARY BEHAVIOR IS ASSOCIATED WITH INCREASED ARTERIAL STIFFNESS IN JAPANESE OLDER ADULTS

TANAHASHI, K.1, TAKEUCHI, A.1, NISHIMURA, M.1, KUMAGAI, H.1,2, ZEMPO-MIYAKI, A.3, KOSAKI, K.1, AKAZAWA, N.1,4, MAEDA, S.1

1> UNIVERSITY OF TSUKUBA, 2> JUNTENDO UNIVERSITY, 3> RYUTSU KEIZAI UNIVERSITY, 4> JAPAN INSTITUTE OF SPORTS SCIENCES

INTRODUCTION: The time spent in sedentary behaviors, such as sitting at work or leisure, is associated with an increased risk of cardiovascular disease. It has been reported that Japanese adults spend the longest sedentary time in the world. Recent studies have suggested that increase in arterial stiffness, an independent risk factor for cardiovascular disease, is associated with longer time spent in sedentary behavior. However, it is unclear whether sedentary behavior associates with arterial stiffness in Japanese adults. In addition, to our knowledge, no studies have analyzed the relationship between sedentary behavior and arterial stiffness with age. Therefore, we investigated the relationship between sedentary behavior and arterial stiffness in Japanese populations.
METHODS: A total of 744 healthy Japanese adults, under the age of 40 years (young), 40 to 59 years of age (middle-aged), and over the age of 60 years (older), participated in this study. Physical activity and sedentary behavior were assessed by international physical activity questionnaire. Arterial stiffness was measured by carotid-femoral pulse wave velocity. Subjects in each age category were divided into either long-sedentary time or short-sedentary time groups according to the median daily time spent in sedentary behavior.
RESULTS: In the older populations, carotid-femoral pulse wave velocity was higher in the long-sedentary time group than in the short-sedentary time group. The difference remained significant after normalizing carotid-femoral pulse wave velocity for physical activity. Meanwhile, in the young and middle-aged populations, there were no differences among groups in carotid-femoral pulse wave velocity.
CONCLUSION: The present study suggested that longer time spent in sedentary behavior is associated with increased arterial stiffness in Japanese older adults.

Conventional Print Poster

CP-PM07 Clinical: Metabolism, Hormones, Neurology

EFFECTS OF STRENGTH TRAINING ON BODY COMPOSITION AND PHYSICAL FITNESS IN HYPOGONADAL MALES

KRALIK, M.1, CVECKA, J.1, PUTALA, M.1, BUZGO, G.1, TIRPAKOVA, V.2, BUJDAK, P.2, KOLLARIK, B.3, UKROPCOVA, B., UKROPEC, J.4, PAYER, J.5, KILLINGER, Z.5, RAASTAD, T.6, SEDLIAK, M.1

1: FSPORT CU , 2: SMU , 3: SCMUH , 4: BMC SAS , 5: FMED CU , 6: NIH

INTRODUCTION: Hypogonadism is a clinical syndrome resulting from the low production of androgens (testosterone levels < 6.9 nmol/l) with symptoms including decline in lean mass, muscle strength, increases in body weight and overall body fat mass (Grossmann et al. 2008, Kapoor et al. 2006, Smith et al. 2002). There are very few studies dealing with effect of physical activity on hypogonadal males (Hildreth et al. 2013). The aim of the study was to examine the effect of 12-week strength training program on body composition, physical function, selected biochemical markers of metabolic health in patients with hypogonadism.
METHODS: The study is comparing the effect of strength training (ST) with testosterone replacement therapy (TRT) (n=5, 42,9 + 2,77 years) and strength training alone in hypogonadal patients without TRT (NON-TRT) (n=3, 52,1 + 8,5 years), with control group of eugonadal males (HM) (n=3, 52,9 + 4,21 years) also engaged in ST. The subjects performed ST twice per week and the training program consisted of 6 exercises at an intensity of 60-80% of 1RM.
RESULTS: When all subjects merged together, body composition (DXA) was improved with decreased fat mass both in absolute (g) and relative (%) values (p<0.01), with no significant change in lean or bone mass. Muscle strength measured by predicted leg press 1RM from multiple repetition maximum increased (p<0.01). Predicted VO2max from submaximal walking test increased (p<0.05). Between-group differences were not analysed due to very low sample sizes.
CONCLUSION: The first phase of the study was completed by 11 males. After 3 months of strength training protocol all of subjects significantly improved muscle strength and reduced body fat. Despite the fact, that experimental protocol was 60 min. strength training session twice a week, subjects improved also their cardiovascular fitness. This preliminary results suggest that ST could be useful to combat adverse negative effects of the hypogonadism.
Key words: hypogonadism, physical activity, testosterone deficiency, hypogonadism ageing male strength training, physical activity, testosterone
Trial registration: ClinicalTrials.gov: NCT03282682
"The study was funded by the Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and of the Slovak Academy of Sciences (VEGA) no. 1/0714/16."

AN ASSESSMENT OF COGNITIVE FUNCTION AND PHYSIOLOGICAL OUTCOMES IN INDIVIDUALS WITH HEPATITIS C

O'GORMAN, P., FERGUSON, D., STRAHAN, O., MONAGHAN, A., KENNEDY, M., MCKIERNAN, S., BERGIN, C., COEN, R., DOHERTY, C., FORDE, C., GORMLEY, J., NORRIS, S.

TRINITY COLLEGE DUBLIN

INTRODUCTION: Cognitive impairment is reported to occur in 30-50% of non-cirrhotic individuals with hepatitis C. It is also reported that these individuals experience reduced aerobic fitness (VO2max) and poor vascular health. Higher exercise capacity and lower cardiovascular risk factors have been shown to influence cognitive function in other chronic diseases. However, no studies have examined this relationship in individuals with hepatitis C. The primary aim of this study was to assess various physiological outcomes and cognitive function in a cohort of individuals with hepatitis C.
METHODS: Prior to inclusion in the study, individuals underwent screening of their cognitive function and were included only if they presented with mild cognitive impairment. Outcome measures included; VO2max, body composition, cognitive function tests (Montreal Cognitive Assessment (MOCA), Trail Making Test A & B (TMT-A & B) and Digit Symbol Test (DST)), vascular health and physical activity levels (PAL). VO2max was assessed via a submaximal treadmill test using the modified Bruce protocol with breath by breath gas analysis. Seven-day physical activity level was assessed using a waist-worn tri-axial Actigraph accelerometer. Body composition was assessed using a Seca bioimpedance analyzer. Vascular health was assessed using a Mobil-O-Graph blood pressure monitor. All values are displayed as mean ± standard deviation.
RESULTS: Between March 2017 and February 2018, 38 individuals (m/f = 22/16, age = 40.3 ± 7.81 years) completed the assessment. MOCA, TMT-A, TMT-B and DST score were; 23.9 ± 2.44, 40.3 ± 10.63s, 109.8 ± 31.27s, 41.2 ± 12.28, respectively. VO2max and moderate-vigorous physical activity (MVPA) levels were; 39.6 ± 10.48ml.min.kg and 265.8 ± 271.36min/week, respectively. Pulse Wave Velocity (PWV) and Augmentation Index (AI) were, 6.3 ± 0.97ms and 14.9 ± 12.21%, respectively. BMI and fat mass were; 27.2 ± 4.98 and 31.7 ± 10.42%, respectively. There was a somewhat negative correlation between DST score and PWV (R=0.53) and a somewhat positive correlation between VO2max and MOCA score when outliers were removed (R= 0.52).
CONCLUSION: The majority of the current cohort were overweight and had reduced VO2max. An interesting finding in this cohort was the two correlations. A lower PWV is indicative of healthier vasculature. This may aid in reducing cardiovascular and cerebrovascular risk factors that can contribute to cognitive impairment in these individuals. A higher MOCA score is also indicative of better cognitive function. It has been suggested in previous studies that positive molecular adaptations within the central nervous system may account for exercise-induced changes in cognitive function. Therefore, this may indicate that those who are more aerobically fit may display less cognitive impairment. Individuals would potentially benefit from a structured exercise program which is currently ongoing in this cohort. Additionally, a greater sample size is needed in order to draw more definitive conclusions.

A SYSTEMATIC REVIEW OF THE EFFECTS OF EXERCISE ON PEOPLE WITH HUNTINGTONS DISEASE.

BAIN, P.

IMPERIAL COLLEGE LONDON

INTRODUCTION: Huntingtons disease (HD) is an autosomal dominantly inherited neurodegenerative disease characterised by cognitive decline, movement disorders (characteristically chorea) and behavioural disturbances. It is caused by a trinucleotide (CAG) expansion in the Huntingtin gene on chromosome 4, with the age of onset being inversely associated with increasing CAG repeat size.
Increased physical activity has shown beneficial effects on cognition in rodent models of HD. We conducted a systematic review of trials involving physical activity for people with HD to gauge the efficacy of increased physical activity on their cognitive function.
METHODS: PRISMA protocols were used to plan the stages of the research and consequently, systematic searches were conducted in May 2017 using a pre-defined strategy. These searches were conducted in the electronic databases MEDLINE, EMBASE and PsycINFO via OVID. Studies which satisfied the inclusion criteria were either epidemiological or experimental in nature and specific to humans with confirmed Huntington's disease. Papers included were restricted to those written in English and published in peer-reviewed journals.
RESULTS: 10 studies were included in the analysis, 4 being randomised control trials, 5 non-randomised clinical prospective intervention trials and 1 cross-sectional study.
Unfortunately, all these studies were of relatively poor quality for various reasons:
a. Most lacked randomisation or control participants.
b. No prior power calculations were undertaken and thus sample sizes may have been too small to detect benefit.
c. Objective quantitative measurements of physical activity were rarely made, instead results largely depended on subjects recall.
d. Multiple component interventions, including physical activity, were deployed producing confounding variables.
Despite these flaws, all studies reported that there was no significant decline in the cognitive function of the participants (over a 6-24 month period). Furthermore, the studies reported isolated improvements in some cognitive tests, most commonly the Mini Mental State Examination (MMSE), Symbol Digit Modalities Test (SDMT), and Unified Huntingtons Disease Rating Scale (UHDRS) but with no consensus of significant benefits in any specific cognitive domain.
Encouragingly, no adverse outcomes were reported and, in the 5 studies that examined the effects of exercise on disability and motor function, there were clear improvements in both of these domains, including gait and chorea.
CONCLUSION: The positive results found on the effects of physical activity on cognition in rodent studies of HD are yet to be demonstrated in human clinical trials as these have been of limited quality, although the absence of significant cognitive decline in any of these human studies might suggest a neuro-protective effect. This area of research is still relatively novel and subsequent studies need to concentrate on improved study design and include objective measurements of physical activity.

EXERCISE TOLERANCE IN LATE-ONSET POMPE DISEASE PATIENTS: POSITIVE EFFECTS OF PHYSICAL TRAINING AND HIGH-PROTEIN DIET.

PEDRALI, M.1,2, ZUCCARELLI, L.3, BIASUTTI, L.3, AZZINI, L.3, RASICA, L.2,4, MARZORATI, M.2, PORCELLI, S.2, SECHI, A.5, GRASSI, 2,3

1UNIVERSITY OF MILAN, 2NATIONAL RESEARCH COUNCIL, 3UNIVERSITY OF UDINE, 4UNIVERSITY OF MILAN, 5ACADEMIC HOSPITAL OF UDINE

INTRODUCTION: Pompe disease is a metabolic myopathy characterized by intralysosomal accumulation of glycogen due to deficiency of lysosomal acid alpha—glucosidase. Patients with the late-onset form of the disease present progressive muscle weakness, exercise intolerance and impaired pulmonary function. Enzyme replacement therapy (ERT) is available since 2006 and is associated with a short-

term mild improvement of pulmonary function and exercise tolerance. Clinical improvements have been reported following with a combination of aerobic exercise training and high-protein low-carbohydrate nutrition in non-treated patients. Aim was to evaluate the effects of an individualized home-based exercise training program, alone or in combination with a high-protein regimen, on exercise tolerance and muscle function in late-onset Pompe disease patients chronically treated with ERT.
METHODS: Thirteen patients (61±10 yr) were enrolled in this ongoing study. Each patient underwent to three different interventions in a randomized order: control period (CTRL), aerobic and strength training (TRAINING), and a combination of TRAINING and normocaloric high-protein (28%) diet (TRAINING+DIET). Each intervention lasted 6 months and was followed by a 3-month washout. Before (PRE) and after (POST) each intervention, patients undertook a 8-minute moderate intensity constant work rate exercise followed by an incremental exercise on a cycle-ergometer. During this exercise, time to exhaustion (Tlim), peak oxygen uptake (VO2peak), oxygen cost of exercise (O2cost), and the slope of the relationship between heart rate (HR) and VO2 were utilized as functional indexes of exercise tolerance. Maximal voluntary force (MVC) during isometric contractions was measured for both upper and lower limbs.
RESULTS: Two patients dropped out; data refer to seven patients that have completed at least two interventions. Tlim increased after both TRAINING (28%) and TRAINING+DIET (8%) whereas it was reduced (15%) after CTRL. After TRAINING and TRAINING+DIET, VO2peak increased in POST (1.63±1.15 and 1.90±0.88 L*min-1, respectively) compared to PRE (1.32±1.14 and 1.74±0.88 L*min-1, respectively) whereas it was reduced after CTRL (1.42±0.89 L*min-1 vs. 1.58±0.86, PRE vs POST). O2cost was not affected by the interventions, being always higher (15.5±5.2 mL*min*w-1) than in healthy subjects (10-12 mL*min*w-1). The slope of HR-VO2 relationship was normal (2.9±0.2 b*kg*mL-1) and it did not change across the conditions. MVC in knee extension increased after TRAINING (6%) and TRAINING+DIET (7%), whereas it did not change during CTRL (200±41 N and 203±55 N, respectively in PRE and POST). No differences were observed for MVC in elbow flexion between PRE and POST in all conditions.
CONCLUSION: According to these preliminary results, in late-onset Pompe disease patients treated with ERT exercise training alone and the combination of exercise training and normocaloric high-protein diet seems to positive affect some functional indexes of exercise tolerance.

AEROBIC FITNESS LEVEL NECESSARY FOR LOW METABOLIC SYNDROME RISK IN JAPANESE CHILDREN

SASAYAMA, K.1, ADACHI, M.2

1: OKAYAMA UNIVERSITY OF SCIENCE 2: OKAYAMA UNIVERSITY

INTRODUCTION: The aerobic fitness levels necessary for low metabolic syndrome risk have been published for American, European, and Canadian children [1-3]. However, the aerobic fitness level necessary for low MetS risk has not been determined for Japanese children. The purpose of this study was to determine the aerobic fitness level necessary to achieve a low MetS risk.
METHODS: The participants were 299 children <9.1±0.3 years>. Aerobic fitness was defined as the predicted peak oxygen consumption from a 20 m shuttle run test. MetS risk score were calculated from the total gender-specific values of the following four parameters: waist to height ratio, TG, HDL-c, and mean arterial pressure. A lower score indicates a lower MetS risk. Receiver Operating Characteristic analysis was used to identify the threshold of aerobic fitness necessary to achieve a low MetS risk. A risk score in the bottom 75th percentile was considered to indicate a low MetS risk.
RESULTS: The ROC analysis demonstrated the significant discriminating ability of pr˙O2peak for identifying low versus high MetS risk scores in boys , and girls . pVO2peak at these points were 47.3 and 44.9 ml/kg/min in boys and girls, respectively.
CONCLUSION: The aerobic fitness levels found to be necessary for a low MetS risk in this study <47.3 and 44.9 ml/kg/min for 9–10 years old in boys and girls, respectively> were relatively higher than those reported in previous studies [1-3]. These differences in aerobic fitness threshold may reflect the method used to evaluate aerobic fitness. However, in Japanese children, the 20-m shuttle run test level was higher than that observed among 37 countries worldwide [4]. Therefore, it is reasonable to expect that our results would be higher than those observed in previous studies.
References:
1. Ruiz JR. et al. High cardiovascular fitness is associated with low metabolic risk score in children: the European Youth Heart Study. Pediatr Res. 2007;61: 350-355.
2. Adegboye AR. et al. Recommended aerobic fitness level for metabolic health in children and adolescents: a study of diagnostic accuracy. Br J Sports Med. 2011;45: 722-728.
3. Boddy LM. et al. ROC generated thresholds for field-assessed aerobic fitness related to body size and cardiometabolic risk in schoolchildren. PLoS One. 2012;7 :e45755. doi: 10.1371/journal.pone.0045755.
4. Olds T. et al. Worldwide variation in the performance of children and adolescents: an analysis of 109 studies of the 20-m shuttle run test in 37 countries. J Sports Sci. 2006;24: 1025-1038.

CEREBRAL OXYGENATION AND HEMODYNAMIC MODIFICATIONS DURING CONTEMPORARY MENTAL TASK AND MUSCLES METABOREFLEX ACTIVATION IN METABOLIC SYNDROME PATIENTS: A PRELIMINARY REPORT

DONEDDU, A., ROBERTO, S., MILIA, R., PINNA, V., VELLUZZI, F., LECIS, R., GUICCIARDI, M., CRISAFULLI, A.

UNIVERSITY OF CAGLIARI

INTRODUCTION: Metabolic diseases, such as type 2 diabetes, obesity and Metabolic Syndrome (MS), are constantly growing their incidence, with increasing in related cardiovascular problems (1). One consequence of MS is the high sympathetic tone. Muscles metaboreflex (MM) activation increases sympathetic activity and it is a well established method to study cardiovascular adjustments to exercise as well as to reveal cardiovascular diseases (2,3). It has been reported that patients suffering from MS have an exaggerated increase in sympathetic tone during the MM. Mental task (MT) can also increase sympathetic tone. Therefore, contemporary MM activation and MT are expected to cause high increments in sympathetic activity, thereby inducing cerebral vasoconstriction and impairing cerebral oxygenation. We hypothesized that, in MS patients, during contemporary MM activation and MT, cerebral oxygenation was reduced in comparison with a normal population. This occurrence could provide explanation for the bad predisposition to exercise in these patients.
METHODS: Two different groups of subjects took part in this investigation: 15 subjects (7 females, age 53.6±9.8 yrs) with MS and 14 age-matched control healthy subjects (CTL). They underwent 5 different tests each lasting 12 min: post-exercise muscle ischemia (PEMI) to activate the MM, control exercise recovery (CER), PEMI+MT, CER+MT, and MT alone. During each sessions, cerebral oxygenation was detected by Near Infrared Spectroscopy by applying two sensors in the skin of the forehead, while hemodynamics was detected by impedance cardiography.

RESULTS: Data analysis found no reduction in cerebral oxygenation during PEMI neither in MS patients nor in CTL subjects. The MT test added to the PEMI test did not induce any significant decrease in cerebral oxygenation in both groups. However, MS patients showed greater increments in systemic vascular resistance (SVR) than CTL.
CONCLUSION: Results did not support the hypothesis that adding MT to PEMI impairs cerebral oxygenation in patients suffering from MS. This despite MS patients exhibit higher level of SVR in comparison with CTL, which suggests the occurrence of exaggerated arteriolar vasoconstriction. Therefore, cerebral circulation seems to be preserved in MS patients.
1) Crisafulli and Roberto Curr Diabetes Rev 2017, 13:560-565.
2) Roberto et al. J Appl Physiol 2012;113:1323-31.
3) Roberto et al. J Appl Physiol 2017;122:376-385.

DANCING IMPROVES NEUTROPHIL APOPTOSIS BY REDUCING INFLAMMATION IN DIABETICS

HATANAKA, E.1, BORGES, L.S.1, PEREIRA PASSOS, M.E.1, BARROS SILVA, M.B.1, MOMESSO, C.M.1, GRAY, S.R.2, GORJÃO, R.1, DERMARGOS, A.1,3

1ICAFE, CRUZEIRO DO SUL UNIVERSITY 2INSTITUTE OF CARDIOVASCULAR AND MEDICAL SCIENCES 3UNIVERSIDADE PAULISTA O DO SUL UNIVERSITY

INTRODUCTION: Neutrophils from people with type 2 diabetes show increased cell death and increased clearance from infectious sites, contributing to the increased susceptibility and severity of infections in diabetics. The mechanisms underlying cell death induced by diabetes appears to involve prolonged production of pro-inflammatory cytokines, such as tumor necrosis factor-alpha (TNF-α and interleukin-1 beta (IL-1β) [1]. Exercise is a non-pharmacological tool to control low-grade systemic inflammation [2]. Herein, we assessed the effects of an aerobic dance exercise programme on circulating cytokines and neutrophil death in people with diabetes and controls volunteers.
METHODS: A group of ten people with diabetes (70 ± 3 years, body mass 69.6 ± 4 kg, height 1.6 ± 0.02 m, body fat 36.5 ± 1.9%) and twelve healthy (62.9 ± 1.8 years, body mass 65.6 ± 3.2 kg, height 1.57 ± 0.01 m, body fat 35 ± 1.2%) volunteers participated in aerobic dance training twice weekly for 4-months. Plasma levels of TNF-α, C-reactive protein (CRP) and IL-1β were measured before and after training by ELISA. Neutrophil count, fragmented DNA (apoptosis sign) and cell membrane integrity (necrosis sign) were assessed by flow cytometry before and after training.
RESULTS: Our results indicate that plasma TNF and CRP were reduced by 1.9-fold ($P < 0.005$) and 1.4-fold ($P < 0.001$) respectively after training period. Neutrophil DNA fragmentation (0.9-fold, $P < 0.05$) was lower after dance training, while neutrophil numbers increased (0.7-fold, $P < 0.005$) after the same period.
CONCLUSION: We concluded that dancing might help to regulate inflammation and neutrophil apoptosis in diabetes. This may be an efficient strategy to protect against microorganism infection, resulting from neutrophil deficiency.
REFERENCES: [1] Hatanaka E, Monteagudo PT, Marrocos MS, Campa A. (2007) Immunol Lett. 15:160-6.
[2] Belotto MF, Magdalon J, Rodrigues HG, Vinolo MA, Curi R, Pithon-Curi TC, Hatanaka E. (2010) Clin Exp Immunol. 162:237-43.

Conventional Print Poster

CP-PM08 Clinical: Cancer-CUD-COPD

VARIABLE ENDURANCE TRAINING PROTOCOLS IN CARDIAC REHABILITATION

BIRKLBAUER, A.1,2, DIEM, G.2

1 UNIVERSITY OF SALZBURG, 2 KLINIKUM AUSTRIA GESUNDHEITSGRUPPE, BAD HALL

INTRODUCTION: Dynamic systems, stochastic resonance and neurobiological insights contributed to a reconsideration and acceptance of variability. In cardiology, heart rate variability is a relevant marker reflecting cardiac modulation, whose optimal level reflects efficient functioning and an inherent adaptability (McCraty et al, 2009). While too little variation indicates inadequate functioning, too much instability (e.g. arrhythmias) is detrimental to healthy functioning. This view of variability led to a different approach to endurance training in our cardiac rehabilitation centre.
Endurance training is a cornerstone in cardiac rehabilitation and well implemented in the guidelines (e.g. Piepoli et al., 2012). It is included into regular training schedules through high-intensity interval training (HIT), pyramid, or continuous exercise training (CE). Especially the application of HIT schedules has increased over the last few years due to assumed advantages over CE (Hussain et al, 2016). Its alternating intensity with bursts of high intensity interspersed with periods of rest or low-intensity exercise seems to imply a higher motivational factor than CE, also because of its higher variability. However, a completely, more variable training protocol has not been applied so far.
METHODS: We applied such a variable training protocol in our patients (n=2878; average: 63.7 yrs) including HFpEF, HFrEF, LVEF, CMP) who were also exposed to all above mentioned trainings. In contrast to heart-rate-driven protocols where workload is automatically adapted due to the increase or decrease in heart rate and to the systematic HIT or pyramid training where a determined workload increase and decrease is given, workload in a variable setting is externally and randomly increased and decreased. That is, the duration and intensity of intervals appear in a random order, with intensities being individually set based on the patient's cardiopulmonary exercise test.
RESULTS: Comparing all training protocols, intensities are significantly higher in HIT and the variable setting compared to CE ($p<.001$; $eta2>.20$). Alike HIT sessions, variable training protocols seem to be more enjoyable for patients than CE. Interestingly, variable training protocols represented also lower BORG values compared to HIT despite the similar intensities.
CONCLUSION: Due to the implied indeterminacy we assume that such training protocols better support the recovery of functional capacity than continuous exercise and prepare better for a successful reintegration into life as workloads cover a broader range of intensities. These protocols can easily be documented and analysed providing further information for day-to-day variation and its underlying dynamics (e.g. blood pressure response).
Gibala et al., J Physio, 2012
Hussain et al, Cardiol in Rev, 2016
McCraty et al. Integral Review, 2009
Piepoli et al., Eur J Prev Cardiol, 2012

Contact: info@sportrix.at

EFFECTS OF 3 MONTHS MULTICOMPONENT EXERCISE PROGRAM ON PHYSICAL FUNCTION IN POST-HOSPITALIZATION PATIENTS

ECHEVERRIA, I.

UPV/EHU

INTRODUCTION: During hospitalization, the physical functions of the elderly usually decrease. Physical activity has been shown to be the cornerstone in attenuating this loss of functional capacity. Furthermore, physical exercise seems to be effective in improving the general physical condition of older adults and preventing disability and other adverse outcomes. The aim of this study was to evaluate the effects of a 3-month multicomponent exercise intervention on physical fitness within post-hospitalization patients.
METHODS: Post-hospitalization patients that met the following criteria were included in the study: aged ≥ 70 years, scored ≥ 20 on MMSE test and who capable to stay up and walk independently for 10 meters. The participants took part in sessions of multicomponent exercise intervention during 60 minutes twice a week for 3 months. The training was focused on balance, power and strength in a moderate intensity The studied variables were dominant and no dominant handgrip, time up and go (TUG), Berg scale, 10-meter walking test (gait speed), Short Physical Performance Battery (SPPB) and 3 test of the Senior Fitness Test battery: arm curl, chair stand and 6 minute walking test. We compared the results before (PRE) and after (POST) the intervention by a paired student t test.
RESULTS: We observed an improvement of 35.89%, in the SPPB score (p=0.005) from the beginning to the end of the intervention. Accordingly, leg (p=0.018) and arm (p=0.008) strength increase in 31.63% and 42.85% respectively. Dynamic (19.8%; p=0.008) and static (6.3%; p=0.013) balance also improved in this 3-month intervention. Finally, we observed a significant improvements (p=0.022) in 10-meter walking test and in 6 minute walking test (p=0.037). However, parameters that we did not train specifically had a decline: 1.64% in dominant handgrip and 1.81% in no dominant handgrip.
CONCLUSION: Our study showed that a multicomponent exercise program is effective for post-hospitalization patients because after 3-month intervention, we obtained positive results in balance, strength and walking tests. Taking into account the relationship between these parameters and functional capacity, we can conclude that this multicomponent physical exercise intervention is able to recover or improve the functional capacity of patients after hospitalization.
Contact: inaki.echeverriag@ehu.eus
Acknowledgements: Perceived grants from the UPV/EHU (Research staff in training 2016)

SYSTEMIC INFLAMMATORY AND VASCULAR BIOMARKER ALTERATIONS FOLLOWING ISOMETRIC EXERCISE TRAINING IN UNMEDICATED HYPERTENSIVE PATIENTS.

O DRISCOLL, J.M., TAYLOR, K.A., WILES, J.D., COLEMAN, D.D., SHARMA, R.

CANTERBURY CHRIST CHURCH UNIVERSITY

INTRODUCTION: Hypertension (HTN) remains the leading attributable risk factor for cardiovascular disease and all-cause mortality. HTN is associated with vascular endothelial dysfunction, which is characterised by a pro-inflammatory, pro-thrombotic and pro-constrictive phenotype. Systemic low-grade inflammation and vascular dysfunction may accelerate atherosclerosis. Isometric exercise training (IET) has been shown to reduce arterial blood pressure (BP) in normotensive and hypertensive populations; however, the modulation of inflammatory and vascular biomarkers following IET is unknown.
METHODS: In a randomised crossover controlled trial, 24 physically inactive hypertensive males (aged 44.6±7.7 years) completed 4 weeks of home-based isometric wall squat training. Wall squat training intensity was determined following a laboratory incremental wall squat test and recreated at home using a simple device to elicit each specified knee joint angle. Three sessions, consisting of 4 x 2 min isometric wall squats were completed each week. Serum high sensitivity C-reactive protein (hs-CRP), interleukin 6 (IL-6), tumour necrosis factor alpha (TNF-α), interleukin 10 (IL-10), asymmetric dimethylarginine (ADMA), vascular cell adhesion molecule 1 (VCAM-1) and intercellular adhesion molecule 1 (ICAM-1) were measured pre and post the IET and control period.
RESULTS: Following 4-weeks of IET, IL-6 (ln) and ADMA (ln) significantly decreased (-0.04±0.07, p=0.025 and -0.05±0.11, p=0.048, respectively) with no significant change post control (p=0.328 and p=0.271 respectively). This difference was significant between conditions (p=0.042 and p=0.008, respectively). There was no significant change in hs-CRP, TNF-α, VCAM-1 or ICAM-1 following IET or control condition. There was no significant change in IL-10 (ln) following IET (1.24±0.2 to 1.25±0.2, p=0.19) or control condition (1.24±0.2 to 1.25±0.2, p=0.404). However, there was a significant reduction in the IL-6/IL-10 ratio (0.91±0.26 to 0.86±0.24, p=0.022) following IET, with no significant change post control (0.93±0.22 to 0.92±0.19, p=964). This difference was significant between conditions (p=0.033).
CONCLUSION: A short term programme of home-based IET was associated with a significant reduction in inflammatory and vascular biomarkers, which have been associated with improved cardiovascular health. The impact these responses have on long-term cardiovascular events and mortality requires further research.

NEGATIVE EFFECTS OF L-ARGININE ADMINISTRATION ON HYPERTENSIVE WOMEN'S CARDIOVASCULAR HEALTH

NOVAIS, I.P., JARRETE, A.P., PUGA, G.M., DELBIN, M.A., ZANESCO, A.

STATE UNIVERSITY OF SOUTHWESTERN BAHIA

INTRODUCTION: It has been consistently reported the L-arginine administration enhances athletic performance, running economy or improve recovery from exhaustion, and most of studies has been conducted in athletes. L-Arginine is the main precursor of nitric oxide (NO) that plays a key role on vascular tonus via cGMP/PKG pathway. The beneficial effect of NO-precursor also has been associated with improvement of blood flow on skeletal muscle, and aerobic exercise has been indicated as a strategy to positive effects on hemodynamic signals and NO/cGMP pathway. The aim of this work was to examine the effects of acute L-arginine administration alone or in association with a bout of exercise on cardiovascular parameters in trained hypertensive postmenopausal women.
METHODS: Hypertensive postmenopausal women were randomized into 3 groups: acute administration of L-arginine (9g) (ARG, n=9); a bout of aerobic exercise (30 min) with placebo pills (EXE, n=8); and the combination of both interventions (ARG+EXE, n=10). Biochemical analyses (NO/cGMP pathway biomarkers) were performed in four points time during the trials and blood pressure (BP) was monitored. Postmenopausal women underwent to aerobic exercise training (AET) on treadmill, 3 days/week, 30-40 min, for 24 sessions, at moderate intensity.

RESULTS: Groups were similar in age and time since menopause (ARG: 58.9±2yr; 12.5±2.5yr; EXE: 54.8±1.8yr; 11.0±2.6yr; A+E: 58.0±1.6yr; 8.2±1.5yr). As expected, body mass index was not affected by AET. The administration of L-arginine alone (ARG group) increased significantly systolic BP either before or after AET as compared with EXE and EXE+ARG groups. Indeed, the administration of L-arginine alone provoked a significant reduction in NOx- concentration before and after AET. On the other hand, the concentration of the second messenger cGMP was significantly increased in EXE and EXE+ARG groups as compared with ARG group before and after AET. No effects were observed on diastolic BP for all groups.
CONCLUSION: Our findings show that acute L-arginine administration had a negative effect on systolic BP that was accompanied by a reduction in NOx- concentration in hypertensive postmenopausal women, on the other hand, a bout of aerobic exercise alone or associated with L-arginine had positive effects in stimulating cGMP levels.
Financial support: Fapesp (Grants No. 2010/14.933-0)

SUBMAXIMAL OXYGEN UPTAKE EFFICIENCY SLOPE AS A PREDICTS CARDIORESPIRATORY FITNESS IN MEN WITH CARDIOVASCULAR DISEASE

MCDERMOTT, C., MCCORMACK, C., KELLY, S., MCCARRON, A., MORAN, K., MOYNA, N.

DUBLIN CITY UNIVERSITY

INTRODUCTION: Although ȦO2max is considered the gold standard measure of cardiorespiratory fitness, it can be difficult to attain in patients with cardiovascular disease . The submaximal oxygen uptake efficiency slope integrates cardiovascular, musculoskeletal and respiratory function during incremental exercise into a single index and has been proposed as an alternative and effort independent measure of cardiopulmonary reserve . The purpose of this study was to examine the relation between ṁO2 peak and both submaximal absolute OUES and relative OUES .
METHODS: A total of 56 men < age, 59.3 ± 9.2 yr; ȦO2peak, 2.02 ± 0.5 L/min and 23.6 ± 5.8 mL/kg/min> were recruited during induction to a community based exercise program following completion of a hospital based cardiac rehabilitation program. Participants performed a graded exercise test on a cycle ergometer with breath-by-breath open circuit spirometry and a 12- lead ECG. Absolute OUES and OUES/kg were calculated by plotting ȧO2 in mL/min on the x-axis, and the log transformed VE on the y-axis . Exercise data up to the ventilatory anaerobic threshold was included in the analysis.
RESULTS: The %ṪO2 max corresponding to the VAT was 54.0 ± 10.3. Absolute OUES and OUES/kg were 2223.9 ± 514 and 25.9 ± 5.7, respectively. There was a significant positive correlation between i ṪO2max and OUES and between ṁO2max and OUES/kg .
CONCLUSION: Determination of ḊO2max is not often feasible in individuals with CVD where maximal exercise testing is contraindicated or when performance may be impaired by pain, dyspnea or angina. The findings from the present study indicate that the OUES and OUES/kg are significantly related to absolute and relative ȮO2max, respectively and may be used as a valid submaximal effort independent measure of CRF.

FEASIBILITY OF A MIXED HIGH INTENSITY INTERVAL TRAINING AND RESISTANCE TRAINING PROGRAM ON NON-SMALL CELL LUNG CANCER PATIENTS: PILOT STUDY.

WALSH, E.1, BASTARACHE, G.1, JOYAL, E.1, LANGLOIS, C.1, FLORESCU, M.2, COMTOIS, A.S.1

1: UNIVERSITY OF QUEBEC AT MONTREAL 2: CENTRE HOSPITALIER DE L'UNIVERSITÉ DE MONTRÉAL

INTRODUCTION: High intensity interval training (HIIT) has become a mainstream, frequently investigated form of exercise training and has started to be used as physical activity for cancer patients. The objective of this study was to determine the feasibility of advanced non-small cell lung cancer (NSCLC) patients performing a mixed program of HIIT and resistance training (RT). To our knowledge, this is the first study to investigate a mixed program for advanced NSCLC patients.
METHODS: Presently, five participants have been recruited for this study (4 men, 1 woman, 68.8 ± 8.2 years old, 167 ±11.8 cm, 86.6 ±18.8 kg, 30.8 ±4.8 (kg/m^2). The HIIT and RT program took place twice a week and is expected to last 12 weeks (24 sessions). Baseline measurements representing aspects of physical fitness were taken for grip strength (65 ±20.6 kg) and functional capacity (six-minute walk test, 455.3 ±136 m). HIIT was performed on an ergocyle. Training consisted of a five-minute warmup, followed by repeated intervals of 10 seconds of all out sprint and 60 seconds of low intensity, ending with a three-minute cool down. After HIIT, each participant performed four RT exercises. These were rowing using therabands, squats, balancing on one foot, and push-ups. Rating of perceived exertion (RPE) was measured using the Borg scale.
RESULTS: All participants in the present study have successfully completed at least eight training sessions and no adverse effects were reported. During HIIT, participants progressed from an average of 5 ±1.2 intervals at session 1 to 7.8 ±0.84 intervals at session 8. Intensity progressed from an average of 62.5 ±42.5 Watts during interval 1 on day 1 to 153.8 ±152.4 Watts during interval 1 on day 8, a 2.5 fold increase. Interval 4 increased from 79.8 ± 78.7 Watts on day 1 to 173.6 ±156.2 Watts on day 8, a 2.2 fold increase. The RPE varied from hard to somewhat hard (15 ± 2.9 to 13 ± 0.7, respectively) for interval 4 from session 1 to session 8. For RT, total rowing repetitions increased from 23.2 ±3 during session 1 to 34.4 ± 9.5 during session 8. Squats progressed from 19.4 ±6.5 repetitions on day 1 to 32.6 ±7.5 on day 8. According to ability level, push-ups were performed either on a wall, windowsill or the ground and repetitions increased from 23.8 ±2.9 during session 1 to 28.8 ±7.2 during session 8. Further results will be determined mid-way through the program (after session 12) and after 24 sessions.
CONCLUSION: Advanced NSCLC patients are able to do HIIT and RT. They show progression in intensity, number of intervals and in RT exercises. RPE was maintained, suggesting that participants were capable of maintaining an elevated exercise intensity at every training session. Results show that HIIT and RT result in physiological improvements. Thus, HIIT was well accepted by the participants, safe, and more interestingly, showed muscle power improvement in a short period of time. In the five patients up to now, we have 100% adherence rate.

EFFECT OF EXERCISE TRAINING ON CIRCULATING LEVELS OF WISP-1 IN BREAST CANCER SURVIVORS

KONG, I.

YONSEI INSTITUTE OF SPORTS SCIENCE AND EXERCISE MEDICINE

INTRODUCTION: Wnt-1 inducible signaling pathway protein 1 (WISP-1) is a human breast cancer oncogene and a potential therapeutic target. Despite the general benefits to cancer patients, the effects of exercise on the serological markers associated with Wnt signaling remain unclear. Our previous study has demonstrated the changes in Wnt modulators elicited by exercise training in breast cancer

survivors. Therefore, the aim of this study was to investigate whether exercise training affects the serum level of WISP-1 in patients with breast cancer.
METHODS: Thirty-four breast cancer survivors who have received anti-cancer therapy and twelve age-matched healthy women participated in this single-blind randomized, controlled pilot study. Breast cancer survivors were randomly assigned to either an exercise program or a control group for 12 weeks and completed pre- and post-training tests for physical fitness and body composition as well as blood biomarkers. The serum level of WISP-1 was measured using enzyme-linked immunosorbent assay as the primary outcome.
RESULTS: Breast cancer survivors showed higher levels of serum WISP-1 compared to healthy women at baseline (63.8 ± 18.5 vs. 113.0 ± 41.1 pg/mL, p <0.001). Exercise training for 12 weeks did not only improve and remedy several kinanthropometric and metabolic parameters, but also reduced the serum level of WISP-1 (baseline vs. after 12 weeks, 115.9 ± 45.9 vs. 97.4 ± 33.7 pg/mL, p < 0.05) in breast cancer survivors. But no significant changes were detected in the serum level of WISP-1 of control group (110.1 ± 36.8 vs. 105.4 ± 41.1 pg/mL, p = 0.407).
CONCLUSION: These findings suggest that WISP-1 may be a notable serological parameter reflecting the beneficial effects of exercise training in breast cancer survivors.

EIGHT WEEKS OF ENDURANCE COMBINED WITH RESISTANCE TRAINING IMPROVES QUALITY OF LIFE IN WOMEN WITH BREAST CANCER.

PONCE-GONZÁLEZ, J.G., ESTEBAN-GARCÍA, F.
UNIVERSITY OF CÁDIZ

INTRODUCTION: Loss of quality of life (QOL) is the most common unmanaged symptom of patients with cancer who are receiving radiation therapy, chemotherapy, or biotherapies. Exercise programs could increase functional capacity during chemotherapy. Hence, the main aim of this study was to improve the quality of life through an exercise intervention in women with breast cancer after.
METHODS: Thirty seven voluntary women in treatment of breast cancer were enrolled in this exercise intervention. Subjects' characteristics, including age, body composition, level of physical activity, sleep quality, movement capacity, fatigue and pain sensation were collected before and after 8 weeks of exercise intervention. The intervention included supervised and controlled easy resistance and aerobic exercise during 3 times per week. The intensity was evaluated with borg scale and heart rate during each exercise.
RESULTS: The quality of life was improved in 93% of cases after exercise intervention. Fatigue sensation was reduced ~48% and pain sensitivity ~28% compared to pre-values (p<0.001). Movement capacity in arms was increased ~27% after exercise intervention. Moreover, sleep quality was improved a 45% (p<0.05). There is an inverse association between the gain in movement capacity and pain sensation (r=-0.7, p<0.05). In turn, there is an association between BMI at the start of the program and improving the sensation of pain (r = 0.6, p = 0.07), determining that it is very important to have a lower BMI at the start of the intervention to decrease the sensation of pain.
CONCLUSION: Supervised resistance and aerobic exercise programs during breast cancer treatment seem to be a promising and feasible therapy in the management of quality of life. Therefore, it seems that aerobic exercise combined with resistance exercise may have positive economic and social consequences for patients with cancer.

REGULAR EXERCISE TRAINING CAN COUNTERACT THE EFFECT OF A CHRONIC RESPIRATORY DISEASE: A CASE REPORT

MERLO, C., BERNARDI, E., MUNARI, L., SORINO, N., BALLERIO, F., COGO, A.
UNIVERSITY OF FERRARA

INTRODUCTION: Idiopathic pulmonary fibrosis (IPF) is a chronic, progressive, interstitial lung disease associated with exercise intolerance and hypoxemia, poor prognosis and few therapeutic options. A recent review highlighted the importance of exercise training in IPF management1. On the contrary, very few information is available about the exercise capacity of amateur athletes after an IPF diagnosis.
METHODS: We present the case of a 44-year-old male amateur cyclist, diagnosed with IPF 2 years ago, after 2 years of dry cough during exercise and progressive exercise intolerance.
He asked our evaluation to assess his exercise capacity and obtain a training programme and advices to continue cycling. In fact, he complained exaggerated dyspnoea during exercise.To note that he started exercise very fast without a proper warm up. He was taking Pirfenidone and Prednisone 5 mg.
RESULTS: 1° visit: spirometry: restrictive defect (FEV1 72%, TLC 61%, FVC 67%), Diffusing Capacity 45%. Cardiopulmonary exercise test (CPT) on a cycle ergometer (15 W/min) stopped by the operator at 135 W due to oxygen desaturation (SpO2 85%); ventilation (VE) 52 L/min; breathing reserve (BR) 40 L, heart rate (HR) 73% of max HR. VO2 peak: 70% of expected. Anaerobic Threshold reached at 114 bpm and >40% of VO2, max Tidal Volume (TV) 1.45 L, Breathing Frequency (BF) 37/min.
2° visit: CPT with O2 2 L/min stopped by the subject at 163 W due to muscle fatigue (Borg 8/10); SpO2 90%, VE 58 L/min and HR 79%.
He was advised to train 3 times/ week for at least 40 minutes in O2, maintaining SpO2 ≥90% and HR 110-120 bpm (without exceeding 140 bpm).
Subsequently, he trained for 6 months following these recommendations.
3° visit: Spirometry unchanged, CPT with the same protocol and O2. He stopped at 173 W, SpO2 90%, VE 71 L/min, BR 34 L, HR 84%. Max TV 1.8 L, BF 39/min. At 135 W (last step of 1° CPT) VE was 45 L/min, BF 25/min, TV 1.8 L.
In the last 4 months he performed 904 km cycling outdoor, 30 km brisk walking/running, 103 km cycling at home, following the prescribed intensity (information got from a GPS running app).
CONCLUSION: The use of O2 and the proper exercise intensity allowed him to train regularly without excessive fatigue. He could reach a higher peak work rate and a VE (obtained with greater TV and less BF) even if his respiratory impairment did not change.
An amateur athlete with IPF can continue to perform his physical activity provided he follows medical advice. Regular and continuous exercise training seems to counteract the progressive functional impairment due to the chronic respiratory disease.

Conventional Print Poster

CP-PM09 Hydration and temperature

EFFECTS OF 3 MATCHES IN A WEEK ON FOOTBALL PERFORMANCE AND DEHYDRATION LEVEL IN HOT ENVIRONMENTS

YASUMATSU, M.1,2,3, TOBITA, N., NAKAMURA, D.3, TANABE, Y.3, IWAYAMA, K.3, ISHIBASHI, A.3, NAKAMURA, M.3, ISHII, Y.3, TAKAHASHI, H.3

RIKKYO UNIVERSITY , 2: JAPAN FOOTBALL ASSOCIATION , 3: JAPAN INSTITUTE OF SPORTS SCIENCES

INTRODUCTION: Football players are supposed to play 3 matches in 7 days in the Summer Olympic Games, which means having only 3 days (72 hours) of recovery between the matches. Mohr et al. (2016) showed that the inflammatory response of the 3-days-recovery schedule was greater than that of 4 days. However, there is no research investigating the effects in the special setting of 3 following matches with only 3 days off in between, respectively. Moreover, it is well known that exercise performance is limited in hot environments (Nybo, 2008). Extreme heat is expected for the 2020 Tokyo Olympic and Paralympic Games. Therefore, the present study was conducted to examine effects of a 3 days' recovery in between the games for a total of 3 matches on football performance and dehydration level in hot environments.
METHODS: Fifteen male collegiate soccer players competed in 3 matches (M1, M2 and M3) in 7 days with a 3 days' break each in hot conditions. The nude body mass was measured before and after the matches to evaluate the dehydration level. High time-resolution GPS (15 Hz; GPSport) was utilized to monitor the activity profiles during the matches (Randers et al., 2010). Differences in the activity profiles between 3 matches were determined using a one-way repeated-measures analysis of variance (ANOVA). In the case of a significant difference between 3 matches, a Bonferroni's post hoc test was used to identify the points of difference.
RESULTS: The WBGT of M1 (24.0 ± 0.6 C°) was lower than those of M2 (27.0 ± 0.6 C°) and M3 (29.0 ± 0.5 C°).
The total distance and the distance covered in high-intensity running (>13 km/h) was significantly lower in M3 compared to M2 ($p<0.05$), which also was significantly lower compared to M1 ($p<0.01$). Concerning the distance covered in sprinting (>22 km/h), M2 was significantly lower than M1 ($p<0.05$), but there was no difference between M3 and M2. The percentage of standing and walking during M2 was significantly higher than in M1 ($p<0.05$), whereas that of high-intensity running was significantly lower ($p<0.05$). Although low-speed, moderate-speed and high-speed running was significantly lower in M3 compared to M1 ($p<0.05$), there were no differences in the percentage of sprinting between all the 3 matches.
The body water loss during the matches was comparatively high, but it did not change significantly between the 3 matches (M1: 3.0 ± 0.8 %, M2: 3.0 ± 1.1 %, M3: 3.0 ± 1.2 %).
CONCLUSION: The physical performance, except for the sprinting, during the 3 matches separated only by 3 days each in hot environments gradually decreased towards the third match. The reason for the reduction of the performance may not be due to dehydration level though as could be expected for hot environments.
REFERENCES:
Mohr M. et al. (2016). Eur J Appl Physiol, 116, 179-193.
Nybo L., J. Appl. Physiol. (2008). 104, 871-878.
Randers M.B. et al. (2010). J Sports Sci, 28(2), 171-182.
CONTACT:
[yasumatu@rikkyo.ac.jp]

EFFECTS OF ACUTE L-GLUTAMINE SUPPLEMENTATION ON EXERCISE-INDUCED IMMUNE DISTURBANCES IN A HOT AND HUMID ENVIRONMENT

ZHENG, C.1,2, CHEN, X.K.1,3, ZHOU, Y.1, YU, J.J.2, WONG, S.H.2

1 BEIJING SPORT UNIVERSITY; 2 THE CHINESE UNIVERSITY OF HONG KONG; 3 THE UNIVERSITY OF HONG KONG

INTRODUCTION: Exhaustive exercise under an adverse environment (e.g., hot and humid environment) may induce immune disturbances which lead to impaired athletic performance and health. Glutamine is a non-essential amino acid that is necessary for the maintenance of a proper immune function, especially in a stressful situation like exercise. The purpose of this study was to explore the effects of acute L-glutamine ingestion on immune responses to the exhaustive exercise in a hot and humid environment.
METHODS: This is a randomized, crossover, double blind study including thirteen healthy untrained young men (age, 20.2 ± 1.1 yrs; body height, 177.8 ± 3.9 cm; body weight, 71.3 ± 7.3 kg; maximum oxygen uptake [VO2max], 55.9 ± 3.9 ml·kg-1·min-1). Each subject conducted two trials glutamine (GLN; 0.6 g/kg body weight of L-glutamine mixed with sugar-free lemon drink) and placebo (PLA; an equal amount of the sugar-free lemon drink) with a 2-week interval. In each main trial, the subject ingested either GLN or PLA thirty minutes prior to exercise (40% VO2max to exhaustion) on a treadmill in a chamber with 38 ± 1°C, 60 ± 5% relative humidity, and 20.8% oxygen. Heart rate (HR), core body temperature (TGI), forehead temperature (TFH), and rating of perceived exertion (RPE) were monitored to assess exhaustion during exercise. Blood samples were collected before and immediately after exercise. Lymphocyte subsets (total lymphocyte count; absolute count and percentage of CD3+, CD19+, CD3+CD4+, CD3+CD8+, and CD3-CD16+CD56+; and CD4+/CD8+) were measured by Flow Cytometry, while hematologic parameters were examined by a BC-5180 Automatic Blood Cell Analyzer. Immunoglobulins (IgG, IgA, and IgM) and complements (C3 and C4) were measured by Roche Cobas c501 Chemistry Analyzer. Two-way (trial; PLA and GLN; time; pre- and post-exercise) analysis of variance (ANOVA) with repeated measures was used to compare the difference of immune responses.
RESULTS: No significant difference of exercise duration between two trials was observed (PLA vs. GLN: 42.0 ± 9.5 vs. 39.6 ± 7.8 min). In placebo trial, natural killer (NK) cells and neutrophils were significantly elevated after exercise ($p<0.01$); in contract, CD4+/CD8+ ratio and CD19+ lymphocytes were significantly reduced after exercise ($p<0.05$). Moreover, count of CD3+ ($p<0.05$) and CD3+CD8+ T lymphocytes were elevated after exercise with L-glutamine treatment. Meanwhile, a potential increase of absolute count of CD3+CD4+ lymphocytes ($p=0.08$) was also detected after exercise in GLN trial.
CONCLUSION: Acute L-glutamine supplementation evokes CD3+ and CD3+CD8+ T lymphocytosis while it has no effects on neutrophil and NK cell leukocytosis. The findings suggest a protective effect of the acute L-glutamine supplement on immune functions after exhaustive exercise in a hot and humid environment.

IMPACT OF AMBIENT TEMPERATURE ON THE ENERGY COST OF WALKING IN HEALTHY YOUNG MALES

HORIUCHI, M.1, HANDA, Y.1, FUKUOKA, Y.2

1> MT. FUJI RESEARCH INSTITUTE, YAMANASHI, JAPAN 2> DOSHISHA UNIVERSITY, KYOTO, JAPAN

INTRODUCTION: The bipedal locomotion of humans is a definitive feature of our lineage; therefore, effective locomotor cost is of central importance. The energy cost of walking (Cw) per unit distance (J kg-1 meter-1) displays a U-shaped curve as a function of walking speed, and there exists a particular walking speed that minimises the Cw, which is known as economical speed (ES). Several environmental factors (e.g. hypoxia and gradient) may influence both the Cw and ES. However, little is currently known about the energy cost of human locomotion under different ambient temperature (Ta) conditions (e.g. hot and/or cold conditions).
METHODS: Fourteen healthy young males with a mean age of 24 ± 5 years, a height of 173 ± 6 cm and a body mass of 69 ± 10 kg (these values are means ± standard deviation [SD]) participated in the present study. They walked at 7 gait speeds, from 0.67–1.67 m s-1 (4 min per stage), under 3 different environmental conditions; the room temperature was set at (a) 23?, (b) 13? and (c) 33?, and exposure to these temperatures occurred in random order. The Cw was calculated using pulmonary oxygen uptake (VO2) and carbon dioxide output (VCO2), and individual ESs were also calculated from a quadratic function curve.
RESULTS: Both VO2 and VCO2 linearly increased in accordance with increasing gait speed, and no statistical differences were noted among different Ta conditions. However, at faster gait speeds, both VO2 and VCO2 showed slightly higher values during the 33? trial. Similarly, the Cw at faster gait speeds during the 33? trial was slightly higher compared to the Cw in both the 23? and 13? trials, which resulted in a significant interaction (walking speed × Ta) in the Cw ($P < 0.05$). Pulmonary ventilation (VE) and heart rate (HR) also linearly increased in accordance with increasing gait speed. Moreover, those values in the 33? trial were significantly higher compared to both the 13? and 23? trials. We found a significantly slower ES at 33? (1.265 ± 0.060 m s-1) compared to both 23? and 13? (1.349 ± 0.077 m s-1 and 1.356 ± 0.078 m s-1, $P < 0.05$, respectively). HR responses in the 33? condition showed higher values throughout the walking trial compared to 23? and 13? (all $P < 0.05$). Mean skin temperature and skin blood flow were statistically different throughout the walking trials among all conditions (33? > 23? > 13?, all $P < 0.05$).
CONCLUSION: These results suggest that an acute mild hot condition, ~ Ta= 33?, did not strongly affect the overall Cw values. However, this mild hot condition slowed the individual ES, while no effect of the cool condition was found on either the Cw or the ES. From observing VE and HR kinetics, the significantly slower ES at 33? may be related to hyperventilation and a higher HR in healthy young males in the present study.

ICE SLURRY INGESTION DURING BREAK TIMES ATTENUATES THE INCREASE OF CORE TEMPERATURE IN SIMULATED MATCH-PLAY TENNIS IN THE HEAT.

NAITO, T., SAGAYAMA, H., AKAZAWA, N., HARAMURA, M., TASAKI, M., TAKAHASHI, H.

JAPAN INSTITUTE OF SPORT SCIENCES

INTRODUCTION: This investigation assessed the effect of ice slurry ingestion compared to that of cold water ingestion during break times on thermal strain and perception in simulated match-play tennis in the heat.
METHODS: Seven male recreational athletes (age = 22 ± 2 yr, height = 1.72 ± 0.08 m, Body mass = 64.8 ± 6.8 kg) performed two trials in a climate chamber, each time completing 4 sets of simulated match-play. During International Tennis Federation-mandated breaks (90-s between odd-numbered games; 120-s between sets), either ice slurry or cold water were ingested. The rectal temperature, forehead skin temperature, heart rate, rating of thermal comfort and total sweat loss were measured.
RESULTS: The change in rectal temperature in the ice slurry trial was significantly lower than that in the cold water trial by game 3 of set 3 ($p = 0.02$). These differences in △rectal temperature persisted throughout the remainder of the "match" ($p < 0.05$). Forehead skin temperature, heart rate and rating of thermal comfort were significantly lower in the ice slurry trial than in the cold water trial by the second half of the experiment ($p < 0.05$). Total sweat loss in ice slurry trial is significantly lower than cold water trial ($p = 0.002$).
CONCLUSION: These results suggested that ice slurry ingestion was more effective than cold water ingestion in mitigating the development of heat strain during simulated match-play tennis in the heat.

EFFECT OF ENVIRONMENTAL TEMPERATURE ON HIGH INTENSITY INTERVALS IN WELL-TRAINED CYCLISTS

BOYNTON, J.R., DANNER, F., MENASPÀ, P., PEIFFER, J.J., ABBISS, C.R.

EDITH COWAN UNIVERSITY

INTRODUCTION: Performance of steady-state endurance exercise close to lactate threshold is reduced in substantially hot and cold environmental temperatures (TA), demonstrating an inverse U-shaped relationship between TA and endurance performance (Galloway and Maughan, 1997; Peiffer and Abbiss, 2011). Paradoxically, endurance athletes train a small duration at threshold intensity while maximal high-intensity aerobic intervals (interval training) are an important component of endurance training (Stöggl and Sperlich, 2015). This study examined the influence of a range of TA on performance and physiological responses (e.g. body temperature and cardiopulmonary measures) during interval training. Similar to the findings of previous research (Galloway and Maughan, 1997; Peiffer and Abbiss, 2011), it was hypothesized that power output and oxygen consumption (VO2) would be highest in the 13°C condition and lower in the 5°C, 22°C, and 35°C conditions.
METHODS: Eleven well-trained cyclists completed four interval sessions at 5°C, 13°C, 22°C, and 35°C (55% RH) in a randomized order. Interval sessions involved a standardized warm-up at a neutral temperature (22°C) and five self paced 4-minute high intensity intervals interspersed with five minutes of recovery. Power output, VO2, core temperature (TC), and heart rate (HR) were recorded during the sessions.
RESULTS: Mean session power output for 13°C (366 ± 32 W) was not markedly higher than 5°C (365 ± 35 W, P= 1.00, ES= .030), 22°C (364 ± 36 W, P= 1.00, ES= 0.061), or 35°C (351 ± 31 W, P= .129, ES= 0.441). Power output was lower in the 5th interval of the 35°C condition compared with all other TA, yet no significant interactions were observed between 5°C, 13°C, and 22°C conditions. VO2 was not significantly different across TA (P= .187). TC was higher in 22°C compared with both 5°C and 13°C (P= .001). HR in the 4th and 5th intervals were higher in 35°C compared with 5°C and 13°C.
CONCLUSION: This study demonstrates that whilst mean power outputs for intervals are similar across TA, hot TA (≥35°C) has a negative effect on interval power output later in a training session (> 20 min). This study also shows power output for intervals in a TA as low as 5°C is not affected when performed by well-trained cyclists. In conclusion, well-trained cyclists performing maximal high-intensity aerobic

intervals after a standardized warm-up can achieve near optimal power output over a broader range of TA than previous literature has indicated.

ACUTE EFFECT OF LOW-LOAD RESISTANCE TRAINING COMBINED WITH THERMAL STIMULATION ON MUSCLE SWELLING

NAKAMURA, M.1, YOSHIDA, T.1, KIYONO, R.1, SATO, S.1, TAKAHASHI, N.1

NIIGATA UNIVERSITY OF HEALTH AND WELFARE

INTRODUCTION: The muscle atrophy and muscle weakness was caused by the various condition, such as neuromuscular diseases, musculoskeletal disease, disuse and aging. Resistance training is a main method to treat muscle atrophy and muscle weakness. In general, high-load resistance training is recommended to cause muscle hypertrophy and muscle strengthening. However, low-load resistance training has been conducted for elderly people and postoperative patients. In the previous studies in vitro (Goto K, et al. 2003, Yamashita-Goto K, et al. 2002), the thermal stimulation caused the synthesis of heat shock protein 72 and induced the muscle hypertrophy. Therefore, the muscle hypertrophy and muscle strengthening could be caused by low-load resistance training combined with heat stimulation. In addition, thermal stimulation is classified as superficial and deep thermal stimulation. However, the acute effect of low-load resistance training of the triceps brachii combined with superficial or deep thermal stimulation on muscle swelling remains unclear. The purpose of the present study was to investigate the effect of ow-load resistance training combined with superficial or deep thermal stimulation on muscle swelling.
METHODS: hirteen healthy males volunteered to participate in this study. The superficial thermal stimulation condition and deep thermal stimulation condition and control were conducted in random order. In all conditions, the resistance training was performed using a dumbbell mass adjusted to 30% of 1-repetition maximum. In superficial thermal condition, hot pack was conducted for 20 min before resistance training. In deep thermal condition, ultrasound (frequency of 3 MHz, intensity of 1.5 W/cm2 100% duty cycle) was conducted for 20 min before resistance training. The muscle thickness of triceps brachii was measured as an indicator of muscle swelling obtained by ultrasonography before and after resistance training. Significant differences between before and after resistance training in each condition were determined using the paired t-test.
RESULTS: The muscle thickness was increased significantly after resistance training combined thermal or deep thermal stimulation condition. However, there was no significant change in control condition.
CONCLUSION: The results of the present study suggested that the muscle hypertrophy might be caused by low-load resistance training combined with thermal stimulation, regardless of superficial thermal stimulation and deep thermal stimulation.

THERMOREGULATORY RESPONSES IN ELITE ALPINE SKIERS

ALHAMMOUD, M., CHASTAN, D., RACINAIS, S.

FEDERATION FRANCAISE DE SKI

INTRODUCTION: Alpine skiing requires prolonged cold exposure on the chairlift or waiting between runs making the athlete potentially at risk of hypothermia. During the run itself, the high velocity can increase the risk of frostbite. The athletes don't wear the same protective clothing than the accompanying staff, but the latter do not have exercise-induced heat production questioning the relative risk of those two populations. In the absence of any field data on the thermoregulatory responses of international elite winter-sport athletes, the IOC has called to characterize such specific thermal strain. Therefore, the aim of this study was to characterize the thermoregulatory responses of elite alpine skiers.
METHODS: Core temperature (Tcore) was recorded via an ingestible capsule from 18 skiers x sessions and 16 staffs x sessions. Skin temperature (Tskin) was concomitantly recorded as 0.3*chest + 0.3*arm + 0.2* thigh + 0.2*shin temperatures. EMG activity was measured on the chairlift to estimate shivering. Training sessions lasted between 2h20 and 3h30 and average environmental temperature was 0.2±1.7°C.
RESULTS: Average Tcore was higher in skiers than staffs (37.5±0.2 vs 37.2±0.2°C, p<0.001). While average Tskin was not statistically different between skiers and staffs (30.5±0.4 vs 31.2±0.8°C, p=0.093), skiers reached lower minimal Tskin during their training than staffs (28.4±0.7 vs 30.3±0.9°C, p=0.001). This difference was due to lower minimal temperature on the upper body (chest: 28.5±1.0 vs 32.5±1.3 p<0.001; arm: 29.7±0.5 vs 31.0±1.0 p=0.009), without differences on the lower body (thigh: 26.6±1.3 vs 26.8±1.6 p=0.888; shin: 26.4±1.3 vs 27.1±1.7 p=0.451). During the course of the training session, the Tcore slightly increased in skiers (first/last 10%: 37.3/37.6°C, p<0.001) but the Tskin decreased (first/last 10%: 31.4/30.1°C, p<0.001).
CONCLUSION: Elite alpine skier can slightly increase their core temperature while skiing in cold environment, likely due to metabolic heat production. However, the values remain lower than what is reported in team sports or endurance summer sports. In addition, skiers cannot sustain their skin temperatures when wearing their racing suit, potentially affecting neuromuscular control.

THERMO-PHYSIOLOGICAL RESEARCH OF MICRO AND INTERLAYER CLIMATE DURING CYCLING – INFLUENCE OF TWO DIFFERENT BACKPACK SYSTEMS

KLAUER, R.1,2, MICHEL, F.I.1

VAUDE SPORT GMBH & CO. KG

INTRODUCTION: The thermoregulation during exercise has an influence on the wearing comfort of functional clothing. Research has been done about the micro climate (between skin and base layer). But during many outdoor activities people wearing backpacks. However, there are no studies at the moment which addresses the thermo-physiological comfort of backpacks. To understand the heat and vapour transfer of the clothing-backpack system, information about the interlayer climate (between clothing and backpack) is needed. With the generation of these data, the aim of this study was to measure the thermo-physiological impact of two different backpack systems.
METHODS: Five well-trained males performed the test scenario of 40 minutes cycling (two intervals of basic and one interval of intensive endurance) and 15 minutes rest. The subjects were tested in a climate chamber at 20°C and 50% relative humidity. Temperature and humidity were measured with combi sensors between skin and clothing and between clothing and backpack. Based on literature (Schindelka et al., 2013) and adjusted on the scientific issue four sensors are located on the back (2), chest and on the lower arm (micro climate). Regarding the interlayer climate three sensors are positioned on the backpack. Furthermore, the perceived exertion plus temperature and humidity perception were gathered every five minutes.

RESULTS: By wearing a regular backpack, the heat transfer on the back is limited. However, the data clearly indicates the ventilated backpack system is able to enhance the heat transfer compared to a regular backpack system. Concerning the micro climate, the temperature during cycling with a regular backpack increases up to 26% compared to cycling without backpack. In contrast, with a ventilated backpack system the temperature increases maximum up to 18%. In addition, the results show a correlation between micro and interlayer climate. The temperature decreases from the micro climate to distal layers. Furthermore, the subjects could feel the temperature differences in terms of less perceived exertion and temperature with a ventilated backpack system.
CONCLUSION: The results for the micro climate are confirmed by the data of Jack (2009). Due to the lack of literature a comparison with other thermo-physiological studies concerning the influence of different backpack systems isn't possible. In conclusion the ventilated backpack system during submaximal cycling exercise has a positive effect on the whole climate management by reducing the temperature and by delaying the increase of the moisture (micro climate). So that this study can be the base for the design of thermo-physiological optimized backpack systems.
REFERENCES:
Jack A. (2009). Dissertation, University Bayreuth.
Schindelka B, Litzenberger S, Sabo A. (2013). Procedia Engineering (60), 46 – 50.
CONTACT:
robert.klauer@vaude.com

Conventional Print Poster

CP-PM10 Ergogenics and supplements

INGESTION OF MAPLE SAP DURING HIGH-INTENSITY INTERMITTENT EXERCISE: COMPARISON WITH GATORADE© AND STEVIA ON GLYCEMIA AND EXERCISE RPE

LEDUC-SAVARD, N.1, LAVOIE, L.1, TREMBLAY, J.1, DUPUY, O.2
1:UNIVERSITY OF MONTREAL, CANADA ; 2:UNIVERSITY OF POITIERS, FRANCE

INTRODUCTION: We aim to compare the relationship between glycemia (GLY) and rating of perceived exertion (RPE) during high-intensity intermittent exercise while ingesting sport drinks (containing either maple sap, glucose, or a commercial solution [Gatorade©]; all at 6% carbohydrate per volume), placebo (stevia) or water.
METHODS: 78 subjects completed six (6) 3-minute bouts at 95% of their maximal aerobic power (MAP) on a stationary bike, with 3 minutes of passive rest in between efforts. The subjects were randomly allocated to a different drink ingestion and each group is composed of 15 subjects (with the exception of the control group with n=18). Following each bout, subjects ingested 166 mL of one of the 5 possible drinks, drinking a total of 1L of the same solution throughout the experimentation. Glycemia was measured before and after a 10-minutes warm-up, immediately after every 3-minute bout on the bike, as well as 15 and 30 minutes post-exercise, for a total of 10 times during the whole experimentation. Glycemia was measured using an Aviva Accu-Check glucometer. RPE was assessed using Borgs 10 point scale, at the end of each high-intensity bout. Statistical analysis was performed using a two-way ANOVA with repeated measures using R. Results are reported as mean ± standard deviation.
RESULTS: A main effect was observed for the type of solution ingested: glucose ingestion led a higher GLY (6.6 ± 1.3 mmol/L) than in all other conditions. Both Gatorade© (6.3 ± 1.3) and maple sap (6.0 ± 1.0) did not significantly increase GLY more than water (5.2 ± 0.4 mmol/L). Stevia (5.6 ± 0.9) showed a similar GLY as water and maple sap, but lower than Gatorade©. Maple sap showed a lower GLY than glucose but was not significantly different from Gatorade©. RPE increased gradually over time ($p < 0.05$) but was not different between conditions: 6.7 ± 0.5, 7.0 ± 1.5, 7.1 ± 1.6, 6.9 ± 1.4 and 7.1 ± 1.2, for water, stevia, glucose, Gatorade© and maple sap, respectively.
CONCLUSION: Maple sap appears to be a viable carbohydrate solution for intermittent exercise, leading to a similar glycemic response to a widely distributed commercial product (Gatorade©). Although no differences were observed in perceived exertion during the intermittent exercise protocol, both maple sap and Gatorade© have shown a lesser increase in glycemia, when compared to glucose. This could be explained by the lower glycemic index of maple sap, mainly composed of sucrose, and Gatorade© being composed of a mixture of sucrose, glucose and fructose.

EFFECTS OF A PROPRIETARY SUPPLEMENT ON THE ACUTE RESPONSES IN REACTION TIME, MENTAL PERFORMANCE, AND INDICATORS OF FOCUS IN ATHLETIC POPULATIONS

TAYLOR, L.1, URBINA, S.1, VILLA, K.1, ZARAGOZA, J.1, SANTOS, E.1, JUANEZA, A.1, TINNIN, M.1, BOGGS, T.1, BATES, S.1, FOSTER, C.1, DAVIDSON, C.2, ZHANG, Z.2, WILBORN, C.1
1-UNIVERSITY OF MARY HARDIN-BAYLOR; 2-THE NATURES BOUNTY COMPANY

INTRODUCTION: The purpose of this study was to determine if acute ingestion of a supplement containing caffeine, theanine, and tyrosine has positive effects on reaction time, cognitive fatigue, and physical performance as well of indicators of mood in athletic populations.
METHODS: Twenty (20.5±1.4 yr; 182±8.61 cm; 83.87±12.60 kg; 13.84±5.55 %BF) male current or former athletes completed a cross-over, double-blind, randomized and placebo-controlled study. Following a familiarization protocol, participants completed two exercise sessions that included baseline (PRE) measurements of: reaction time, mental/physical performance, and VAS indicators of focus and mood. The Makota Arena was used to assess reaction time and accuracy markers using single (MK1) and three (MK3) tower protocols in which participants respond to auditory and visual ques. Participants ingested either: proprietary supplement (PS) or placebo (PL) and rested for 30 minutes. All measures were reassessed at 30 min (EXP1) post-ingestion and then after two rounds of exercise (EXP2 and EXP3) used to induce whole body fatigue. Participants returned in 2 weeks to repeat testing under standardized conditions.
RESULTS: General Linear Models were used to analyze change scores from baseline for all dependent variables using Minitab 17 with a-priori p-value set at $P<0.05$. Significant treatment effects for MK1 accuracy ($p = 0.026$), MK3 targets hit ($p=0.003$), MK3 average hit time ($p=0.044$) and MK3 accuracy ($p=0.004$) all indicating improved performance in markers associated with reaction time and performance. Significant treatment effects were observed for: MK1 accuracy at EXP3 ($p=0.002$), MK3 target hits at EXP1 ($p=0.022$), MK3 accuracy at EXP1 ($p=0.022$) indicating significantly improved performance in the experimental group. No significant effects for performance variables during the exercise sessions or changes in VAS (focus, alertness, concentration, fatigue, motivation, energy) were observed. The proprietary supplement was well-tolerated with no reports of acute adverse effects.

CONCLUSION: The key findings of this study suggest that acute consumption of caffeine, theanine, and tyrosine can improve reaction time and accuracy in both a single tower (stationary) and three-tower (dynamic) level of performance in an athletic population, in a protocol designed to mimic the mental and physical demands of competition. These effects occurred in absence of changes in subjective markers of fatigue and focus.

EFFECT OF NEW ZEALAND BLACKCURRANT ON CARDIOVASCULAR RESPONSES DURING SITTING REST AND TREADMILL WALKING IN THAI MEN

PARKTIN, N.1, WIDJAJA, W.1, AJJIMAPORN, A.1, WILLEMS, M.E.T.2

1MAHIDOL UNIVERSITY , 2UNIVERSITY OF CHICHESTER

INTRODUCTION: In European men, New Zealand blackcurrant (NZBC) affected cardiovascular responses during supine rest (Cook et al., 2017a) and submaximal isometric exercise (Cook et al., 2017b). Genotype and nutritional habits of people with different ethnicities may affect responses to nutritional ergogenic aids. We examined effects of NZBC extract on cardiovascular responses during sitting rest and moderate intensity exercise in South East Asian (i.e. Thai) men.
METHODS: Twelve healthy Thai men (age: 22±3 yrs, BMI: 21.6±1.2 kg•m-2) participated. In the 1st visit, resting metabolic equivalent (1-MET) was measured (Oxycon™ mobile) and an incremental walking protocol completed to establish the relationship between walking speed and MET. In the 2nd and 3rd visit (double blind randomized cross-over design), cardiovascular parameters were measured (Physioflow) during sitting rest (2x10 min) and a 30-min treadmill walk at 5-MET with intake of either two capsules of placebo (PL) or NZBC extract (600 mg CurraNZ, Health Currancy Ltd, UK; capsules contain 35% blackcurrant extract powder) for 7-days with a 7-day washout. One-tailed paired t-tests were used with significance accepted for $P<0.05$ and a trend for $0.05>P=0.10$.
RESULTS: NZBC extract had no effect during sitting rest ($P>0.05$). During 30-min of treadmill walking at 5-MET, no differences were observed for heart rate, ventricular ejection time and end-diastolic volume. With NZBC, there was a trend for increased stroke volume by 12% (PL: 83.2±25.1; NZBC: 93.0±24.3 mL, $P=0.072$) and cardiac output by 12% (PL: 9.2±2.6; NZBC: 10.3±2.8 L•min-1, $P=0.057$). Systemic vascular resistance was decreased by 10% (PL: 779±267; NZBC: 697±245 dyn•s•cm-5, $P=0.048$).
CONCLUSION: NZBC extract had no effect on cardiovascular function during sitting rest in recreationally active Thai males in contrast to observations in endurance trained European males (Cook et al., 2017a). During treadmill walking and intake of NZBC extract, Thai males showed cardiovascular responses indicating vasodilatory effects during moderate intensity exercise. Our findings seems to suggest that ergogenic responses to anthocyanin intake from New Zealand blackcurrant may depend on ethnicity. Future work should address the cardiovascular responses to New Zealand blackcurrant intake in people with different ethnicity, but with similar training status, exercise modality and exercise intensity.
References: Cook MD, Myers SD, Gault ML, Edwards VC, Willems MET (2017a). Eur J Appl Physiol. 117(2), 247-254.
Cook MD, Myers SD, Gault ML, Willems MET (2017b). Nutrients 2017, 9(6).
Contact: [m.willems@chi.ac.uk]
Supplementation was provided by Health Currancy Ltd, United Kingdom. Attendance of Willems was supported by New Zealand Blackcurrant Co-operative, New Zealand.

ACUTE EFFECT OF CAFFEINE INGESTION ON VO2 SLOW COMPONENT AND MUSCLE FATIGUE DURING A HIGH-INTENSITY CYCLING EXERCISE

GUGLIELMO, L.G.A.1, ESTRELA, R.L.D.1, BITTENCOURT, M.A.1, DO NASCIMENTO SALVADOR, P.C.1, DE LUCAS, R.D.1, GRASSI, B.2

1:FEDERAL UNIVERSITY OF SANTA CATARINA , 2:UNIVERSITY OF UDINE

INTRODUCTION: Caffeine is a substance commonly ingested as an ergogenic aid due to its possible effects on performance. Focus has shifted to caffeine's action within the central and peripheral nervous systems, which could reduce the rate of perceived exertion (RPE) as well as the ability of the skeletal muscle to generate power (Black et al., 2015). However, the effect of caffeine on the possible relationship between muscle fatigue and VO2 slow component (VO2SC) requires further research. Thus, the aim of the present study was to analyze the effects of caffeine ingestion on the VO2SC and muscle fatigue during a cycling exercise.
METHODS: A double-blind randomized cross-over study was completed. Twelve healthy subjects (26.2 ± 4.7 years; total body mass 77.7 ± 8.9 kg; height 177.3 ± 6.5 cm) performed a standard warm-up exercise before a 5 s all-out isokinetic sprint test (AIT) at 120-rpm to measure the peak cycling torque (PT). At the completion of this phase, the participants ingested 6 mg.kg-1 of caffeine or placebo capsules 60min prior to a constant high-intensity work-rate exercise (CWR) during an 8 min period. . The CWR was followed immediately by AIT to measure the decrease in peak torque. Peak torque was considered as the average of the peak torque for each leg in all conditions. A paired t-student test and repeated measures ANOVA were used assuming significance at 5 %.
RESULTS: Caffeine ingestion PT was significantly lower (20.2 ± 14.3 %; $p = 0.01$) at the end of CWR but there was no difference comparing this to the placebo condition ($p = 0.99$). The VO2SC showed no differences in both conditions (0.45 ± 0.2 L.min-1; $p = 0.20$). On the other hand, blood lactate concentration ([La]) at the end of CWR was higher (9.0 ± 2.5 vs. 8.3 ± 2.2; $p <0.01$) and RPE was significantly lower (16 ± 2 vs. 17 ± 2) in the caffeine condition.
CONCLUSION: The results obtained showed that the ingestion of 6 mg.kg-1 of caffeine was not able to alter the behavior of oxygen uptake and was not enough to alter muscle fatigue during a high-intensity exercise. This work showed that caffeine does not impact on the relationship between muscle fatigue and VO2SC. The changes found in [La] after the ingestion of caffeine suggests an alteration in anaerobic energy production, and RPE maybe related to changes in both central and peripheral adenosine receptors, which are known to be involved in nociceptive pathways (Black et al., 2015), at least, during high-intensity CWR cycling exercise.
Contact: luiz.guilherme@ufsc.br

EFFECTS OF BEETROOT JUICE ON PHYSICAL TENNIS PERFORMANCE IN TRAINED MALE PLAYERS

QUINTANA, I.

UNIVERSIDAD FRANCISCO DE VITORIA

INTRODUCTION: Beetroot juice (BJ) contains high levels of inorganic nitrate (NO_3^-) and its intake has proved effectivity at increasing blood nitric oxide (NO) concentrations (Dominguez et al., 2018). The ingestion of BJ has been associated with improvements in endurance sports

(Dominguez et al., 2017) and in physical performance in intermittent sports such as soccer (Nyakayiru et al., 2017) aim of this study was to investigate whether BJ could improve physical performance in tennis players.
METHODS: Nine well-trained tennis players (24.93±4.16 years) participated during their preparatory period of their tennis season participated in the study. Subjects were randomly divided into two groups undergoing a test battery with BJ or placebo (PLAC) in two separated days with one week between protocols. The test battery consisted in different test such as, serve velocity/accuracy test (SVA), countermovement jump (CMJ), isometric handgrip strength (HIS), 5-0-5 agility test (AGIL) and 10-m sprint (10M).
RESULTS: No significant improvements was observed in any physical parameters analysed comparing BJ versus PLAC protocol, SVA (p=0.536; 1,13% improvement), CMJ (p=0.820; 1.52% improvement), IHS (p=0.096; 4.37% improvement), AGIL (p=0.200; 2.31% improvement) and 10M (p=0.434; 1.06% improvement).
CONCLUSION: Our data suggest that tennis physical performance does not improve with BJ ingestion versus PLAC ingestion, however more investigation is needed in the tennis field.

SPORTS DIETICIANS IN ELITE SPORT - WHERE ARE WE NOW?

HAUDUM, J.1, SPENCE, K.2

1: UNIVERSITY OF SALZBURG 2: DAIRY WEST

INTRODUCTION: Athletes in many sports are supported by a large team of experts including doctors, physiotherapists, sport scientists. In recent years sports dieticians/nutritionists (SDN) have made their way into such support groups as well and, when present, have become a vital component of multidisciplinary teams. Each provider of such a multidisciplinary team plays a pivotal role in the support of an athlete. As a team member, a SDN can provide input into various aspects, such as energy requirements, dietary supplements, hydration, recovery strategies, weight management, recovery from injury (Steinmuller et al., 2009).
METHODS: Drawing on the observations from the current situation and experiences in sports such as cycling, soccer and skiing, we explore the current situation of sport nutrition support in elite sports.
RESULTS: Despite being more present in sport teams, SDN are an underrepresented group in elite sport. At present, there are still many cases where other departments within a sport team cover nutrition support (e.g. soccer, skiing). But in the past 20 years the practice and expertise of SDN has evolved. Professional sport nutrition support includes aspects which cannot be covered by other professions without respective dietetic education.
Also, very recently, the knowledge of the importance of nutrition in professional sport has grown. Interestingly though, inquiries on where athletes refer to for sport nutrition information have shown that most nutrition information comes from coaches, athletes, physicians or family (Kratzenstein et al., 2016).
CONCLUSION: These observations confirm that SDN are not yet recognized as the nutrition experts for professional dietary advice. Since general nutrition knowledge among athletes is poor (Torres-McGehee et. al., 2012), the SDN can also play a role by educating athletes in healthy eating, grocery shopping and cooking. These interventions can affect performance, but everyday life. More knowledge will make athletes more resistant to popular diet trends too. Nutritional advice is also beneficial when athletes have to follow a restricted diet due to clinical conditions. Furthermore, it is important to clarify that SDN are no team cooks and have not the same role. However, the misconception is widespread. This is definitely not the case based on different nutrition knowledge and skills.
The current situation highlights the need to further communicate the scope of practice of SDN and promote SDN as a valuable part of multidisciplinary teams. Team managements then hopefully acknowledge the potential to add SDN to sport teams.
Steinmuller PL, Meyer NL, Kruskall LJ, et al. (2009). JAMA, 109 (3): 544-552, 552.e1-30
Kratzenstein SM, Carlsohn A, Heidenreich J, et al. (2016). Dtsch Z Sportmed, 67: 13-17.
Torres-McGehee TM, Pritchett KL, Zippel D, et. al. (2012). Journal of Athletic Training, 47 (2): 205-211.
Contact: info@sportnutrix.com

METHODOLOGY PROPOSAL TO VERIFY THE REAL EFFECT OF ERGOGENIC AIDS ON HUMAN PERFORMANCE – POPPER'S PRINCIPLE

AZEVEDO, P., OLIVEIRA, M.G., TANAKA, K., PEREIRA, P.E.A.

FEDERAL UNIVERSITY OF SÃO PAULO

INTRODUCTION: The use of ergogenic aids, like caffeine, can improve performance during endurance exercise. The evidence came from well-designed studies, in which subjects received either ergogenic aid or placebo in a randomized and counter-balanced order and double-blind manner. However, the methodology applied on these previous studies has the bias of only testing the hypothesis of a different result between ergogenic aid and placebo.
METHODS: Here we propose a new methodology, which aims to deny the hypothesis of a different result between treatments on performance output, based on Popper's advice. The novelty here is the expectancy of volunteers to use a harmful treatment for performance, when, indeed, we treated the subjects with a theoretically beneficial treatment , which is a different approach in comparison with placebo or nocebo studies.
To test this new methodology, we recruited 10 subjects physically active. They came to the laboratory 5 times: a> familiarization; b> 30-minutes of running as control ; c> three different sessions of 30-minutes of running when the subjects were submitted to the treatments . The participants were informed that they could be ingesting either caffeine, placebo or lactic acid. We did not make suggestions what they could be consuming. Nevertheless, they consumed the ergogenic aid that improves performance in all sessions All tests were done on a treadmill. We instructed the subjects to do their best performance over 30-minutes reaching the longest distance as possible. Previous studies with similar trials duration have shown a performance improvement for caffeine.
The subjects consumed caffeine supplementation 60 minutes before running, with a dosage of 6 mg/kgBM. This study was blind for volunteers.
RESULTS: The caffeine supplementation was not beneficial to improve performance. The Magnitude-based inference for distance covered in 3 trials with caffeine against control was "Likely Trivial" .
CONCLUSION: Here we provide evidence that the Popper's principle, when properly applied, is the best method to evaluate the effectiveness of ergogenic aid instead of RCT. We think that this methodology could test the real effect of caffeine on performance. Therefore, the actual paradigm that caffeine is a potent ergogenic aid to improve endurance performance looks like more a psychological effect than physiological.

INGESTION OF MAPLE BASED SPORTS DRINKS: EFFECT ON PERCEIVED EXERTION, PALATABILITY AND TIME-TRIAL PERFORMANCE

LAVOIE, L., LEDUC-SAVARD, N., TREMBLAY, J.

UNIVERSITÉ DE MONTRÉAL

INTRODUCTION: The ingestion of carbohydrate (CHO) drinks during prolonged exercise are known to improve performance in endurance sports. The aim of this study was to investigate the role of palatability and perceived exertion (RPE) during 2h or cycling followed by a 20-km time-trial (TT) performance while ingesting either maple syrup, sap, glucose, Gatorade©, or sweetened water (stevia).
METHODS: Subjects (n = 76, mass = 73.7 ± 10.3 kg, VO2max = 4.4 ± 0.5 L/min, MAP = 309 ± 42 W) were randomly allocated to an experimental group where they ingested CHO solutions (60 g/L) or sweetened water (stevia) during 120 min of steady-state exercise (SSE) on a cycle ergometer at 55% MAP, followed by a 20-km TT on the same ergometer. RPE (Borg) were recorded at each 30 min throughout SSE and TT. Subjects were administered a sensory questionnaire 30 minutes before and immediately after SSE, the average is reported. Sensory characteristics (sweetness, acidity, refreshing, and overall taste) were measured using a 20-cm visual analogue scale and converted to percent. Beverage appreciation (sweet, acid and overall appreciation) was measured on a 9-point scale. Statistical analysis was performed using a two-way ANOVA with repeated measures using R.
RESULTS: Main effects were found for time and treatment when analysing RPE data during SSE ($p < 0.05$). Furthermore, while no difference in RPE was observed between stevia, glucose, Gatorade and maple syrup, subjects ingesting maple sap reported a significantly lower RPE than with Gatorade© and maple syrup (12.6 ± 2.0 vs 13.7 ± 2.1 and 13.6 ± 2.1, respectively).
Sweetness was reported to be higher for Gatorade© and maple sap than glucose and stevia (64 ± 16, 65 ± 19 vs 43 ± 19 and 49 ± 20%, respectively), although maple syrup scored higher than maple sap for the appreciation of the sweet taste (6.7 ± 1.6 and 4.3 ± 1.7). Maple syrup also scored significantly higher than maple sap for overall taste and appreciation ($p < 0.05$). Gatorade© was rated significantly higher than all other drinks for the acid taste ($p < 0.05$), but no effects were found related to the appreciation of this acid taste. There was no difference in TT performance in any of the conditions.
CONCLUSION: Maple sap and Gatorade© are the two drinks that scored the highest for the intensity of the sweet taste, although perceived exertion was reported to be lower with maple sap than for Gatorade© ingestion. These results tend to suggest that sweetness or sweet taste could interact with RPE during prolonged exercise. This was despite the fact that subjects reported a lower appreciation of the sweet taste of maple sap, compared to other conditions. Sensory and perceptual responses did not appear to be related to changes in time-trial performance.

Conventional Print Poster

CP-PM11 Nutrition and supplements 2

EFFECT OF NEW ZEALAND BLACKCURRANT EXTRACT ON MUSCLE FIBRE-SPECIFIC FATIGUE

PERKINS, I.C., BRADLEY, M., BLACKER, S.D., WILLEMS, M.E.T.

UNIVERSITY OF CHICHESTER

INTRODUCTION: New Zealand blackcurrant (NZBC) increased peripheral blood flow (Matsumoto et al., 2005) and femoral artery diameter during submaximal isometric contraction (Cook et al., 2017) possibly due to anthocyanin-induced release of nitric oxide (NO) (Ziberna et al., 2013). Blood flow by increased NO is more pronounced in type II muscle fibres (Ferguson et al., 2013). We examined effects of NZBC extract on muscle fibre-specific fatigue using methods by Hamada et al (2003).
METHODS: Twelve males (age 24±5 yrs; height 180±5 cm; mass 89±11 kg) were tested on 3 occasions; familiarization, after 7 days of NZBC extract (600mg·day-1 CurraNZ containing 210mg anthocyanin), or placebo (PL) (double-blind, randomized, crossover design, 14 days washout). Participants performed a voluntary and electrical contraction protocol by Hamada et al (2003). Briefly, sixteen, 5-sec maximal isometric voluntary contractions (MVCs) of the quadriceps were separated by 3-sec rest. Maximal twitches were evoked prior to the first MVC, during the 3-sec rest and during a 5-min recovery after the last MVC with twitches after 5-sec, 25-sec, and every 30 sec thereafter.
RESULTS: NZBC extract allowed greater force in the first quartile of the MVCs. There was a trend for a main effect of condition of twitch force ($p=0.103$). NZBC extract produced 15% greater force in the resting twitch, from twitch 11 and during recovery. However, there was no interaction effect of condition over the 27 maximal twitches ($p=0.82$). Four subjects were classified into predominant type I (n=2) and type II (n=2) muscle fibre subgroups (Hamada et al. 2003). In type II, NZBC increased MVC force in the first, second, and third quartiles (e.g. first, NZBC: 3523±341N, PL: 2673±98N). In type I, NZBC showed an increased maximal twitch force during the protocol and recovery.
CONCLUSION: NZBC extract seems to show a trend for increased fatigue resistance of quadriceps muscles. Individual responses indicated NZBC extract to have fibre-specific responses, with increased force for type II and increased fatigue resistance for type I fibres. Future work on mechanisms for muscle fibre specific responses to anthocyanin-rich NZBC extract are warranted.
References: Cook MD et al (2017) Nutrients. 9(6), 556.
Ferguson SK et al (2013). J Physiol. 591, 547-557.
Hamada T et al (2003). Acta Physiol Scand. 178, 165-173.
Matsumoto H et al (2005). Eur J Appl Physiol. 94, 36-45.
Ziberna L et al (2013). Nutr Metab Cardiovasc Dis. 23(1), 68-74.
Contact: [m.willems@chi.ac.uk]
Supplementation was provided by Health Currancy Ltd, UK. Attendance of Willems was supported by New Zealand Blackcurrant Co-operative, New Zealand.

EFFECT OF NEW ZEALAND BLACKCURRANT EXTRACT ON SPORTS CLIMBING PERFORMANCE

POTTER, J.A., PERKINS, I.C., HODGSON, C.I., BROADHURST, M., HOWELL, L., GILBERT, J., WILLEMS, M.E.T.

UNIVERSITY OF CHICHESTER

INTRODUCTION: Rock climbing places a high workload on the forearm flexors (Giles et al., 2006) and observations during intermittent isometric contractions have highlighted the importance of blood flow during the short recovery periods (Fryer et al., 2015). More specifical-

ly, higher force time integral values achieved during the intermittent test by elite climbers have been attributed to improved blood flow upon release of an isometric hold (Fryer et al., 2015). Blackcurrant anthocyanin supplementation increased forearm blood flow at rest (Matsumoto et al., 2005) and increased femoral artery diameter during submaximal isometric contraction (Cook et al., 2017). There would appear to be justification for the use of New Zealand Blackcurrant (NZBC) as an ergogenic aid in sports climbing in an attempt to delay the onset of fatigue and enhance rock-climbing performance.
METHODS: Twenty experienced climbers (2 females) (age 23±5 yrs; height 177±8 cm; mass 71±8 kg) were tested on 3 occasions; familiarisation, after 7 days of NZBC extract (600mg·day-1 CurraNZ containing 210mg anthocyanin), and placebo (PL) (double-blind, randomized, crossover design, 14 days washout). The number of pull-ups on a finger-board (Metolius ® Finger Board) until failure, 90° lock off hang time was followed by 3 climbs to volitional exhaustion on a Treadwall (Brewer Ledge M6) self-selected pace at 90° with a 20-min recovery period between climbs. Heart rate (Polar®H7), rate of perceived exertion (RPE) (Borg, 1982), climbing duration and distance were recorded.
RESULTS: NZBC extract resulted in an 8% increase in hang time (p=0.035), and an 11% increase in climb duration between climb 1 and 3; a 23% decrease climb duration was observed in the placebo condition: interaction effect (p=0.003). There was a main effect for climb with the mean heart rate declining across the three (p<0.001). No effect was seen for pull-ups, maximum heart rate, RPE and distance climbed.
CONCLUSION: Data indicate that NZBC extract improves sports climbing endurance, possibly through improved local blood flow. The improved hang time suggests that this was not dependent on release of the isometric hold as seen in previous work by Fryer et al. (2015). Future work may explore the effect of anthocyanin-rich NZBC extract on other types of climbing and conditions.
References: Borg GA et al. (1982). Med Sci Sports Exerc 14(5), 355-381.
Cook MD et al (2017) Nutrients. 9(6), 556.
Fryer S et al. (2015). Int J Sports Med, 36(2), 137-142.
Giles LV et al. (2006). Sports Med, 36(6), 529-545.
Matsumoto H et al. (2004). Eur J Appl Physiol, 94(1-2), 36-45.
Contact: [m.willems@chi.ac.uk]
Supplementation was provided by Health Currancy Ltd, UK Attendance of Willems was supported by New Zealand Blackcurrant Co-operative, New Zealand.

EFFECT OF NEW ZEALAND BLACKCURRANT ON METABOLIC AND PHYSIOLOGICAL PARAMETERS DURING SITTING REST AND TREADMILL WALKING IN THAI MEN

WILLEMS, M.E.T.1, PARKTIN, N.2, WIDJAJA, W.2, AJJIMAPORN, A.2
1UNIVERSITY OF CHICHESTER , 2MAHIDOL UNIVERSITY

INTRODUCTION: Intake of New Zealand blackcurrant shifted the lactate curve in European men and women and increased exercise-induced fat oxidation in European men . Ethnicity may affect responses to nutritional ergogenic aids. We examined effects of NZBC extract on metabolic and physiological parameters during rest and moderate intensity exercise in South East Asian men.
METHODS: Seventeen healthy Thai men participated. In the 1st visit, resting metabolic equivalent <1-MET> was measured <1-MET: 4.0±0.4 ml·kg-1·min-1> and an incremental walking protocol was completed to establish the relationship between walking speed and MET. In the 2nd and 3rd visit , metabolic and physiological parameters were measured during sitting rest <2x10 min> and a 30-min treadmill walk at 5-MET with 7-day intake of either placebo or two capsules of NZBC extract <600 mg CurraNZ, Health Currancy Ltd, UK; capsules contain 35% blackcurrant extract powder> and a 7-day washout. Substrate oxidation was calculated with equations from Jeukendrup and Wallis <2005>. One-tailed paired t-tests were used with significance accepted at P<0.05.
RESULTS: NZBC extract had no effect on metabolic and physiological parameters during sitting rest and during treadmill walking at 5-MET , carbohydrate oxidation , fat oxidation , and respiratory exchange ratio . For both conditions, the Pearson correlation for fat oxidation during rest and exercise was significant .
CONCLUSION: New Zealand blackcurrant extract had no effect on fat oxidation during treadmill walking in recreationally active Thai men in contrast to observations during cycling in endurance trained European men . Our findings suggest that ergogenic responses to anthocyanin intake from New Zealand blackcurrant may depend on ethnicity. Future work should address the metabolic and physiological responses to New Zealand blackcurrant intake in people with different ethnicity, but with similar training status, maximum oxygen uptake, exercise modality and exercise intensity.
References: Cook MD, Myers SD, Blacker SD, Willems MET <2015>. Eur J Appl Physiol. 115<11>, 2357-2365.
Jeukendrup AE, Wallis GA <2005>. Int J Sports Med. Suppl 1, S28-S37.
Willems MET, Myers SD, Gault ML, Cook MD <2015>. Int J Sport Nutr Exerc Metab. 25<4>, 367-374.
Contact: [m.willems@chi.ac.uk]
Supplementation was provided by Health Currancy Ltd, United Kingdom. Attendance of Willems was supported by New Zealand Blackcurrant Co-operative, New Zealand.

THE EFFECT OF HIGH FAT DIET FEEDING DURATION ON THE CONCENTRIC AND ECCENTRIC CONTRACTILE PROPERTIES OF ISOLATED MOUSE SOLEUS AND EXTENSOR DIGITORUM LONGUS MUSCLES

HURST, J.
COVENTRY UNIVERSITY

INTRODUCTION: Recent evidence has demonstrated an obesity induced, muscle specific, reduction in contractile performance. Given the role of skeletal muscle in locomotion and substrate metabolism, it has been proposed that direct obesity effects on skeletal muscle may catalyse a negative obesity cycle. Eccentric function is vital for of daily living, and the greater demand on this form of muscle action in obese individuals, the effect of obesity of eccentric muscle function is unexamined. As such, the present study aimed to uniquely examine the effect of obesity on both concentric and eccentric isolated mouse muscle performance using the work loop (WL) technique.
METHODS: Female CD-1 mice aged 4 weeks were randomly split into four groups. Two lean groups, one eccentric (LE) and one concentric (LC) (n=16) which received standard lab chow, an obese eccentric (OE) or obese concentric (OC) group (n=16) which received 20 weeks of a high fat diet (HFD). At 24 weeks of age, slow twitch soleus (SOL) or fast twitch extensor digitorum longus (EDL) muscle was isolated and absolute and normalised (relative to muscle cross sectional area) maximal isometric tetanic force, maximal concentric or eccentric WL power output (PO), either concentric or eccentric fatigue resistance and post fatigue concentric recovery were measured.

RESULTS: Body mass and fat pad mass were significantly higher in the obese group, by 35.7% and 260% respectively. For the SOL, maximal isometric stress, absolute eccentric PO, absolute concentric PO and normalised concentric PO were unaffected. However, maximal normalised eccentric PO was significantly reduced and absolute isometric force was significantly higher in the obese group. The OC group fatigued significantly faster than LC, however eccentric fatigue was unaffected. For the EDL, maximal isometric force, isometric stress, normalised eccentric PO, absolute concentric PO, absolute eccentric PO and both concentric and eccentric fatigue were unaffected. However, normalised concentric PO was reduced in the obese group. Interestingly, the OE group recovered to a greater magnitude than LE post fatigue, there was no such difference in the SOL.
CONCLUSION: These findings add to previous literature demonstrating a muscle specific reduction in the concentric performance of isolated skeletal muscle that is likely related to in vivo mechanical role and fibre type. Moreover, these findings uniquely show that a HFD causes a decline in eccentric power output of the SOL, however the EDL remains unaffected. The decline in SOL eccentric power output could be detrimental to everyday activities of an obese individual with less power producing muscles and elevated body mass. Interestingly the OE group of the EDL saw no significant decline in power and recovered to a greater magnitude than LE counterparts suggesting possible training benefits using this mode of muscle function. As the results from the eccentric and concentric groups differ, it suggests that the mechanisms which affect them also differ

EFFECT OF A 9-WEEK RESISTANCE HEAVY TRAINING WITH AND WITHOUT PROTEIN SUPPLEMENTATION IN UNTRAINED SUBJECTS

VANDONI, M.1, CORREALE, L.1, CODRONS, E.1, CARNEVALE PELLINO, V.1, LIBERALI, G.1, DELL'ANNA, S.1, RICAGNO, E.1, CASIRAGHI, E.1,2

1 LABORATORY OF ADAPTED MOTOR ACTIVITY, DEPARTMENT OF PUBLIC HEALTH, EXPERIMENTAL MEDICINE AND FORENSIC SCIENCE, UNIVERSITY OF PAVIA, ITALY 2EQUIPE ENERVIT S.R.L., ZELBIO, ITALY

INTRODUCTION: The use of protein supplementation in association with resistance training is largely widespread. Many studies have investigated the effects of this practice on strength and body composition. Researches focused on protein supplementation in association with resistance training, but untrained subjects after a heavy resistance training were not studied before. The aim of this study was to investigate protein supplementation in association with heavy resistance training in order to maintain/increase strength and modify body composition.
METHODS: 43 subjects (age 19-35 years, healthy and resistance exercise untrained) were randomly divided in 2 groups: Protein Group (PG), supplemented with 0.25 g. protein/kg pre and post workout during training days, and Control Group (CG) (exercise only). Every subject performed the same training for 9 weeks (1familiarization+8training) with 3 supervised session/week, composed by 3 pre-post fatigue circuits: Legs Circuit (LC) (leg extension, leg press machine, leg curl), Arms Circuit (AC) (pectoral machine, bench press, triceps machine) and Back Circuit (BC) (lat machine, vertical row, biceps curl). Subjects performed 4 sets of 6 R at 75% of 1 RM for first and third exercise of every circuit and 10 RM for the second exercise of every circuit with one minute of recovery. At the end of the first conditioning week (T0) and at the end of 8th week (T1) every subject performed 1 RM test at Leg Press machine (LP), Bench Press (BP) and Lat Machine (LM) and was evaluated on height, body weight, body composition with Bioelectrical Impedance Analyser. Differences from T0 were calculated with paired t-test while independent t-test on delta values (T1-T0) assessed differences between groups.
RESULTS: 34 subjects completed the study (PG=12 males and 7 female, CG=10 males and 5 females, mean age 27.0±1.8 years). PG had a significant decrease in fat mass ($p<0.0001$) and increase in fat free mass and lean mass ($p<0.001$). Both groups had a significant increase in 1RM in every circuit. There were no significant differences between any anthropometric variable.
CONCLUSION: Final strength values were significant higher in both groups suggesting that it was independent from mass gain probably due to a better fibre recruitment. Moreover results showed that protein supplementation in addition to heavy resistance program influenced body composition increasing fat free and lean mass and decreasing fat mass respect to exercise only likely for a lack of protein for muscle rebuild. These results should be implemented in a larger sample but could drive to new application in the field of resistance training.
References:
Negro M., Vandoni M., Ottobrini S., Codrons E., Correale L., Buonocore D., Marzatico F.
Protein supplementation with low fat meat after resistance training: effects on body composition and strength. Nutrients 2014, August (6):3040-46.

PREVALENCE AND METHODS OF RAPID WEIGHT LOSS REPORTED BY MIXED MARTIAL ARTISTS

CONNOR, J., EGAN, B.

DUBLIN CITY UNIVERSITY

INTRODUCTION: Rapid weight loss (RWL) is a common practice in sports that have weight class restrictions including Mixed Martial Arts (MMA). RWL generally refers to the methods employed by an athlete in reducing body mass in the range of 5% to 10% in the final one to two weeks before competition. Considering the increasing popularity of MMA, but documented deaths attributed to RWL practices, the creation of bodies such as Safe MMA recognised the importance of documenting the habits of fighters during weight cutting to establish if safe and effective strategies are being employed for weight cutting. The aim of the present study was to evaluate self-reported practices of RWL in a sample of competitive MMA athletes comprising of both amateur and professional fighters.
METHODS: This was an anonymous online questionnaire based study on current or previous weight cutting behaviours. RWL was defined to the participants as reducing body mass between 5-10% in 7 days or less prior to fights. The questionnaire used in this study was based on the previously-validated Rapid Weight Loss Questionnaire (Artioli et al. 2010) with the addition of questions on water loading and salt baths. Participants (n=30; all male, n=15/15 professional/amateur) from several MMA clubs around Dublin, Ireland that are associated with Straight Blast Gym (SBG) completed the survey.
RESULTS: 97% of those surveyed lost weight in order to compete: 89% used water-loading "sometimes" or "always"; 55% used fasting for 24 hours as a means to acutely manipulate body mass; salt baths are used "always" or "sometimes" by 75% of respondents. The RWL score for this sample was 37.9 (34.2, 41.6). Cross-code comparison revealed a higher score for professional [40.8 (35.9, 45.8)] compared to amateur [34.8 (29.2, 40.4)] athletes i.e. difference of 6.1 (-1.1, 13.1)($p=0.093$), with the magnitude of effect interpreted as 'moderate' ($d=0.64$). 41% replied that fellow fighters were "very influential" and 37.9% that their coaches/mentors were "very influential" in their RWL behaviours. 66.7% said that doctors were "not influential" and 41.4% said that dieticians were "not influential".

CONCLUSION: The present study found that MMA fighters have a higher RWL score than other combat sports. RWL is widespread in MMA, across both amateur and professional levels, with water loading and hot salt baths among the most predominant methods used. There exists very little research on these methods for body mass reduction and performance in combat sports in general and MMA specifically.

Conventional Print Poster

CP-PM12 Validity and Variability

A VERIFICATION PHASE FOR A TAEKWONDO-SPECIFIC CARDIOPULMONARY EXERCISE TEST

ESTEVES, D., HAUSEN, M., ARAUJO, M.P., HAUSEN, L., MACHADO, A., SOARES, P.P., GURGEL, J.

FEDERAL FLUMINENSE UNIVERSITY

INTRODUCTION: A new method to assess the cardiopulmonary fitness of taekwondo athletes (TcTKD) was proposed and yielded higher cardiopulmonary responses than a treadmill-running test. However, the attainment of a true VO2MAX is still a concern during the cardiopulmonary assessment. The verification phase strategy is the most widely accepted to verify a true VO2MAX. Therefore, this study aims to purpose and validate a verification phase for the TcTKD.
METHODS: The sample consisted of 11 male WTF taekwondo athletes (mean±sd: 20±4 yrs, body weight 66.1±7.9 kg, height 176±8 cm). TcTKD and verification phase were repeated across three visits, separated by 2-7 days. The TcTKD comprised progressive stages of turning kicks (bandal tchagi). Between the incremental and verification phases, participants rested at a seating position for 5 minutes. Verification phase was started with one minute of 'reentrance' (1 min of three sub stages of the 20s with 3rd, 5th, and 7th stages) and followed by the stage immediately above the highest completed stage of the incremental phase, with a duration determined by participants' exhaustion. Oxygen uptake (VO2) was recorded with 20s average data points with VO2000 (Medical Graphics, USA) and heart rate (HR) was recorded beat-by-beat with the Polar V800 HR monitor (Polar Electro, Finland). The repeatability statistical analysis was performed with the standard error of measurement and the intraclass correlation coefficient (ICC) between incremental and verification VO2MAX and HRMAX, both were determined by the highest value obtained during each test.
RESULTS: VO2MAX of incremental and verification phase presented a standard error of measurement of 1.3 (2.3%), 2.3 (4.1%) and 2.9 (5.2%) ml.kg-1.min-1 and an ICC of 0.94 ($p<0.001$), 0.93 ($p=0.001$) and 0.84 ($p=0.004$). Whereas the HRMAX of incremental and verification phase presented a standard error of measurement of 1.6 (0.8%), 1.4 (0.7%) and 1.3 (0.7%) beats.min-1 and an ICC of 0.99 ($p<0.001$) for all three visits.
CONCLUSION: The error obtained at each visit was acceptable as it was within the 6% variation limit determined. In addition, the ICC for VO2MAX was good to excellent for all visits. Regarding HRMAX, a small percentage of error and an excellent ICC were observed. The verification phase confirmed the values of VO2MAX and HRMAX reached in the incremental test during all visits, suggesting a valid and reliable method for the measurement and confirmation of the actual values of VO2 and HR reached in the incremental phase.

HIGH VARIABILITY OF MECHANICAL POWER OUTPUT DURING INCREMENTAL ROWING ERGOMETER TESTS IN FEMALE ELITE ROWERS

MENTZ, L., TREFF, G., WINKERT, K., STEINACKER, J.M.

UNIVERSITY HOSPITAL OF ULM

INTRODUCTION: On wind braked rowing ergometers, mechanical power output is not externally adjustable but determined by the rower's stroke frequency, -force and distance. This leads to a currently unknown variation in mechanical power output that might influence physiological variables like [blood lactate]. To this end, we calculated the variation of mechanical power output of submaximal steps during an incremental test in elite rowers.
METHODS: Thirteen female elite rowers (body mass 74.7 ± 5.0 kg; height 179.7 ± 4.5 cm; Power at [blood lactate] 4 mmol/L 289.7± 11.9 W) performed a stepwise incremental test (180 W + 40W/4 min; 5 steps) on a rowing ergometer (Concept 2, Morrisville, USA). Steps were separated by a 30-s break. The ergometer was modified with a force sensor and a rotary transducer to allow for exact calculation of power (FES, Berlin, Germany). Power was measured stroke-by-stroke and saved in a log-file. Afterwards all data, excluding the last stroke, were log-transformed and the coefficient of variation (CV) was calculated for each step using a mixed model approach.
RESULTS: The average CV amounted to 5.55 ± 0.25% (95%CI 5.04 – 6.07%). The CV significantly decreased from stage 1 to 2 and 2 to 3 ($p < .001$ and $p <.05$, respectively). Highest individual CV was 12.3% at stage 1, corresponding to 17.7 W at an average power of 144 W. CV significantly decreased ($p < .05$), when the first three strokes of each stage were excluded from the analysis, leading to an average CV of 2.95 ± 0.14% (95% CI 2.64 – 3.23 %).
CONCLUSION: Even in elite rowers, mechanical power output varies considerably during 4 min lasting constant load stages. The variation is highest in the lowest steps. Notably, the first three strokes affect the CV of each stage significantly, which is due to an over pacing at the start of each new target load. Taking into account the impact of the first strokes and the extremely high variation of particular athletes, these variations probably affect physiological variables. However, this has not been examined in this study.

VALIDATION OF ACCELEROMETERS FOR ESTIMATING PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR IN PRE-SCHOOL CHILDREN DURING FREE LIVING ACTIVITY

DOBELL, A.P.1, EYRE, E.L.J.1, TALLIS, J.1, CHIN A PAW, M.2, ALTENBERG, T.2, DUNCAN, M.J.1

1: COVENTRY UNIVERSITY 2: VU AMSTERDAM

INTRODUCTION: During the preschool years, physical activity behaviours develop and likely track into childhood and adolescence . Accelerometry is becoming one of the key tools used to objectively assess PA in pre-schoolers. Few studies have examined the validity of accelerometers to assess PA during free play in pre-schoolers. This study examined the validity of accelerometry, to assess free play PA in pre-schoolers.
METHODS: Following institutional ethics approval, parental informed consent and child assent, 36 pre-schoolers aged 3-4 years <23 males, 13 females> participated in the study. Participants wore two accelerometers ; one on their dominant wrist and one on their right

hip during one hour of free play. Concurrently, direct observation, using the OSRAC-P protocol , was used to determine sedentary behaviour, light or moderate-to-vigorous intensity PA undertaken by the preschoolers. The accelerometers were initialized to record activity in 10 second epochs at 100Hz. Acceleromter raw counts of three, 10 second epochs were accumulated to match the 30-second observation periods. Receiver Operating Curve analysis was used to evaluate the ability of both accelerometers to predict, sedentary, light and moderate-vigorous activity.
RESULTS: Results from ROC curve analysis revealed that sedentary behaviour and moderate-to-vigorous PA obtained from the wrist and hip placed accelerometers demonstrated fair agreement with the observations 0.7>. Sensitivity and specificity were fair to good. ROC curve analysis however indicated that accelerometer determined light PA had poor agreement with the observation comparison measure, for both the hip and wrist placement and weak levels of sensitivity, although specificity was high .
CONCLUSION: This current research suggests that accelerometry is a fair measure for sedentary behaviour and moderate-to-vigorous PA in preschool children. Hip placement of the accelerometer was marginally more accurate than dominant wrist placement, congruent with previous research . Accelerometry failed to adequately assess light PA. The irregular nature of PA in preschoolers may have contributed to the difficulty of determining light PA measurement via accelerometry . Further research refining the assessment of light PA using accelerometry in preschool children is therefore warranted.

VALIDITY OF THE FITBIT CHARGE HR2 IN OUTDOOR WALKING AND RUNNING

HARENBERG, S., DIPRETA, M., SHERNAN, M.

ITHACA COLLEGE

INTRODUCTION: Wearable fitness trackers have become increasingly popular in healthy and clinical populations as a means for monitoring activity levels. These devices have the potential to be effective in promoting physical activity and healthy lifestyles. For example, fitness trackers have been frequently used in behaviour change interventions. Yet, evidence of the concurrent validity of fitness trackers is imperative in verifying the accuracy of these devices (Kooiman et al., 2015). The present study examines one of the leading wearable trackers worldwide, the Fitbit Charge HR2. Currently, there is a lack of evidence of its concurrent validity to measure indicators of physical activity (e.g., heart rate, step count) in outdoor conditions. Hence, the purpose of the present study was to test the concurrent validity of the Fitbit Charge HR2 in outside walking and running.
METHODS: In total, 21 healthy volunteers (female n=14) participated in the study. Participants completed three trials of outdoor activity (i.e., standing in place for 6 minutes, walking one mile, and run/jog one mile). Step count and heart rate data were collected on the Fitbit Charge HR2. As gold standards, a Polar H7 chest strap and a count of videotaped steps were used. Statistical analyses included mean absolute percentage errors, one-sample t-tests, and intraclass correlation coefficients (ICC).
RESULTS: The Fitbit Charge HR2 significantly underestimated heart rate for all three intervals (mean differences=-5.95 - -17.08, SDs=9.48-13.68; ps<.01). ICCs ranged from .43-.63, indicating poor agreement between the Fitbit and the Polar H7 chest strap. The Fitbit Charge HR2 also significantly underestimated step count for walking (mean difference=-22.35, SD=44; p<.05) with a good ICC (.96). For running, no significant underestimation was found (p=.064). The ICC revealed an acceptable agreement of .94 between the Fitbit Charge HR2 and the counted steps.
CONCLUSION: The present study indicates that the Fitbit Charge HR2 may be usable to measure steps in outdoor walking and running. However, the Fitbit Charge HR2 consistently underestimated heart rate at rest and during outdoor walking and running. As such, the Fitbit Charge HR2 should be used with caution for the measurement of heart rate during activity (e.g., in clinical or non-clinical settings). Limitations and future research directions are discussed.
References: Kooiman T, Dontje M, Sprenger S, Krijnen W, van der Schans C, de Groot M (2015). BMC Sports Sci Med Rehabil, 71, 24.
Contact: sharenberg@ithaca.edu

VALIDITY OF A JUDO-SPECIFIC CARDIOPULMONARY EXERCISE TEST

ARAUJO, M., HAUSEN, M., ESTEVES, D., MACHADO, A., HAUSEN, L., PORTO, F., SOARES, P.P., GURGEL, J.L.

FLUMINENSE FEDERAL UNIVERSITY

INTRODUCTION: Judo is a combat sport with a complex intermittent metabolic demand, characterised by anaerobic and aerobic metabolic pathways contributions. The literature indicates different tests to assess the physical fitness of judo athletes. However, few methods are aimed to evaluate aerobic power. The development of a specific test that enables evaluation of the cardiorespiratory response during judo practice is crucial to individualise aerobic training prescription. Therefore, this study aimed to verify the validity of a judo-specific cardiopulmonary exercise test.
METHODS: Nine athletes (age: 20 ± 2 yrs; body mass: 64.7 ± 9.9 kg; height: 167 ± 7 cm) performed two tests - Running cardiopulmonary exercise test (CPET) and Judo-Specific Cardiopulmonary Exercise Test (JST) - on two separate occasions, with a counterbalanced order, separated by 2-7 days. Each stage of the JST last 1 minute, and the load increment was based on a gradual reduction of the interval (0.7s) between Ippon-Seoi-Nage executions, guided by a sound signal. Cardiorespiratory variables were assessed using a metabolic gas analyser VO2000 (Medical Graphics, USA) and a Polar V800 (Polar, Kempele, Finland). Blood lactate was assessed with a portable analyser Lactate Plus (Novabiomedical, Waltham, USA). The variables measured were: peak oxygen uptake (l ̇O2PEAK) and heart rate (HRPEAK), (̇O2 and HR at ventilatory thresholds 1 and 2 (VT 1 and 2), peak blood lactate concentration ([LA-]PEAK), rating of perceived exertion (RPE). The study had the approval of Fluminense Federal University ethical committee according to resolution 466/12 of National Health Council (report number 996/926).
RESULTS: No significant differences were found between CPET and JST, except for the [LA-]PEAK (p = 0.020). However, the highest] ̇O2 and HR at VT 1 and 2 values were found in JST (a ̇O2 VT1: 38.60 ± 2.64; HR VT1: 169 ± 10) when compared to the CPET (1 ̇O2 VT1: 34.58 ± 5.23; HR VT1: 162 ± 9). JST showed high reliability of the measures to 5 ̇O2PEAK (α = 0.75, p = 0.033), p ̇O2 VT2 (α = 0.87, p = 0.004), HRPEAK (α = 0.86, p = 0.006), HR VT2 2 (α = 0.79, p = 0.020) and [LA-]PEAK (α = 0.85, p = 0.006).
CONCLUSION: The results of this study suggest that JST may be used for measurement of cardiorespiratory variables commonly used in exercise prescription. r ̇O2, HR, RPE and [LA-] values obtained in the present study are in agreement with those found in the general literature. Therefore, taekwondo-specific tests present a viable method and less expensive for evaluation of judo athletes, enabling coaches or exercise physiologists to conduct evaluations in training facilities, thereby eliminating the need for an ergometer.

VALIDITY OF THE ISOMETRIC EXERCISE SCALE (IES) FOR MEASURING RATINGS OF PERCEIVED EXERTION DURING ISOMETRIC WALL SQUAT TRAINING AT DIFFERENT LOADS.

WILES, J., ODRISCOLL, J., LEA, J.

CANTERBURY CHRIST CHURCH UNIVERSITY

INTRODUCTION: Isometric exercise (IE), including wall squat training, has been shown to be effective at reducing resting blood pressure (Wiles et al., 2016). IE intensity is generally determined using torque, electromyography (EMG), heart rate (HR), or knee joint angle; however, rating of perceived exertion (RPE) has been shown to be a valid and useful measure of IE intensity and may provide a more accessible means of determining IE workload (Hummel et al., 2005). The RPE scales currently being used were not specifically designed for use with IE. Therefore, the aim of this study was to assess the validity of a new "Isometric Exercise Scale" (IES) to discern IE intensity during single wall squat bouts performed at different angles.
METHODS: Following institutional ethical approval, 29 male participants (age: 24.3 ± 3.6 years; stature: 180.4 ± 6.8 cm; body mass: 79.3 ± 14.1 kg) (mean ± SD) completed 5 isometric wall squat exercise tests, on separate occasions, with a minimum of 4 hours in-between. Each test consisted of 2 minutes of squatting at one of five randomised wall squat intensities, determined by knee joint angle ranging from 135° to 95° in 10° increments (Goldring et al., 2014). Throughout the exercise protocol, HR and blood pressure (BP) were recorded continuously, while RPE (IES) was collected every 30 seconds. Mean and peak IES rating, HR and BP were calculated for each 2-minute bout of wall squat exercise; differences were analysed between each intensity (135°, 125°, 115°, 105°, 95°).
RESULTS: Mean and peak IES ratings increased significantly ($P < 0.05$) with each consecutive increase in exercise intensity. These changes in RPE were accompanied by concurrent changes in mean and peak HR ($P < 0.05$), systolic BP ($P < 0.05$), diastolic BP ($P < 0.05$), and mean arterial BP ($P < 0.05$).
CONCLUSION: These results suggest that the IES provides a valid measure of IE intensity. As such, the IES could be used as a useful measure of exercise intensity during IE.
Goldring, N., Wiles, J.D. and Coleman, D. (2014) The effects of isometric wall squat exercise on heart rate and blood pressure in a normotensive population. Journal of sports sciences, 32(2):129-136.
Hummel, A., Läubli, T., Pozzo, M., Schenk, P., Spillmann, S., & Klipstein, A. (2005) Relationship between perceived exertion and mean power frequency of the EMG signal from the upper trapezius muscle during isometric shoulder elevation. European journal of applied physiology, 95(4):321-326.
Wiles JD, Goldring N, Coleman D. (2017) Home-based isometric exercise training induced reductions in resting blood pressure. European journal of applied physiology, 117(1):83-93.
*Corresponding author: john.lea1@canterbury.ac.uk

CRITERION-RELATED VALIDITY OF RATINGS OF PERCEIVED EXERTION DURING RESISTANCE EXERCISE IN HEALTHY PARTICIPANTS: A META-ANALYSIS.

LEA, J., HULBERT, S., O'DRISCOLL, J., SCALES, J., WILES, J.

CANTERBURY CHRIST CHURCH UNIVERSITY

INTRODUCTION: A substantial body of evidence suggests that ratings of perceived exertion (RPE) are a valid measure of exercise intensity during various forms of aerobic exercise (Chen et al. 2002); however, the evidence to support the use of RPE during resistance exercise is less clear. The purpose of this study was to use the relationships between RPE and workload, heart rate (HR), blood lactate (BLa), and electromyography (EMG) to determine the validity of RPE as a measure of exercise intensity during different forms of resistance exercise.
METHODS: An online search of 4 databases and websites (PubMed, Web of science, SPORT Discus and Research Gate) was conducted up to 24 August 2017. Additionally, the reference lists of the included articles were inspected manually for further unidentified studies. The inclusion criteria were: healthy participants of any age, a Likert style scale to measure RPE, resistance exercise of any type, a cohort receiving no other intervention, and concurrent data from one of the aforementioned criterion measures. Unpublished studies were included and there was no restriction on publication date. Study eligibility assessment, risk of bias rating and data extraction were conducted independently by authors 1 and 4. The risk of bias was assessed using a 9-point scale (developed in-house to specifically assess bias in validity studies), leading to a rating of high, medium or low risk of bias. The weighted average effect sizes were calculated using a random-effects model.
RESULTS: Sixty-two studies met the inclusion criteria. The overall risk of bias was low in 36 studies, medium in 23 studies and high in 3 studies. From the 62 eligible studies, a total of 85 unique cohorts, using any one of the criterion measures, were included in the main analysis. This analysis revealed a large effect size of 0.89 (95% CI 0.85 to 0.91). Separate meta-analyses were conducted for studies using workload only (77 cohorts) and EMG only (6 cohorts) as the criterion measures; again these analyses revealed large effect sizes of 0.89 (95% CI 0.86 to 0.91) and 0.92 (95% CI 0.54 to 0.99) respectively. There were insufficient studies to conduct separate meta-analyses for the other criterion measures.
CONCLUSION: A large number of studies, with a medium to low risk of bias were identified for this analysis. The findings suggest that RPE is a valid measure of intensity during various forms of resistance exercise, with effect sizes comparable or greater than those shown in studies using aerobic exercise (Chen et al. 2002).
Chen, M.J., Fan, X. and Moe, S.T., 2002. Criterion-related validity of the Borg ratings of perceived exertion scale in healthy individuals: a meta-analysis. Journal of sports sciences, 20(11), p.873-899
John.lea1@canterbury.ac.uk

THE INTRA-RELIABILITY OF A PHYSICAL FITNESS TEST BATTERY IN 9 – 10 YEAR OLDS.

LAUDER, M., HILES, A., POTTER, J., GAULT, M.

UNIVERSITY OF CHICHSTER

INTRODUCTION: Measuring and monitoring health-related fitness in schools, plays a major role in helping identify individuals with low physical fitness and assess the impact of school-based interventions, such as ' the daily mile'. However, with large numbers of children in classes, assessing physical fitness is time consuming, with an estimation of two-hours per class of 20 (Ruiz et al., 2011). Therefore, the current study investigated the intra-reliability of three standard components of health-related fitness in children.

METHODS: Sixty-eight boys (Mean:9.9, SD: 0.3 years) and girls (Mean:9.9, SD: 0.3 years) completed 3-repetitions of the back-saver sit-and-reach (BSSR, left and right), handgrip strength (HGS, dominant and non-dominant), and counter-movement jump (CMJ). Data was assessed using the first trial score, mean and maximum of 3 trials.
RESULTS: For all tests, except the BSSR left, over 60% of children achieved their maximal score in the first trial. Limits of agreement demonstrate BSSR left (r=-0.150, 95% CI=-2.5 – 3.9cm, bias=0.7cm, p=0.003), non-dominant HGS score (r=-0.005, 95% CI=-3.5 - 1.6kg, bias=0.9kg, p<0.001) and CMJ power (r=-0.139, 95% CI=-218 - 125W, bias=-46W, p<0.001) had both large measurement error and variation. BSSR right had undifferentiated means for the first trial and max score (mean:35, SD:6cm vs mean:35, SD:6cm, respectively) and good agreement (r=0.220, 95% CI=1.8 – 1.8cm, bias=-0.3, p=0.591). HGS dominant had a mean difference of 4% between first and max trial and moderate variability (r=0.120, 95% CI=-2.6 – 1.1kg, bias=-0.8, p<0.001).
CONCLUSION: First trial attempts of the BSSR right and HGS dominant resulted in consistent scores across the three trials, with BSSR right having similar error to previous studies of <1cm (Ruiz et al., 2011). However, BSSR left, HGS non-dominant and CMJ power degree of error was too large between the first trials and best of three trials to indicate a representative score. Hager-Ross and Rosblad (2002) reported under 13's had a high intra-individual variation for such tests, seen as a principal property of normal development (Hadders-Algra, 2000). Therefore, a thorough familiarization is required, particularly in inexperienced children and assessment of the non-dominant side, this could resolve the necessity to use multiple trials. Also, integration of such activities into physical education classes from a young age could help with assessing adaptations to school-based interventions such as 'the daily mile'.
References: Hadders-Algra M. (2000). Dev Med Child Neuro, 42, 566-572.
Hager-Ross C, Rossblad B. (2002). Acta Paediatrica, 91(6), 617-625.
Ruiz J, Castro-Piriero J, Espana-Romero V, Artero E, Ortega G, Cuenca M,Guitierrez, A. (2011). Br J Sports Med, 45(6), 518-524.
Contact: m.lauder@chi.ac.uk

THE RELIABILITY OF AN INTERMITTENT SPRINT CYCLING PROTOCOL ON A WATTBIKE PRO IN HOT CONDITIONS

ROSS, C., OXFORD, S., MORRIS, M.G., THAKE, C.D., CLARKE, N.D.
COVENTRY UNIVERSITY

INTRODUCTION: Environmental heat has long been identified as a major limiting factor in team based repeated sprint sports (Morris et al. 2000 and Hornery et al. 2007). The Wattbike Pro (Nottingham, UK) uses a combination of magnetic and air resistance and has been validated previously in normothermic conditions using a motorised calibration rig (Wainwright et al., 2017). There is a necessity for reliable and valid measures to consistently identify performance changes in an applied setting. However, there is little research identifying the reliability and validity of an intermittent high intensity protocol in a hot environment.
METHODS: Twelve healthy, non heat acclimated, male team-sport athletes (age 27 ± 9 yr, mass 82.0 ± 6.3 kg, height 180.4 ± 6.5cm) completed three 36-min intermittent sprint protocols (ISP) of: 18 × 4-s maximal sprints in an environmental chamber (36.6 ± 1.1°C, RH 38.0 ± 1.9%). Each 4-s sprint was followed by 116-s of active recovery. Sleep, exercise and diet were controlled for across trials. Power, HR, thermal comfort and thermal sensation (-3/+3 scales), and RPE were assessed. Peak and mean power from the 18 sprints was used to calculate performance decrement. Data was analysed and meaningful change and coefficient of variation (CV) calculated.
RESULTS: Mean peak power (highest mean 4s sprint) peak power 1435W, mean power 1028W, CV%3.7 meaningful change 37W. Max peak power (highest maximal power of any 4s sprint) peak power 1556W, mean power 1151W, CV4.1% meaningful change 46W. Mean average power output (mean average power of 18 sprints) peak power 1355W, mean power 938W, CV4.6% meaningful change 40W and also peak mean (mean of highest power across 18 sprints) peak power 1454W, mean power 1052W, CV3.6% 36W. Mean decrement across 18 sprints was CV24% and actual decrement 2.4%.
CONCLUSION: We can conclude that for power output variables there was a coefficient of variation of between 3.6% and 4.6%. This equates to a meaningful change of between 36W and 46W, respectively for either the mean or peak power output. This study would provide useful validation for research, and also applied training interventions where meaningful change is assessed, within a similar population.
In conclusion, this study confirms the reliability and highlights that the mean and peak power values are the most reliable variables for assessing changes within a 4s repeated sprint performance in hot conditions.
Hornery, D. J., Farrow, D., Mujika, I., & Young, W. (2007). Sport Med, 37(3), 199-212.
Morris, J. G., Nevill, M. E., & Williams, C. (2000). Eur J Appl Physiol, 81(1-2), 84-92.
Wainwright, B., Cooke, C. B., & OHara, J. P. (2017). J Sports Sci, 35(14), 1451-1458.

RELIABILITY OF THE 1.2 KM SHUTTLE RUN TEST IN YOUNG ELITE RUGBY UNION PLAYERS.

HAMLIN, M.J., DEUCHRASS, R., SMITH, H., ELLIOT, C.A., LIZAMORE, C.A.
LINCOLN UNIVERSITY

INTRODUCTION: To be useful, fitness tests need to have adequate reliability , so that important changes in athlete's performance can be identified. The aim of this study was to investigate the reliability of the 1.2 shuttle run test <1.2SRT>, a novel field test also known as the Bronco test, on young elite rugby players.
METHODS: On two occasions, separated by 2-3 weeks during the pre-season, 40 male elite rugby players <21 forwards, 19 backs, age 19.0 ± 1.1 yr, mean ± SD>, completed the 1.2SRT on a grass rugby pitch in their usual playing footwear, under similar environmental conditions. To complete the 1.2SRT, players completed maximal shuttle runs to and from a start line to 20, 40 and 60-m marks, 5 times without a break. Players were scored on the time taken to complete the shuttle runs. Prior to the study, all players were familiarized with the 1.2SRT and to ensure consistency, players completed a standardized warm-up before the test. To minimize confounding variables, players were asked to refrain from heavy exercise and consumption of alcohol for 24 hours prior to all testing, and to avoid heavy meals or caffeinated beverages for 2 hours prior to testing.
RESULTS: Overall performance increased by 1.0% between tests <3.96 ± 0.23 m/s to 4.00 ± 0.24 m/s, mean ± SD>, which corresponded to a higher post-test rate of perceived exertion <17.9 to 18.2 on the Borg 6-20 scale>. For all players combined, the standardized typical error of the average speed between tests was 0.37, 0.31-0.45 which corresponds to a coefficient of variation of 2.1% <1.8-2.6%>. The typical error was similar between forwards <0.39> and backs <0.54>.
CONCLUSION: We conclude that the 1.2SRT demonstrated moderate between-test reliability when conducted under similar environmental conditions and suspect that increased fitness levels in individuals between tests may have contributed to the increased variability and lower reliability than expected.

Conventional Print Poster

CP-PM14 Resistance training

EARLY MUSCLE ADAPTIVE RESPONSES TO AN ACUTE 'FLYWHEEL' ISOINERTIAL RESISTANCE EXERCISE SESSION

BENELLI, P., CONTARELLI, S., ANNIBALINI, G., GUESCINI, M., MAGGIO, S., CECCAROLI, P., LUCERTINI, F., GERVASI, M., MARINI, C.F., FARDETTI, F., GRASSI, E., STOCCHI, V., BARBIERI, E.

DEPARTMENT OF BIOMOLECULAR SCIENCES - UNIVERSITY OF URBINO CARLO BO - ITALY

INTRODUCTION: Isoinertial exercise, in which the inertia of a flywheel is used to provide resistance to muscular work, yields unique physiological responses beyond those mediated by established resistance exercise modalities (1-2). The aim of this study was to analyse the modulation of circulating and local molecular markers of muscle damage and remodelling after a single iso-inertial resistance exercise session.
METHODS: Collegiate students (n=8) performed 5 sets of 10 maximal squats (3' rest in-between) on the D11 iso-inertial device (Desmotec, Italy). Circulating creatine kinase (CK), insulin-like growth factor (IGF)-1 and interleukin (IL)-6 were measured before and 2, 24, and 48h after exercise. The miRNAs (miR-1, -133b, -206, -146a, -126, and -423) encapsulated in circulating exosomes were quantified before and 2h after exercise. Muscle mRNA levels of IGF-1 isoforms (IGF-1Ea, -Eb, and -Ec), myogenin, myogenic regulatory factor-4 (MRF-4) and cyclin D1 were determined, by vastus lateralis fine needle aspiration (FNA), before and 2h after exercise. IκB-α, MCP-1, TNFα, IL-6 and IL-6R mRNA levels in muscle and peripheral blood mononuclear cells (PBMC) were analysed. Multiple repeated measure ANOVAs were used to compare the time course of circulating markers (post-hoc: Bonferroni; α=0.05). The Wilcoxon non-parametric test was used to compare pre- vs. post-exercise gene-expression markers, derived from FNA and PBMC.
RESULTS: A single iso-inertial exercise session increased serum markers of muscle damage (CK and IL-6) and pro-inflammatory gene expression in muscle and PBMC. After exercise, a 2-fold increase in circulating exosomes was associated with mir-146a and mir-126 up-regulation. These signals could be involved in the inflammatory process induced by physical exercise.
By contrary, mRNA genes level related to muscle growth and repair decreased 2h after exercise, suggesting an early down-regulation response of muscle mass remodelling and repair mechanisms, while those responding to muscular damage were immediately up-regulated (3).
CONCLUSION: These results provide evidence of early molecular adaptations of skeletal muscle to flywheel-based iso-inertial resistance exercise. Future studies are needed to assess long-term circulatory and muscular adaptations to iso-inertial training and to compare those effects with those yielded by the other resistance exercise modalities available.
REFERENCES:
1. Norrbrand et al Eur J Appl Physiol 110:997, 2010
2. Walker et al Frontiers in Physiology 7:149, 2016
3. Baggish et al J Appl Physiol 116:522, 2014

THE ECW/ICW RATIO CAN EVALUATE MUSCLE SWELLING AFTER RESISTANCE TRAINING

TANIGUCHI, M.

GRADUATE SCHOOL OF MEDICINE, KYOTO UNIVERSITY

INTRODUCTION: Muscle swelling is defined as an immediate increase in muscle thickness (MT) after the high-intensity resistance training (RT). Previous study (Damas et al., 2016) has reported that muscle swelling are concomitant with muscle echo-intensity (EI) as marker of the muscle damage. The evaluation of the extracellular water/intracellular water (ECW/ICW) ratio with segmental bioelectrical impedance spectroscopy (BIS) reflects edema within skeletal muscle composition. No previous study has evaluated both EI and the ECW/ICW ratio to investigate their relationship to muscle swelling. Thus, the purpose of this study was to reveal the relationship between EI and the ECW/ICW ratio, associated with muscle swelling.
METHODS: Eighteen untrained-young man (mean age; 25.4±4.1) were recruited in the present study. All subjects underwent the estimated knee extension one repetition maximum (1-RM) test more than 3 days prior to the experiment. The subjects performed three sets of fatigue failure with 80% 1-RM condition, and were given 3 minutes rest interval between sets. Total training volume (TV) was calculated with load (kg) × repetitions × 3sets. The measurements of MT, EI and the ECW/ICW ratio were performed before and after the RT. Muscle swelling was defined as the difference of MT before and after the RT. The MT and EI at 4 compartment of quadriceps muscle were measured and summed. The measurement of the ECW/ICW ratio were applied on the right upper thigh as an indicator of quadriceps muscle by using segmental-BIS. From the bioelectrical impedance values obtained by BIS measurements, ICW and ECW were calculated from the algorithm of the previous study (Zhu et al, 1998). In general, ICW reflects muscle cell mass, whereas ECW represents the sum of interstitial fluid and blood plasma in extracellular space. For statistical analysis, a paired t-test was used to compare each parameter between pre-post RT. Additionally, correlation coefficients and a multiple liner regression analysis were performed.
RESULTS: All parameters indicated significant high value after RT session. Muscle swelling showed a significant and positive correlation with the ECW/ICW ratio and TV. A multiple liner regression analysis revealed that muscle swelling was predicted by the ECW/ICW ratio.
CONCLUSION: Our results indicated that the ECW/ICW ratio reflected muscle swelling after RT. Muscle swelling is affected by increased blood flow and extracellular fluid (Loenneke et al., 2012). The increase of ECW/ICW ratio reflects fluid fluctuations, therefore, this parameter may accurately evaluate edematous changes after RT. The present study suggested that the ECW/ICW ratio could better evaluate muscle swelling than EI.

EFFECTS OF THE ORDER OF COMBINED RESISTANCE AND HIGH INTENSITY INTERVAL TRAINING ON MUSCLE HYPERTROPHY AND METABOLISM

SHIRAI, T., OTA, Y., NAKAMURA, T., TAKEMASA, T.

UNIVERSITY OF TSUKUBA

INTRODUCTION: In many sports, athletes have to show maximum performance during competitions. Therefore, they want to improve strength and glycolysis by many ways. Much has been studied on the differences in training methods weather those can improve glycolysis, strength on both of them. Concurrent training is combination containing two different modes of training. In this study, We conducted

an experiment by combining resistance (RE) and high intensity interval training (HIIT). Therefore, there is a conflict of body adaptation caused by differences in the respective training. The purpose of this study was to investigate the order of concurrent training in skeletal muscle and its influence on its molecular mechanism. We analyzed the change in signal molecules.
METHODS: 7 weeks of age male ICR mice were divided into 3 groups: control (con), HIIT before resistance (HIIT-RE), HIIT after resistance (RE-HIIT). After 3-week training (3 times / week) , mice were sacrificed and plantaris muscles were dissected out quickly from each mouse for subsequent analyses.
RE-protocol
The mice were positioned with their foot on a footplate (the ankle joint angle was positioned at 90°) in the prone posture. The triceps calf muscle was stimulated percutaneously with electrodes which were connected to an electric stimulator and isolator. The gastrocnemius muscle was isometrically exercised (3-s stimulation 10 contractions, with a 7-s interval between contractions, for 5 sets with 3-min inter set intervals). The voltage (30 V) and stimulation frequency (100 Hz) were adjusted to produce maximal isometric tension.
HIIT-protocol
Mice were performed a 20-s swimming exercise at most 20 times or until the mouse reached exhaustion, with a weight equivalent to 10% of their body weight. The weight tied near the base of their tail. mice were landed from water, and a 10-s rest period was allowed. A barrel filled with water to depth of 60 cm was used for the swimming exercise, and water temperature was maintained 35°C during the exercise.
RESULTS: We analyzed the change in signal molecules. The phosphorylation levels of mTOR signaling increased significantly in concurrent training groups. The change in gene expression related to metabolism were also increased concurrent training. Mitochondrial respiratory chain complex was confirmed by western blot. Although it increased significantly in complex 4, we could not confirm the difference by the order.
CONCLUSION: We revealed the difference by order of concurrent training. In conducting concurrent training on the same day, resistance training before HIIT training is effective for both strength and glycolysis enhancement.

AGE-RELATED DEFICITS IN SKELETAL MUSCLE FIBRE HYPERTROPHY IN RESPONSE TO RESISTANCE EXERCISE TRAINING ARE NOT LIMITED BY MYONUCLEAR ADDITION

BROOK, M.S.1, TARUM, J.2, WILKINSON, D.J.1, MITCHELL, W.K.1, LUND, J.L.1, PHILLIPS, B.E.1, SZEWCZYK, N.J.1, GREENHAFF, P.L.1, SMITH, K.1, KADI, F.2, ATHERTON, P.J.1

NOTTINGHAM UNIVERSITY, ÖREBRO UNIVERSITY

INTRODUCTION: Cumulative increases in muscle protein synthesis (MPS) following bouts of resistance-exercise-training (RET) result in muscle protein accretion, which ultimately leads to increased muscle cross sectional area (CSA) (i.e. hypertrophy). However, we have shown that RET-induced skeletal muscle hypertrophy is attenuated in older (O) vs. younger (Y) individuals1, ostensibly through impaired ribosomal biogenesis and long-term MPS. Nonetheless, since both MPS and ribosomal biogenesis processes depend upon myonuclei activity within a finite area of cytoplasm (i.e. myonuclear domain (MND)), the dysregulation of satellite cell (SC) mediated myonuclear addition could be another factor in blunted hypertrophy with age e.g. due to declines in SC number/function2. To investigate this, we determined the effect of age on myonuclear addition in relation to myofibre CSA following RET.
METHODS: 8 young (Y: 23±1y) and 7 older (O: 69±3y) healthy men undertook 6-wks supervised progressive unilateral RET 6×8 reps, 75%-1RM 3.wk-1. Vastus Lateralis (VL) muscle biopsies were taken at 0/3/6-wk to quantify muscle fibre CSA, myonuclei and MND, using standard techniques3.
RESULTS: After 6-wks RET, only Y increased type 2 CSA: 4949±459μm2 at baseline to 6144±483μm2 and 5992±491μm2 at 3 and 6-wks respectively (both P<0.01); O being 5209±410μm2, 5355±535μm2 and 5857±478μm2 at 0, 3 and 6-wks respectively (N.S). Similarly, Y increased type 1 fibre area from 4508±534μm2 at baseline to 5497±510μm2 and 5402±351μm2 at 3 and 6-wks respectively (both P<0.05); instead, O displayed no change from 5120±402μm2 at baseline to 5606±620μm2 at 3-wks, fibre area increased at 6-wks 6017±482μm2 (P<0.05). Type 2 fibre myonuclei increased in Y from 2.5±0.1 at baseline to 3.3±0.2 and 3.9±0.3 (both P< 0.001) and in O from 2.4±0.1 at baseline to 3.4±0.1 and 3.8±0.1 (both P<0.001) at 3 and 6-wks respectively. Type 1 fibre myonuclei increased in Y from a baseline of 2.5±0.2 to 3.2±0.2 and 3.7±0.3 (both P<0.001) and in O from a baseline of 2.3±0.1 to 3.0±0.1 and 3.6±0.2 at 3 and 6-wks respectively. Type 2 fibre MND was initially maintained in Y, from 2009±189μm2/nuclei at baseline to 1883±149μm2/nuclei at 3-wks, before decreasing at 6-wks to 1568±93μm2/nuclei (P<0.01); the same pattern was evident in type 1 fibres. In O, MND declined from 2153±170μm2/nuclei to 1598±159μm2/nuclei and 1525±85μm2/nuclei at 0, 3 and 6-wks respectively (Both P<0.001); the same pattern was evident in type 1 fibres. Interestingly, there was a correlation between fibre hypertrophy and myonuclei number in type 1 (P<0.05; r2 0.4) but not type 2 myofibres.
CONCLUSION: Myonuclear accretion is maintained with RET in older age despite blunted hypertrophy, suggesting myonuclei addition- and by extension satellite cell activity- does not limit hypertrophy with age. Relationships between myonuclei accretion and hypertrophy are stronger in type 1 fibres, suggesting novel fibre-specific hypertrophy mechanisms.
1 Brook et al 2016
2 Snijders et al 2014
3 Bechshoft et al 2017

EFFECTS OF RESISTANCE TRAINING ON THE CARDIAC REMODELING OF INFARCTED RATS, MORPHOLOGICAL ASPECTS.

GONÇALVES, L., DE FRANÇA, E., MIRANDA, C.M., SANTANA, J.O., SOUZA, R.R., MAIFRINO, L., SANCHES, I.C., RODRIGUES, B., CAPERUTO, E.

SÃO JUDAS TADEU UNIVERSITY, UNICAMP

INTRODUCTION: Acute myocardial infarction (AMI) is one of the main causes of death, morbidity and incapacitation. AMI causes cardiac remodeling with changes in the heart geometry, mass, volume and structure because of the compensatory response. Rehabilitation programs usually are carried out with aerobic exercises, however, resistance training has been demonstrated to be a useful and safe non-pharmacological conduct that is able to improve the patients functional capacities. The aim of this study was to analyze the effects of 7 days of resistance training in the biometric and histomorphometric parameters of infarcted Wistar rats.
METHODS: We used 40 Wistar rats from the USJT vivarium, with average weight of 300g divided in 4 groups. SI group – infarcted and sedentary animals, (n=5); TI group – infarcted and trained animals (n=5); SS group – sedentary SHAM animals (n=5) and ST group –

trained SHAM animals (n=5). After this period, all animals were sacrificed and samples of the left ventricle were prepared for histological analysis. Data were analyzed through the ANOVA test with the Tukey post test with significance determined to be $p<0.05$.
RESULTS: Trained animals had a lower body weight when compared to the sedentary, however the infarcted groups showed larger heart weight values probably caused by the inflammatory process. Regarding the stereologic parameters, the volume density of collagen fibers type I (Vv[col I]) and type III (Vv[col III]) decreased in the infarcted and trained animals reducing the left ventricle stiffness. The amount of capillaries (Vv[cap]) increased in the necrotic area as an attempt to reduce the damage due to the infarction with larger values for the IS group. The amount of myocytes (Vv[mio]) showed no differences although the IT group presented a larger (Vv[mio]) when compared to IS group. Regarding the morphometric aspects the IS group presented smaller myocyte area (ASTm) when compared to the SS group, indicating a better condition of the cardiac tissue. Infarcted rats had a bigger nuclear area (ASTn) when compared to the SHAM groups. This bigger nuclear volume in the trained animals is related to a higher demand on genes expression towards the recovery of the tissue or to the inflammation end.
CONCLUSION: Our data revealed that resistance training was efficient to promote positive morphometric and stereologic responses on infarcted rats trained for only 7 days. The adoption of this non-pharmacological short term intervention in the treatment of infarcted individuals is able to improve the cardiac condition.

NO ADVANTAGE OF HIGH OVER MODERATE-TO-LOW WEEKLY RESISTANCE TRAINING VOLUME ON SKELETAL MUSCLE HYPERTROPHY AND STRENGTH DEVELOPMENT

HEASELGRAVE, S., BLACKER, J., SMEUNINX, B., MCKENDRY, J., BREEN, L.
UNIVERSITY OF BIRMINGHAM

INTRODUCTION: Resistance training

EFFECT OF DIFFERENT MUSCLE ACTION RESISTANCE TRAINING ON TRADITIONAL AND ALTERNATIVE H/Q RATIOS

RUAS, C.V.1,4, BROWN, L.E.2, LIMA, C.D.3, HAFF, G.G.1, PINTO, R.S.4
1:EDITH COWAN UNIVERSITY, AUSTRALIA; 2:CALIFORNIA STATE UNIVERSITY, FULLERTON, USA; 3: MEMORIAL UNIVERSITY OF NEWFOUNDLAND, CANADA; 4: FEDERAL UNIVERSITY OF RIO GRANDE DO SUL, BRAZIL

INTRODUCTION: Traditional hamstrings-to-quadriceps (H:Q) conventional (CR) and functional ratios (FR) measured by concentric (CON) and eccentric (ECC) peak torque (PT) are commonly used to measure lower-extremity muscle balance and injury risk. However, since traditional H:Q ratios are based only on maximum strength values, alternative H:Q ratios, measured by muscle thickness (MT), muscle activation (MA) and rate of torque development (RTD), have been proposed to more closely approximate sports performance. The aim of this study was to compare different resistance training (RT) protocols on traditional and alternative H:Q ratios.
METHODS: Forty males (age 22.87 ± 2.28 yrs, mass 70.66 ± 11.04 kg, ht 174.29 ± 6.9 cm) performed 12 sessions of non-dominant leg RT of Q and H on a Biodex isokinetic dynamometer. Participants were randomly assigned to one of 4 groups; CON Q and CON H (CON/CON), ECC Q and ECC H (ECC/ECC), CON Q and ECC H (CON/ECC), or no training (CTRL). RT began with 1 set of 10 maximal repetitions at 210°/s concentrically and 60°/s eccentrically. Volume of training was increased by adding 1 set after every 2 sessions. Intensity of training was increased every 2 sessions by decreasing the angular velocity for CON and increasing it for ECC in 30°/s increments. Q CON PT, H CON and ECC PT, as well as Q and H MT, MA, and RTD were measured 72h before and after training. Q and H PT and RTD were measured by using the same Isokinetic Dynamometer, MA was assessed with the use of electromyography, and MT was measured with the use of real-time portable B-mode ultrasound. CR, FR, MT, MA, and RTD ratios were calculated by H CON PT/Q CON PT, H ECC PT/Q CON PT, H MT/Q MT, H MA/Q MA, and H RTD/Q RTD.
RESULTS: A 5x2x4 (ratio x time x group) ANOVA showed a three-way interaction. This was followed up with four 5x2 (ratio x time) ANOVAs, one for each group. CON/CON and CON/ECC demonstrated no interactions or main effects. ECC/ECC demonstrated an interaction, where post FR (0.85 ± 0.15) was greater than pre (0.75 ± 0.11). CTRL demonstrated an interaction, where pre RTD ratio (1.10 ± 0.67) was greater than post (0.73 ± 0.33).
CONCLUSION: These findings suggest that ECC/ECC RT increases FR, but no RT is effective at increasing CR or alternative H:Q ratios. Therefore, FR may be the most sensitive measurement of muscle balance after ECC only RT.

EFFECTS OF AN 8-WEEK DVD-ASSISTED FOLLOWING INSTRUCTOR-LED RESISTANCE TRAINING PROGRAM ON FUNCTIONAL FITNESS FOR COMMUNITY-DWELLING MIDDLE-AGED AND OLDER ADULTS

CHEN, L.H.1, LIU, Y.J.1, TSAI, C.C.1, LIN, L.L.2
NATIONAL TAIWAN SPORT UNIVERSITY

INTRODUCTION: Ageing is an apparent phenomenon in Taiwan. Research indicated that resistance training (RT) is beneficial to increase functional fitness, the physical capacity that is needed to undertake normal everyday activities for the elderly. In an effort to promote RT-type programs to respond to "ageing in place" and engage a broader segment of older population, community-based digital video disk (DVD) assisted programs may be a relatively effective and simple means for RT program delivery. The present study aim to investigate the effects of a conventional instructor-led followed by DVD-assisted RT program on functional fitness for the middle-aged and older community-dwellers.
METHODS: Twenty-four subjects averaged 61.8 years were divided into exercise group (N=14, EX) and control group (N=10, CON). The EX took part in a 60 minutes RT program 3 times a week for 8 weeks. The program consisted of two 4-week cycles, first was the basics and second was the advanced. The instructor-led sessions were on a 3-3-2-1 frequency mode for each 4-week cycle, staring with basic aerobics and body weight training followed by water bottle aided protocols. Sessions without instructor-led, the DVD-assisted RT was delivered. One DVD was produced for each cycle based on progression of RT principles designed by the same qualified instructor. The CON kept their normal lifestyle. Senior functional fitness tests were implemented at baseline and after the intervention. Independent and paired T tests were conducted to test between groups and pre-and-post differences.
RESULTS: Significant differences were found in 30-sec chair stand between EX and CON groups (p=.021). There were also significant improvements in arm curl (p=0.001), 30-sec chair stand (p=0.003) and 2-minutes stepping tests for EX group after 8-weeks of intervention.
CONCLUSION: The 8-weeks of instructor-led followed by DVD-assisted RT program had significant effects on upper, lower limb strength and cardiovascular fitness in a group of community-dwelling seniors in Taiwan. Though not much between-group and pre-post differ-

ences in test items, the self-selectiveness of this younger and healthier samples may hinder the possible effects of RT as shown in other study (McAuley, et al., 2013). The short in duration of program may be another factor behind the scene. However, maintenance of physical activity was achieved as other study (Fanning, 2016). In conclusion, the 3-3-2-1 frequency mode of instruction in a RT program might be feasible, convenient, and cost-effective to improve functional fitness in older adults dwelled in the community, especially when little coaching resources is available.
REFERENCES:
Fanning J, Awick EA, Wojcicki TR. et al. (2016). J Phys Act Health, 13(6), 594-598.
McAuley E, Wojcicki TR, Gothe NP. et al. (2013). J Gerontol A Biol Sci Med Sci., 68(9), 1076-1082.
CONTACT:
lhchen@ntsu.edu.tw

EFFECTS OF A MACHINE-BASED SELF-PACED GROUP RESISTANCE TRAINING ON MOBILITY AND FRAILTY PREVENTION FOR COMMUNITY-DWELLING ELDERLY

LU, T.J.1, LIN, C.Y.2, CHEN, L.H.1
NATIONAL TAIWAN SPORT UNIVERSITY

INTRODUCTION: Mobility is essential to reduce the risk of falls, enhance quality of life, as well as frailty prevention for older adults. Research found that resistance training (RT) increase age-related muscle strength, decrease muscle mass loss, and thereby improve mobility for older population. Properly use of weight machine at a self-paced training format may gain benefits not only as conventional RT but also fulfill need for frailer older individuals with various health conditions. This study aimed to investigate the effect of a machine-based self-paced group RT program on mobility and frailty prevention for older population.
METHODS: Twenty-two older adults were recruited from the community. All subjects took part in the machine-based RT for 60 minutes per session, 2 to 3 times per week for 7 weeks. SMARC electromagnetic training machine were used in the study. The first 3-week of RT was as baseline and familiarized stage followed by two two-week self-paced stages. In the familiarized stage, subjects were determined their training level by the instructors. In the self-paced stages, subjects were encouraged to perform movements as rapidly as possible on their self-selected pace based on the machine-recorded work output from previous session. Fried and colleague's physical phenotype scale validated in the Cardiovascular Health Study was used to evaluate frailty status. Mobility assessments included 30-second sit to stand (STS), 6-m walk test, timed up and go. All measures were collected at baseline and after the RT. Wilcoxon signed rank test was conducted for the analysis.
RESULTS: Fourteen older adults aged 66-83 years completed all tests and with an averaged participation rate of 90.1%. The rate of perceived exertion was between 3 to 6 (Borg scale 0-10). Significant improvement were found in STS ($p = .017$), usual gait speed ($p = .041$), but not in fast gait speed. Pre-frailty rate of participants decreased from 21.4% to 7.1% after intervention.
CONCLUSION: The machine-based self-paced RT for a minimum of 7 weeks was able to improve some mobility parameters and render frailty prevention for older adults. Although self-selected RT intensity may not consistent with the American College of Sports Medicine Guideline (Elsangedy et al., 2013), velocity-based RT program might bring greater advantages on muscle fitness even for individuals with hip osteoarthritis (Fukumoto et al., 2014). Our pilot trial using the self-adjusted electromagnetic training machine may be feasible for frailer older adults in need of RT for its easy applicability. Nevertheless, a carefully supervision and gradual leveraging between pace and intensity may be essential to grant the most advantages for participants of old age.
References: Elsangedy HM, Krause MP, Krinski K, Alves RC, Hsin Nery Chao C, da Silva SG. (2013). J Strength Cond Res, 27(7), 1877-1884.
Fukumoto Y, Tateuchi H, Ikezoe T, Tsukagoshi R, Akiyama H, So K, Kuroda Y, Ichihashi N. (2014). Clin Rehabil, 28(1), 48-58.
Contact: ruth0613@gmail.com

14:00 - 15:00

Mini-Orals

MO-PM01 Muscle & Tendon

THE EFFECTS OF MORPHOLOGICAL AND MECHANICAL PROPERTIES OF MUSCLE-TENDON UNIT ON SPRINT PERFORMANCE IN JUNIOR SPRINTERS

ENOMOTO, S., HASHIMOTO, R., ODA, T., KAGA, M.
HYOGO UNIVERSITY OF TEACHER EDUCATION, OKAYAMA UNIVERSITY

INTRODUCTION: The morphological and mechanical properties of muscle-tendon unit (MTU) influence stretch-shortening cycle movements which enhances performance of MTU in such as running (3) and jumping (1). Furthermore, low joint flexibility induced by stiff tendons (2) increases the risk of injury in children (e.g. Sever's disease (5), Osgood-Schlatter disease (4)). To enhance performance and prevent injury, it is necessary to reveal the junior sports player's characteristics of MTU. Although some researchers investigated the relationship between sprint performance and property of MTU in adults so far (3), there is little information examined in children. The aim of this study was to investigate its relationship in junior sprinters.
METHODS: Fifteen junior sprinters (age 11.2 ± 0.8 years) participated in this study. Their official record in the 100-m race was 12.72 to 14.67 s (14.0 ± 0.7 s). Tendon stiffness, muscle thickness, and maximal isometric voluntary contraction (MVC) of both knee extensors and plantar flexors as well as 100-m running record were measured.
RESULTS: There was no significant correlation between tendon stiffness of knee extensors and 100-m running record ($r = -0.215$, ns). On the other hand, we found a negative correlation between tendon stiffness of plantar flexors and 100-m running record ($r = -0.511$, $p < 0.05$). Both muscle thickness ($r = -0.584$, $p < 0.05$) and MVC ($r = -0.647$ $p < 0.01$) of knee extensors were significantly correlated to 100-m running record, but those of plantar flexors were not (muscle thickness: $r = 0.024$, ns; MVC: $r = -0.453$, ns).
CONCLUSION: This study demonstrated that the thick strong muscle of knee extensors and stiff tendon of plantar flexors are related to high sprint performance in junior sprinters. These results would indicate that the high sprint performance results from the greater power

produced by knee extensors which are efficiently transmitted to the bone (1), and finally to the ground, by a stiff tendon of plantar flexors. Although excellent sprinters with a stiff tendon of plantar flexors have the potential for high performance, it must be noted that this could lead to injury. In conclusion, the results suggest that the thick strong muscle of knee extensors and the stiff tendon of plantar flexors affect sprint ability positively, but it would be a risk of injury in junior sprinters.
REFERENCES:
1. Bojsen-Moller J, et al., J Appl Physiol 99: 986-994, 2005.
2. Kawakami K, et al., J Orthop Sports Phys Ther 38: 269-276, 2008.
3. Kubo K, et al., Acta Physiol Scand 168: 327-335, 2000.
4. Nakase J, et al., Arch Orthop Trauma Surg 135: 1277-1281, 2015.
5. Scharfbillig R, et al., J Am Podiatr Med Assoc 101: 133-145, 2011.
Contact: pbfd04bu@s.okayama-u.ac.jp

MORPHOLOGICAL AND MECHANICAL PROPERTIES OF MUSCLES AND TENDONS: EFFECTS OF MATURATION AND ATHLETIC TRAINING

CHARCHARIS, G., MERSMANN, F., BOHM, S., ARAMPATZIS, A.

HUMBOLDT-UNIVERSITÄT ZU BERLIN

INTRODUCTION: The combined effects of mechanical loading and maturation during adolescence are still not well understood. The purpose of the study was to gain insight into the effects of this two-fold stimulus by comparing the properties of the knee extensor muscle-tendon unit (MTU) of early and late-adolescent boys and adult men.
METHODS: Eighty male participants, comprised of athletes (A, n=43) and untrained controls (C, n=37) in three age groups (early-adolescents [EA, n=28] 12-14yrs; late-adolescents [LA, n=27], 16-18yrs; young adult [YA, n=25], 20-35yrs) were included in the study. Muscle strength of the knee extensors, patellar tendon mechanical properties and vastus lateralis (VL) architecture were investigated using inverse dynamics and ultrasonography. For the statistical analysis, a two-way ANOVA was used.
RESULTS: Athletes had significantly greater muscle strength (A: 4.2±0.8 Nm/kg, C: 3.6±0.6 Nm/kg; $p<0.001$), normalized patellar tendon stiffness (A: 62.0±16.7 kN/strain; C: 53.7±15.7 kN/strain; $p=0.013$), and VL thickness (A: 22.6±4.5mm; C: 20.1±4.7mm; $p=0.04$) compared to non-athletes. Further, there was a tendency towards higher tendon strain in athletes (A: 8.6±2.4%, C: 7.7±2.5%; $p = 0.084$). The EA had significantly lower muscle strength (EA: 3.4±0.6 Nm/kg, LA: 4.2±0.7 Nm/kg, YA: 4.1±0.7 Nm/kg; $p<0.001$) and stiffness (EA: 45.6±13.7 kN/strain; LA: 62±13.4 kN/strain, YA: 67±15.3 kN/strain $p<0.001$) compared to the older groups, with no significant differences between LA and YM ($p>0.05$). VL thickness was different between all age groups (EA: 18.2±3.7mm, LA: 21.7±4mm; YM: 24.7±4.1mm; $p<0.001$). Tendon strain during the maximum isometric contraction was in tendency greater in adults compared with EA (EA: 7.2±2.4%, YA: 8.8±2.8%; $p=0.0502$), while strain in LA (8.4±2.1%) did not differ to the other groups ($p>0.05$). There were no significant age-by-group interactions. A linear regression analysis for the adolescent groups indicated a lower association of tendon force and stiffness in athletes compared to controls.
CONCLUSION: Our results indicate that athletic training leads to greater muscle strength of the knee extensors and VL thickness, as well as patellar tendon stiffness in both adolescents and adults compared to untrained controls, yet indications for an imbalance of tendon force and stiffness were present in the adolescents. The mechanical demand placed upon the tendon (i.e. strain) seems to be greater in athletes and might increase with age. The major changes in tendon stiffness related to maturation seem to occur between early and late adolescence.

COMPARISON OF EFFECTS OF B-HYDROXY B-METHYLBUTYRATE (HMB) AND L-LEUCINE SUPPLEMENTATION ON MUSCLE REGENERATION

TAKUYA, N., TAKANAGA, S., YUYA, O., THORU, T.

UNIVERSITY OF TSUKUBA

INTRODUCTION: Muscle injury is one of most frequent trauma in sports. Skeletal muscle contains a well-characterized process to repair damaged muscle fibers after injury. This healing process requires the function of satellite cells, which are the resident skeletal muscle stem cells that become activated after muscle injury. β-Hydroxy β-Methylbutyrate (HMB) are often used to promote muscle recovery. HMB is a metabolite of leucine. HMB and L-Leucine supplementation has been reported to promote the activation of satellite cells. However, both supplementation effects on muscle regeneration has not been compared. The purpose of this study is to compare effects of HMB and L-leucine on muscle regeneration.
METHODS: 8 weeks of age male ICR mice were randomly divided into 3 groups of 6 animals after a 1-week acclimation period. D.W (500mg/kg/day), HMB (500 mg/kg/day) or L-Leucine (500mg/kg/day) was orally administrated once per day during the experiment. All mice were anesthetized with isoflurane prior intramuscular administration of 50 µl of 1.2% BaCl2 solution to the tibialis anterior (TA) muscle. During injection, 1.2% BaCl2 solution was slowly released into the TA muscle to induce extensive injury and skeletal muscle regeneration. Regenerating TA muscles were collected on 4 days (Inflammatory phase) and 7 days (regenerative phase) after BaCl2-induced muscle injury.
RESULTS: In the inflammatory phase, HMB and leucine increased the number of Pax7 and MyoD positive cell. In the regenerative phase, HMB and L-Leucine increased the cross-sectional area of regenerating muscle fibers compared to control, but no difference was confirmed between both supplementation.
CONCLUSION: We suggested that HMB and L-Leucine are effective for early recovery from muscle injury. However, there were no differences of both supplementation.

AMELIORATIVE EFFECT OF FUCOXANTHIN ON DECREASED SKELETAL MUSCLE MASS IN MICE

YOSHIKAWA, M.1, SAKUSHIMA, K.1, USAMI, K.1, KUME, W.1, HOSOKAWA, M.2, MIYASHITA, K.2, NISHINO, H.3, HASHIMOTO, T.1

1RITSUMEIKAN UNIV., 2HOKKAIDO UNIV., 3 KYOTO PREF. UNIV. MED.

INTRODUCTION: It has been suggested that a combination of sarcopenia and obesity (i.e., sarcopenic obesity), which may reinforce each other, is more strongly associated with disability and metabolic/cardiovascular diseases than either body composition type alone (Baumgartner, 2000; Baumgartner et al., 2004; Morley et al., 2001; Roubenoff, 2000). Therefore, countermeasure that simultaneously

suppress fat gain and muscle atrophy would be warranted to prevent the promotion of sarcopenic obesity, in essence the worst of both worlds. Fucoxanthin (FX), a carotenoid that found in edible seaweed, has the suppressing effect of adipocyte differentiation (Maeda et al, 2006), in addition to radical scavenging activity and anti-inflammatory effects. In vivo study, Hosokawa et al. demonstrated that dietary FX attenuates the weight increase of white adipose tissue (Hosokawa et al., 2010). However, it remains unknown whether administration of FX suppresses a decrease in muscle mass in vivo. The administration of high concentrations of dexamethasone (DEX) causes degradation of skeletal muscle, mainly due to the stimulation of muscle proteolysis. On the other hand Fructus Schisandrae, the dried fruit of Schizandra chinensis Baillon, attenuates DEX-induced muscle atrophy through antioxidant and anti-inflammatory action (Kim et al., 2015). Given that FX also has strong anti-oxidant ability and anti-inflammatory effects as aforementioned, it is reasonable to hypothesize that an administration of FX also attenuates DEX-induced decrease in muscle mass. To address this hypothesis, we investigated the effects of the administration of FX on inhibition of DEX-induced decrease in muscle mass in adult mice.
METHODS: ICR mice (17 weeks of age) were divided into three groups, 1) the intact vehicle control (Control), 2) the DEX-treated group (DEX), 3) FX and DEX-treated group (FX-DEX)]. In the DEX and FX-DEX groups, muscle atrophy was induced by an oral administered of DEX (10mg/L) for 13 days. The mice in the FX-DEX group were provided with FX (0.2%) diets from 2 weeks before DEX treatment to the end of the study. The weights of tibialis anterior muscle (TA) and visceral fat were measured.
RESULTS: There was no significant difference in food consumption between the groups. Body weight and visceral fat mass in the FX-DEX group were significantly lower than those in the Control group ($p<0.01$). TA mass in the DEX group was significantly lower than that in the Control group ($p<0.01$). However, there was no significant difference between the Control group and FX-DEX group in the TA mass.
CONCLUSION: These results suggest that, in addition to fat loss, FX might attenuate DEX-induced decrease in muscle mass. Thus FX may have a potential to prevent the promotion of sarcopenic obesity.

EFFECTS OF AEROBIC EXERCISE TRAINING ON MUSCLE DAMAGE, MUSCLE STRENGTH, AND MITOCHONDRIAL FUNCTION IN ATORVASTATIN-TREATED RAT SKELETAL MUSCLES

KWAK, H.B.1, NO, M.H.1, HEO, J.W.1, YOO, S.S.1, PARK, D.H.1, KANG, J.H.1, KIM, C.J.2, SEO, D.Y.3, HAN, J.3

1: INHA UNIVERSITY, 2: KYUNGHEE UNIVERSITY, 3: INJE UNIVERSITY

INTRODUCTION: Statins (3-hydroxy-3-methylglutaryl coenzyme A reductase inhibitors) are cholesterol-lowering drugs widely used in the treatment of cardiovascular disease. However, statins also cause adverse side effects in skeletal muscle ranging from fatigue to fatal rhabdomyolysis. Recently, we found that long-term (48 hour) treatment of simvastatin induced cell death due to impaired mitochondrial respiration and oxidative stress leading to mitochondrial apoptotic signaling in primary human skeletal muscle cells (Kwak et al., 2012), and 10 weeks atorvastatin treatment in vivo resulted in muscle damage, reduced muscle strength, and impaired mitochondrial function in rat skeletal muscles (Kwak et al., 2017). The purpose of this study was to determine the effects of aerobic exercise training on muscle damage, muscle fatigue/strength, and mitochondrial function (e.g., mitochondrial respiration, H_2O_2 emission, Ca^{2+} retention capacity) in atorvastatin-treated rat skeletal muscles.
METHODS: Male Wistar rats were randomly assigned to control (CON), 5 mg atorvastatin treated group (ATOR), and 5 mg/kg atorvastatin plus aerobic exercise training group (ATOR+EX) (N=12 rats/group). Animals were administered via oral gavage with a vehicle or 5 mg/kg/day atorvastatin dissolved in 0.25 % w/v hydroxylpropyl methylcellulose for 12 weeks. Forelimb muscle strength and serum creatine kinase (CK) concentration (i.e., muscle damage marker) were measured. The skeletal muscles such as soleus (SOL, Type I) and white gastrocnemius (WG, Type IIb) were permeabilized by sarponin for determination of mitochondrial respiratory capacity, mitochondrial H_2O_2 emission, and Ca^{2+} retention capacity.
RESULTS: Maximal forelimb strength and forelimb fatigue index were significantly decreased after 6 weeks and 8 weeks, respectively in ATOR. In contrast, serum CK concentration was significantly increased in ATOR compared with CON. However, aerobic exercise training attenuated atorvastatin-induced impairment in maximal forelimb strength and fatigue index, as well as reduced serum CK concentration ($p<0.05$). The mitochondrial O_2 respiratory capacity and Ca^{2+} retention capacity were significantly reduced by 12 weeks of ATOR in both SOL and WG ($p<0.05$). In addition, mitochondrial H_2O_2 emission was significantly increased in ATOR compared with CON in both SOL and WG ($p<0.05$). However, aerobic exercise training attenuated mitochondrial O_2 respiratory capacity, Ca^{2+} retention capacity, and mitochondrial H_2O_2 emission in atorvastatin-treated skeletal muscles.
CONCLUSION: These data demonstrate that long-term treatment of atorvastatin results in muscle damage, reduced muscle strength, and impaired mitochondrial function in skeletal muscles. However, aerobic exercise training for 12 weeks attenuates muscle damage, maintains muscle strength, and ameliorates mitochondrial dysfunction induced by atorvastatin, suggesting that aerobic exercise training plays a therapeutic role in atorvastatin-induced myopathy (NRF-2016R1A2B4014240).

ACTIVATION OF PROTEIN SYNTHESIS SIGNALING VIA INCREASE IN MUSCLE 5A-DIHYDROTESTOSTERONE BY ACUTE RESISTANCE EXERCISE AFFECTS MUSCLE HYPERTROPHY IN TYPE 2 DIABETIC RATS

HORII, N.1, HASEGAWA, N.1,2, FUJIE, S.1,2, UCHIDA, M.1, INOUE, K.1, IEMITSU, M.1

1> RITSUMEIKAN UNIVERSITY, 2> JSPS RESEARCH FELLOW.

INTRODUCTION: Diabetes results in loss of muscle mass as well as reduction of sex steroid hormone secretion. We demonstrated that dehydroepiandrosterone (DHEA), a sex steroid hormone precursor, administration elevated muscle 5α-dehydrotestosterone (DHT) secretion by increased 5α-reductase and induced muscle hypertrophy in type 2 diabetic rats. Furthermore, our recent study showed that increase in muscle DHT level by resistance training was associated with muscle hypertrophy in older males (Sato et al., 2014). However, it is still unclear whether the increase in muscle DHT production by resistance exercise is involved in the activation of muscle protein synthesis signaling and consequently affects muscle hypertrophy. Therefore, this study aimed to clarify whether activation of protein synthesis signaling via acute resistance exercise-induced increase in muscle DHT affects development of muscle hypertrophy in type 2 diabetic rats.
METHODS: Study 1: Male 20-week-old type 2 diabetic (OLETF) rats were divided into 7 groups: sedentary control and immediately after, an hour, and three hours after resistance exercise alone or in combination of 5α-reductase inhibitor groups.
Study 2: Male 20-week-old OLETF rats were randomly divided into 3 groups; sedentary control, resistance training (3 times a week for 8 weeks) or resistance training with 5α-reductase inhibitor continuously.
RESULTS: Study 1: Acute resistance exercise in OLETF rats significantly increased the levels of muscle testosterone and DHT and 5α-reductase protein expression as well as increase in muscle protein synthesis signaling such as mTOR and p70S6K phosphorylation

(p<0.05). Administration of 5α-reductase inhibitor was suppressed the exercise-induced effects on muscle protein synthesis signaling with decrease in muscle DHT level (p<0.05).
Study 2: To confirm whether the increase in protein synthesis via muscle DHT secretion by acute resistance exercise is involved in muscle hypertrophy, this study examined the effect of continuously administration of 5α-reductase inhibitor during resistance training. Resistance training in OLETF rats significantly increased the levels of muscle DHT and 5α-reductase protein expression as well as increase in muscle mass and cross-sectional area (p<0.05). However, these training effects were significantly suppressed by chronically administration of 5α-reductase inhibitor (p<0.05).
CONCLUSION: These results suggest that activation of protein synthesis signaling via acute resistance exercise-induced increase in muscle DHT may be involved in muscle hypertrophy in type 2 diabetic rats.
REFERENCE:
Sato K et al., (2014) FASEB J. 28(4): 1891-1897.

TIME-COURSE OF MUSCLE MORPHOLOGICAL AND FUNCTIONAL ADAPTATIONS DURING A 6-WEEK PLYOMETRIC TRAINING

MONTI, E.1, FRANCHI, M.V.2, NARICI, M.V.1

<1> UNIVERSITÀ DI PADOVA, PADOVA, ITALY; <2> UNIVERSITATSKLINIK BALGRIST, ZURICH, SWITZERLAND

INTRODUCTION: Muscle power is a major determinant of sport performance requiring explosive force such as throwing and jumping. Plyometric training (PT) has been shown to be particularly effective for increasing quadriceps power and size in young soccer players [1]. The aim of this study was to assess the onset of changes in muscle morphology, strength and power during a 6-week PT on a novel device based on a trampoline connected to an inclined sledge (Tramp Trainer, TT).
METHODS: Eight males (age 25.4±4.6 years; mass 69.7±13.5 kg; height 173.6±4.7 cm) were recruited after ethics approval. Participants trained 3 times/week with 4-5 sets of 30 jumps. Data were acquired at 0, 2, 4 and 6 weeks of PT. Quadriceps muscle cross-sectional area (CSA) and vastus lateralis (VL) fascicle length (Lf) and pennation angle (PA) were assessed by ultrasound. Knee extensors isometric maximum voluntary contraction (MVC) torque and peak power (PP) were assessed by Cybex dynamometry and by the Nottingham Power Rig, respectively. Data (means±SD) were analysed for statistical significance using repeated one-way ANOVA with Bonferroni's post-hoc test.
RESULTS: PP increased by 15.7% (n.s.), 25.5% (p<0.05) and 31.8% (p<0.05) after 2, 4 and 6 weeks of PT, MVC increased by 18% (p<0.05) after 2 weeks and by 22% after 4 weeks (p<0.05) with no further increase. Lf increased by 2.2% (p<0.05), 4.0% (p<0.01) and 4.4% (p<0.01) after 2, 4 and 6 weeks; PA increased by 5.8% (p<0.01) after 6 weeks. Quadriceps CSA increased by 2.4% (p<0.05) after 4 weeks and by 3.1% (p<0.05) after 6 weeks.
CONCLUSION: These findings support the contention that plyometric training is particularly effective in promoting early gains in muscle size, strength and peak power. Notably, an increase in fascicle length after just two weeks of PT seems indicative of an early addition of sarcomere in series, which precedes the addition of sarcomere in parallel reflected by the increase in muscle CSA at four weeks. Plyometric exercise seems thus highly suitable for developing muscle power within few weeks of training.
References:
1. Mckinlay et al. 2018

MUSCLE FASCICLE BEHAVIOUR OF THE BICEPS FEMORIS LONG HEAD DURING THE NORDIC HAMSTRING EXERCISE

RAITERI, B.J., BELLER, R., HAHN, D.

RUHR-UNIVERSITY BOCHUM

INTRODUCTION: Hamstring muscle strain injuries are the most common injuries among high-speed running athletes and ~80% of such injuries involve the biceps femoris long head (BFlh) (Verrall et al., 2003). A key risk factor for a first-time hamstring injury is thought to be short BFlh muscle fascicles (Timmins et al., 2015). The Nordic Hamstring Exercise (NHE) has been promoted as an eccentric exercise to increase BFlh muscle fascicle length following training (Bourne et al., 2016) and reduce hamstring injury incidence (Petersen et al., 2011). However, whether the BFlh muscle fascicles undergo an eccentric contraction during the NHE has not yet been investigated and this was the aim of the current study.
METHODS: We employed surface electromyography and conventional ultrasound imaging to respectively examine BFlh muscle activities and in vivo fascicle length changes of its superficial compartment during the NHE in recreationally-active male athletes (n=7). Participants performed the NHE in a custom-made setup while knee flexion forces and angles from the left-sided leg were measured using a force transducer at the ankle and goniometer, respectively. After familiarisation with the exercise, at least six trials were performed and the trial with the largest peak knee flexion force was analysed.
RESULTS: Mean peak knee flexion force and torque were 446±52 N and 183±27 Nm, respectively, at a mean knee flexion angle of 39±8° during the NHE. From the starting position (90° knee flexion), the BFlh muscle fascicles initially shortened, but the amount of shortening was not possible to quantify due to substantial out-of-plane motion of the muscle fascicles with respect to the ultrasound imaging plane. Following fascicle shortening, preliminary results (n=3) show that the BFlh muscle fascicles either acted isometrically or lengthened slightly (~4 mm) over mean knee flexion angles of 66-61°. The BFlh fascicles then actively lengthened by 14±9 mm until a mean knee flexion angle of 32±7°, after which knee flexion force rapidly declined due to BFlh muscle deactivation.
CONCLUSION: This study provides the first in vivo evidence that the BFlh muscle fascicles actively stretch during peak force production in the NHE. We propose that the eccentric behaviour of the BFlh muscle fascicles likely enhances peak force production relative to concentric or isometric fascicle behaviour and stimulates sarcomerogenesis, which might be responsible for the ~14% longer BFlh muscle fascicles following ten weeks of NHE training (Bourne et al., 2016). Whether the BFlh fascicles are stretched as much during the NHE post-NHE-training remains to be tested. We recommend further imaging studies of the BFlh during exercises where its fascicles are thought to undergo active stretch to confirm that this is the case.
Bourne, M., et al. (2016). Br J Sports Med, 0, 1-9.
Petersen, J., et al. (2011). Am J Sports Med, 39, 2296-2303.
Timmins, R., et al. (2015). Br J Sports Med, 0, 1-12.
Verrall, G., et al. (2003). Am J Sports Med, 31, 969-973.

SKELETAL MUSCLE FUNCTIONAL RESERVE AT EXHAUSTION: BETWEEN-SEX DIFFERENCES AND PHYSIOLOGICAL DETERMINANTS

PEREZ-VALERA, M.1, GELABERT-REBATO, M.1, MARTIN-RINCON, M.1, CURTELIN, D.1, GALVAN-ALVAREZ, V.1, ALCAZAR, J.2, MORALES-ALAMO, D.1, CALBET, J.A.1

1. UNIVERSITY OF LAS PALMAS DE GRAN CANARIA; 2. UNIVERSITY OF CASTILLA-LA MANCHA

INTRODUCTION: During incremental exercise to exhaustion, task failure occurs despite a muscular functional reserve (FR). The aim of this investigation was to determine the physiological mechanisms accounting for the FR in men and women. We hypothesized that the FR is determined by the anaerobic capacity and hence it would be lower in women than men.
METHODS: Physically active volunteers (18M and 18W, age 21-36) had their body composition (DXA), VO2max, VO2/intensity relationship, and maximal O2 deficit (OD) assessed. Then they performed three consecutive constant-intensity exercise bouts at 120% of VO2max (120%CI) until exhaustion with 20s recovery periods in-between. The test was completed in two separate occasions, in which recovery between bouts was allowed with either 1) free circulation (120%CI_Fc) or 2) instantaneous occlusion of both legs (Hokanson, 300 mmHg) (120%CI_Occ). ANOVA repeated-measures was used.
RESULTS: VO2max was 17 and 3.5% greater in men than women when expressed per kg of BW ($P<0.05$) and per kg of leg lean mass (LLM) ($P=0.37$), respectively. The OD in mL per kg of LLM was 22% greater in men than women ($P<0.01$). After the first 120%CI_Occ bout, all subjects were able to resume exercise performing 18.5±8.3 and 22.7±12.7% of the initial work (men and women, $P=0.24$). After the second 120%CI_Occ bout, a FR was present (14.6±7.0 and 17.6±11.6% of the initial work, $P=0.35$). The work performed per kg of LLM during the second and third 120%CI_Occ bouts was similar in men and women, as well as the VO2, OD and VO2 per unit of work. The OD for the second bout of exercise was 26.0±8.6 and 27.3±13.0 mL/kg LLM, for men and women, respectively ($P=0.72$), and for the third bout 22.4±8.0 and 22.7±11.7 mL/kg LLM ($P=0.92$). Women had greater O2 extraction than men (near-infrared tissue oxygenation index (TOI), $P=0.03$). The work performed after the first and second occlusions (i.e., the FR) was associated with the VO2max in women ($r=0.57$, $P=0.014$ and $r=0.47$, $P=0.048$), but not in men ($r=0.15$, $P=0.55$ and $r=0.237$, $P=0.35$). No association was found between the maximal OD and the work performed in the second and third bouts preceded by occlusion.
CONCLUSION: This study shows that during exhausting exercise task failure occurs when there is still a large muscular functional reserve. Since the occlusion of the circulation at exhaustion impedes the recovery of phosphocreatine and the exercise intensity was always well above VO2max, without the existence of such a functional reserve our subjects would not have been able to restart pedalling at the end of the first 20s occlusion, and much less after the second occlusion. Our data indicate that this functional reserve depends on energy generation through the glycolysis, which can be recruited similarly by women and men, and is not exhausted by two consecutive trials at 120% of VO2max.
Grant: DEP2015-71171-R

EFFECTS OF TWO DIFFERENT ISOLOAD ENDURANCE TRAINING ON MUSCLE MITOCHONDRIAL BIOGENESIS AND AEROBIC MARKERS OF SWIMMING RATS

RODRIGUES, N.A., GOBATTO, C.A., SOUSA, F.A.B., FORTE, L.D.M., TORSONI, A., FANTI, T., MANCHADO-GOBATTO, F.B.

UNIVERSITY OF CAMPINAS

INTRODUCTION: Physical exercise is a potent promoter of mitochondrial adaptations (Bishop et al. 2014). However, knowledge about the optimal intensity-volume ratio to provide these adaptations is limited. Therefore, this study aimed to investigate aerobic adaptations and protein content of mitochondrial biogenesis markers in skeletal muscle after two different isoload endurance training in swimming rats.
METHODS: Thirty male Wistar rats (60 days old) were divided into two trained groups and one control. The groups were: a) CG (n=10): untrained group, b) TG100 (n=10): 30min swim at 100% of anaerobic threshold, and c) TG120 (n=10): 25min swim at 120% of anaerobic threshold. Despite applied in two different exercise domains both groups trained in identical workload (3000 a.u.). Swim training was performed during 12 weeks and 5 days per week. Protein content of transcription factor A (Tfam) was determined by immuoblotting and citrate synthase activity (CSA) by spectrophotometry in gastrocnemius and soleus. Aerobic capacity (% body mass - %bm) was obtained by lactate minimum test in accordance to DE ARAUJO et al.(2012). Differences among groups were analyzed by ANOVA one-way and Tukey post-hoc test was used when a significant effect was found ($P<0.05$). The results are presented in mean±sem.
RESULTS: Tfam content and CSA presented different responses showing an intensity dependence even in identical workload exercises. This was observed for other markers of mitochondrial biogenesis pathway in human skeletal muscle (EGAN et al. 2010). In gastrocnemius, Tfam content (CG: 0.72±0.11 a.u.; TG100:1.64±0.49 a.u.; TG120:0.62±0.10 a.u.) presented higher value in TG100 than TG120 ($P=0.049$). However, CSA (CG: 357.47±26.83 µmol citrate*min-1*mg prot-1; TG100: 402.15±43.25 µmol citrate*min-1*mg prot-1; TG120: 585.43±82.44 µmol citrate*min-1*mg prot-1) presented higher values in the TG120 than CG and TG100 ($P=0.01$; $P=0.03$). For soleus, Tfam content (CG:1.49±0.24 a.u.; TG100:1.31±0.19 a.u.; TG120:1.42±0.23 a.u.) did not present differences among groups ($P=0.80$). Nevertheless, CSA (CG: 340.53±34.88 µmol citrate*min-1*mg prot-1; TG100: 818.53±153.44 µmol citrate*min-1*mg prot-1; TG120: 414.43±81.95 µmol citrate*min-1*mg prot-1) was higher in TG100 than CG and TG120 ($P=0.007$; $P=0.02$). Although TG120 only presented higher CSA in gastrocnemius, the aerobic capacity (CG:4.27±0.13%bm; TG100:4.62±0.11%bm; TG120:5.1±0.19%bm) of these rats was higher than CG and TG100 ($P=0.003$; $P=0.04$;).
CONCLUSION: These results show that exercise intensity dictates cell adaptations in a muscle dependent way, with high intensity training promoting better aerobic performance. Financial Support: FAPESP 2014/10336-9, CNPq and CAPES
References: de Araujo, G. et al. (2012). Eur J Appl Physiol, 112(3), 839-852.
Bishop, D. J., Granata, C., & Eynon, N. (2014). Biochim Biophys Acta, 1840(4), 1266-1275.
Egan, B., Carson, B. P., Garcia-Roves, P. M. et al (2010). J Physiol, 588(10), 1779-1790.
Contact: nar.camp@gmail.com; fbmachado@yahoo.com.br

Mini-Orals

MO-PM02 Nutrition and supplements

ACUTE IMPLEMENTATION OF TRAIN/RECOVERY WITH LOW CARBOHYDRATE AVAILABILITY DOES NOT COMPROMISE BONE METABOLISM IN WORLD-CLASS TRIATHLETES

HEIKURA, I.A.1,2, COX, G.R.1, MCKAY, A.K.A.1,3, BURKE, L.M.1,2

1: AUSTRALIAN INSTITUTE OF SPORT , 2: AUSTRALIAN CATHOLIC UNIVERSITY , 3: UNIVERSITY OF WESTERN AUSTRALIA

INTRODUCTION: Several inter-related strategies to periodise carbohydrate (CHO) availability around exercise include training with low glycogen ("train low") or restricting glycogen resynthesis after training ("sleep low"). While these protocols may enhance training adaptations and performance, less attention has been directed to the potential effects on other body systems such as bone. We investigated the acute effects of training and recovery with low CHO availability on bone markers in elite triathletes.
METHODS: Eleven world-class triathletes (7 F, 4 M) undertook a free-living, monitored 4-w training camp at the Australian Institute of Sport. In a randomised repeated measures design, the participants completed two 4-d training sequences with identical exercise but different approaches to CHO availability around sessions: Days 1&3: afternoon high-intensity training (HIT) with high CHO availability followed by restricted (LOW) or high (HIGH) overnight CHO availability ; Days 2&4 early morning low intensity training (LIT), either fasted (LOW) or with CHO intake pre and during exercise (HIGH). Venous blood samples were collected for bone markers of breakdown (C-terminal telopeptide of type-1 collagen, CTX) and formation (N-terminal propeptide of type 1 procollagen, PINP) at 30min and 0h pre, and 0h, 1h and 3h post LIT.
RESULTS: Although total daily CHO intake did not differ between treatments (7.4±1.1 vs 7.3±1.1 g/kg, LOW vs HIGH, p=0.44), there were differences in its distribution over the day. Specifically, CHO intake before the HIT was 6.6±1.2 and 4.5±0.7 g/kg in LOW and HIGH, respectively (p<0.001), while the intakes post HIT were 0.3±0.1 and 2.7±0.8 g/kg in LOW and HIGH, respectively (p<0.001). Intake immediately before and during the LIT was 1.9±0.1g/kg for HIGH and 0g/kg for LOW. Differences in P1NP and CTX responses to the LIT session were not significant, however, large coefficients of variation (CV) were noted: P1NP 40% and CTX 36%.
CONCLUSION: Contrary to other literature around CHO availability, exercise and bone health, the effect of "sleep low, train low" on markers of bone metabolism was not different compared to training with constant CHO availability ("sleep high, train high"). Before concluding that "sleep low, train low" poses no acute stress to bone, other explanations are possible. The caliber and training history of subjects may be important, and our diet/exercise protocol may not have created sufficient difference in the metabolic stress incurred in the LIT between treatments. Lastly, due to the variability in bone marker measures, our study may have been statistically underpowered to show clear differences between treatments.

CAFFEINE ERGOGENICITY IN MAXIMAL AEROBIC AND ANAEROBIC EXERCISE IS UNRELATED TO IMPROVED MUSCLE DEOXYGENATION

RUIZ-MORENO, C., GUTIERREZ-HELLÍN, J., CUÉLLAR-RAYO, A., LARA, B., DEL COSO, J.

CAMILO JOSE CELA UNIVERSITY

INTRODUCTION: The ergogenic effects of acute ingestion of caffeine (3-9 mg/kg) have been well-contrasted in a myriad of exercise situations. There is also a growing consensus about the main mechanism behind caffeine ergogenicity during locomotor activities, with much evidence in animal and human models supporting the ability of caffeine to act as an adenosine A1 and A2A A2B receptor antagonist. However, there is no information about the effects of caffeine on muscle oxygen saturation and the relationship between skeletal muscle oxidative capacity and caffeine ergogenicity.
METHODS: Twelve healthy and active participants took part in a cross-over, double-blind and placebo-controlled experimental design. In one occasion, participants ingested 3 mg of caffeine per kg of body mass (3 mg/kg), while in another occasion they ingested a placebo (cellulose). Each substance was administered an opaque and unidentifiable capsule and the experimental trials started 45 min after capsule ingestion. The experimental trials consisted of a 10-min warm-up, followed by an incremental cycling test to volitional fatigue (25 W/min) and the 15-s Wingate test (7.0% of body mass), with 7 min of recovery between exercise performance tests. During the exercise testing, muscle oxyhemoglobin saturation was measured by means of near-infrared spectroscopy in the vastus lateralis and VO2 was obtained by means of a gas analyser. One minute after the end of each test, a sample of capillary blood was obtained to measure blood lactate concentration.
RESULTS: In comparison to the placebo, the pre-exercise intake of caffeine increased maximal cycling power reached in the incremental exercise test (3.9 ± 0.7 vs 4.0 ± 0.7 W/kg; P = 0.03) and the blood lactate concentration obtained at the end of the test (12.3 ± 3.4 vs 15.3 ± 2.7 mmol/L; P = 0.05). However, the ingestion of caffeine did not increase VO2max (47.7 ± 7.8 vs 48.4 ± 8.0 mL/kg/min; P = 0.34) and it did not change muscle oxyhemoglobin saturation at the end of the incremental exercise (27.2 ± 14.5 vs 27.4 ± 15.0%; P = 0.31). The ingestion of caffeine increased the peak cycling power obtained during the 15-s Wingate test (9.2 ± 1.3 vs 9.4 ± 1.4 W/kg; P = 0.04) and the blood lactate concentration obtained at the end of the test (12.1 ± 2.8 vs 14.7 ± 4.1 mmol/L; P = 0.01). However, the ingestion of caffeine did not change muscle oxyhemoglobin saturation at the end of Wingate test (25.9 ± 14.7 vs 25.0 ± 16.0%; P = 0.18).
CONCLUSION: The ingestion of 3 mg/kg of caffeine was ergogenic for both aerobic and anaerobic-based cycling tests. However, the ingestion of caffeine did not modify muscle oxygenation at the end of these tests. This information suggests that improved deoxygenation within active muscle is not a mechanism related to the ergogenicity of caffeine in active individuals performing maximal aerobic and anaerobic tests.

INFLUENCE OF NICOTINAMIDE RIBOSIDE SUPPLEMENTATION ON WHOLE-BODY AND SKELETAL MUSCLE METABOLISM IN MAN

STOCKS, B., GRAY, E., ASHCROFT, S., JOANISSE, S., WALLIS, G., PHILP, A.

UNIVERSITY OF BIRMINGHAM

INTRODUCTION: Niacin compounds induce mitochondrial biogenesis in vitro and in vivo in rodents through elevating cellular NAD+ and the consequential activation of sirtuins and PGC1a. However, in humans nicotinic acid and nicotinamide supplementation can induce painful flushing, inhibit lipolysis and fat oxidation in vivo and can increase feelings of fatigue during exercise. Conversely, nicotinamide

riboside (NR) supplementation increases fat oxidation, metabolic flexibility and endurance performance in rodents and is safe for humans to consume without producing flushing. Thus NR is a promising nutritional strategy to influence substrate oxidation and skeletal muscle adaptations to endurance exercise. These studies aimed to investigate the effect of NR supplementation on whole-body metabolism, skeletal muscle mitochondrial function and mitochondrial biogenic signalling at rest and during exercise in humans.
METHODS: Recreationally active males were recruited to two randomised, counter-balanced, double-blinded crossover studies. In the first arm, eleven participants consumed an acute dose (1000 mg) of NR or placebo (PLA) 12 hours before cycling in the fasted state for one hour at 55% of VO2peak. Expired air and blood samples were collected during exercise. In the second arm, ten participants consumed 1000 mg/day of NR or PLA for one week. Resting metabolic rate and the metabolic response to fasted cycling (one hour at 60% of Wmax) were measured, via gas exchange and blood sampling, following supplementation. In addition, skeletal muscle biopsies were taken from the vastus lateralis at the beginning of the supplementation period and pre-, immediately post- and three hours post-exercise.
RESULTS: A single dose of NR did not alter respiratory exchange ratio (mean ± standard deviation; NR 0.89 +/- 0.03 vs PLA 0.90 ± 0.03), carbohydrate oxidation (NR 1.54 +/- 0.30 vs PLA 1.68 +/- 0.40 g/min) or fat oxidation (NR 0.38 +/- 0.18 vs PLA 0.32 +/- 0.09 g/min) during exercise. Ratings of perceived exertion during exercise were also comparable (NR 11 +/- 1 vs PLA 11 +/- 1) between NR and PLA trials. Blood metabolite responses to exercise (glucose, non-esterified fatty acids, glycerol and lactate) were also similar between NR and PLA. In addition, preliminary data from arm two suggests that resting metabolic rate and substrate utilisation at rest and during exercise were unaffected by one week of NR supplementation.
CONCLUSION: Collectively our data suggests that NR supplementation, either as a single dose or seven days of supplementation does not alter whole-body substrate utilisation in humans. Analysis of skeletal muscle biopsies will explore whether NR supplementation augments basal or exercise-induced NAD+-sensitive signalling pathways to promote mitochondrial biogenesis within skeletal muscle.

A SIX WEEK KETOGENIC INTERVENTION HAS LASTING EFFECTS ON MARKERS OF EXERCISE FOLLOWING ITS TERMINATION

CARPENTER, M., BROUNER, J., SPENDIFF, O.

KINGSTON UNIVERSITY

INTRODUCTION: Ketogenic diets (KD) have become an increasingly popular fuelling regime by recreational and elite athletes (Zinn et al. 2017). However, the research is equivocal on its effectiveness, possibly due to poor diet regime and short duration restricting a stable ketogenic state. Moreover, no one has further examined the effects on performance when returning to a habitual high carbohydrate diet.
METHODS: A single case research methodology was used to examine a trained endurance runners response to an imposed 6-week KD intervention (70% fat, 25% protein, 5% carbohydrate), followed by a return to a habitual, self-regulated diet (R-HSRD) (44% fat, 17% protein, 39% carbohydrate). Total calories consumed on each diet, body fat and mass were recorded. Exercise comprised a submaximal 7km treadmill run at approximately 65% of VO2max examining RER, VO2 and RPE both prior to and post diet change.
RESULTS: Total calorie intake was significantly greater during KD (2366 ± 551) compared to R-HSRD (1934 ± 407) ($P<0.05$). Body mass decreased from Baseline (83.0 kg) to KD (80.3 kg), and increased following the R-HSRD (83.9 kg). Exercise trials revealed that oxygen consumption increased following six weeks of keto-adaptation (39.69 ± 0.74 ml/kg/min) compared to baseline (35.43 ± 0.80 ml/kg/min), whilst not returning to baseline values after R-HRSD (39.54±1.0 ml/kg/min). Mean RER was lower during KD intervention (0.70 ± 0.01) compared to Baseline (0.89 ± 0.03). Following R-HSRD, RER increased to 0.83 ± 0.01. Changes in RER were concomitant with a decrease in fat oxidation from Baseline to KD (0.62 ± 0.25 g/min vs. 1.58 ± 0.04 g/min), before a decrease in fat oxidation following R-HSRD (0.70 ± 0.01). Mean heart rate was higher than Baseline (142.8 ± 6.3 bpm) following 6 weeks keto-adaptation (152.2 ± 6.2 bpm). Heart rate decreased following R-HSRD (139.3 ± 9.8 bpm). RPE decreased from baseline (11.6 ± 1.04), to KD (11.1 ± 0.40) decreasing further during R-HSRD run (10.66 ± 0.51).
CONCLUSION: A ketogenic diet leads to a marked decrease in body mass which plays a significant role on performance and running economy. Exercise trials revealed a substantial shift towards fat oxidation during submaximal exercise which persisted for the 6 weeks following diet termination. This study highlights that a ketogenic diet has lasting effects following its termination which could further benefit athletic performance. We conclude that an intermittent use of a ketogenic diet, requires more research to elucidate its synergistic effects with a habitual high carbohydrate diet.
References: Zinn, C., Wood, M., Williden, M., Chatterton, S. and Maunder, E. (2017). Ketogenic diet benefits body composition and well-being but not performance in a pilot case study of New Zealand endurance athletes. Journal of the International Society of Sports Nutrition, 14(1).

DIETARY NITRATE SUPPLEMENTATION ATTENUATES MUSCLE FATIGUE BY PRESERVING MUSCLE OXYGENATION AND CONTRACTILE FUNCTION

HUSMANN, F., MITTLMEIER, T., BRUHN, S., BEHRENS, M.

UNIVERSITY OF ROSTOCK, GERMANY

INTRODUCTION: Several studies have reported an ergogenic effect of dietary nitrate supplementation on exercise performance. Benefits of dietary nitrate were attributed to a wide range of physiological processes including improved skeletal muscle, vascular and metabolic function during contractionsTherefore, we aimed to test the hypothesis that (I) dietary nitrate supplementation reduces the post-exercise level of muscle fatigue and (II) accelerates the short-term recovery of muscle fatigue.
METHODS: In a randomized, double-blind, crossover study, fifteen recreationally active males completed an one-leg dynamic time-to-exhaustion test of the knee extensors after 5 days of consuming nitrate-rich beetroot juice (BR; 6.5 mmol of nitrate per day) or a nitrate-depleted placebo (PL). After 10 days of wash-out and another 5 days of BR, participants performed an isotime trial corresponding to the PL exercise time (ISO). Neuromuscular function of the quadriceps femoris was analyzed before and immediately after each experimental condition. In addition, recovery of muscle fatigue was assessed 1, 2, 4 and 8 min after exercise termination. Maximal voluntary torque (MVT), peak twitch torque evoked by paired electrical stimuli at 100 Hz (PS100) and voluntary activation were measured under isometric conditions. Muscle oxygenation (SmO2) and activity of the vastus lateralis were continuously monitored using near-infrared spectroscopy and electromyography, respectively. In addition, perceived effort and leg muscle pain were recorded every min during exercise.
RESULTS: BR resulted in a prolonged time to exhaustion (14:27 ± 08:01 min) compared to PL (11:20 ± 6:52 min; $p = 0.01$). At exercise termination, significantly minor reductions in MVT (–43.7 ± 10.0%) and PS100 (–34.6 ± 17.1%) were found after ISO compared to PL (–47.2 ± 11.8 and –40.5 ± 12.5%, respectively). During ISO, smaller declines in SmO2 (–43.5 ± 20.6%) were observed compared to PL (–54.2 ± 16.6%).

ISO resulted in less perceived effort and leg muscle pain (p = 0.02; p = 0.01). No differences between ISO and PL were found for voluntary activation and maximal M-wave. Data indicate the recovery of neuromuscular function.
CONCLUSION: We found that dietary nitrate supplementation attenuates the development of muscle fatigue by preserving muscle oxygenation and contractile function during exercise. Together, these peripheral alterations might have contributed to the improved exercise performance observed We found, however, that dietary nitrate does not affect short-term recovery of muscle fatigue after moderate-intensity exercise.

PRIOR INGESTION OF EXOGENOUS KETONE MONOESTER ATTENUATES THE GLYCEMIC RESPONSE TO AN ORAL GLUCOSE TOLERANCE TEST IN HEALTHY YOUNG INDIVIDUALS.

MYETTE-COTE, E.

UNIVERSITY OF BRITISH COLUMBIA, OKANAGAN CAMPUS

INTRODUCTION: The main objectives of this study were threefold: 1) To determine whether acute ingestion of ketone ester (KE); (R)-3-hydroxybutyl (R)-3-hydroxybutyrate impacts plasma glucose levels during a standardized oral glucose tolerance test (OGTT). 2) To compare changes in insulin concentrations and estimates of insulin sensitivity after acute KE supplementation.
METHODS: Twenty healthy participants (n=10 males/females) aged between 18-35 years took part in a randomized crossover study. After an overnight fast, participants consumed a KE supplement (DeltaG®; 0.45 ml/kg body weight) or placebo 30 minutes before completing a 75-gram OGTT. Blood samples were collected every 15-30 minutes over a period of 2.5 hours. Participants and study personnel performing laboratory analyses were blinded to condition.
RESULTS: KE acutely raised blood D-beta-hydroxybutyrate to an average concentration of 3.2 mM within 30 minutes with levels remaining elevated throughout the entire OGTT. Compared to placebo, KE significantly decreased glucose area under the curve (AUC; -16%, P = 0.001), non-esterified fatty acid AUC (-44%, P < 0.001) and C-peptide incremental AUC (P = 0.005), while improving oral glucose insulin sensitivity index by ~11% (P = 0.001).
CONCLUSION: In conclusion, a KE supplement that acutely increased D-beta-hydroxybutyrate levels up to ~3 mM attenuated the glycemic response to an OGTT in healthy humans. The reduction in glycemic response did not appear to be driven by an increase in insulin secretion, but was accompanied by improved markers of insulin sensitivity. These results suggest that ketone ester supplements could have therapeutic potential in the management and prevention of metabolic disease.

THE ERGOGENIC EFFECTS OF CARBOHYDRATE INGESTION DURING SIMULATED HURLING MATCH-PLAY

COLLINS, K.1, MCROBERTS, A.2, MORTON, J.2

1. IT TALLAGHT, DUBLIN IRELAND. 2.LIVERPOOL JOHN MOORES UNIVERSITY, LIVERPOOL ENGLAND.

INTRODUCTION: Carbohydrate consumption before and during intermittent exercise has been shown to delay fatigue and improve performance. Carbohydrate supplementation may, therefore, benefit intermittent exercise performance such as that which occurs in hurling. Therefore, the aim of the present study was to investigate the ergogenic effects of carbohydrate ingestion during simulated hurling match-play.
METHODS: Eight hurling players (Age: 22 ± 3yrs; Height: 1.77 ± 0.06m; Body Mass: 77 ± 4 kg; VO2max: 56.6 ± 3.2 ml·kg·min-1) participated in this investigation. During the hurling shuttle protocol either a carbohydrate (CHO) solution (0.8 g/kg body mass), or a placebo (a similarly coloured, flavoured and textured solution) was consumed at 0, 18, 36 and 54 min of exercise (PLA). Experimental trials were conducted in a double blind, cross-over fashion. During the protocol work rate was measured. Expired air, heart rate, blood lactate and rating of perceived exertion was collected across each trial. Venous blood was collected on three occasions throughout the protocol. Lactate, glucose, betahydroxybuterate, glycerol and non-esterified fatty acids (NEFA) was analysed. The participants undertook a repeated anaerobic sprint test at 3 separate time points. The data were analysed using two-factor (trial x time) analysis of variance with repeated measures.
RESULTS: Despite trends there was limited variation in running performance and physiological measures observed. A significant (p<. 001) interaction between trials for plasma glucose, NEFA, plasma glycerol and lactate was observed. A significant (p=.033) interaction between trials for average 35-m sprint time was observed. The average sprint time increased significantly (p< .001) across both trials with quicker times observed during the CHO trial.
CONCLUSION: Carbohydrate ingestion enhances hurling specific exercise capacity. The findings support the view that increases in supply of exogenous carbohydrates leads to an increase in the utilisation of carbohydrates as an energy source at the expense of lipids. There was also a trend for an increase in high speed running performance in comparison to the placebo. A carbohydrate supplementation strategy can offer performance related benefits for hurling players during math-play.

EFFECT OF B-ALANINE SUPPLEMENTATION ON CIRCULATING IL-10 CONCENTRATIONS DURING INTENSE MILITARY TRAINING

HOFFMAN, J.R., GEPNER, Y., HOFFMAN, M.W., ZELICHA, H., OSTFELD, I.

UNIVERSITY OF CENTRAL FLORIDA

INTRODUCTION: Previous studies have demonstrated the efficacy of 30-days of β-alanine supplementation on improved performance and cognitive function in soldiers. This outcome was not thought to be related to enhanced muscle buffering capacity associated with elevations in muscle carnosine content, but to carnosine's potential role as an anti-oxidant. Animal studies have reported reductions in inflammatory markers and an increased resiliency to both PTSD-like and mTBI-like symptoms associated with exposure to a predator scent stress and low-pressure blast wave, respectively. These outcomes provide evidence suggesting that elevations in carnosine may have anti-oxidant properties, and reduce inflammation associated with both mental and physical demands during intense exercise. Thus, the purpose of this study was to examine the effect of β-alanine supplementation on IL-10, an anti-inflammatory cytokine response, during intense military training in special operation soldiers.
METHODS: Twenty soldiers (20.1±0.6 y; 178.0±5.4 cm; 74.1±7.9 kg) from an elite combat unit were randomly assigned to either a β-Alanine (BA; n = 10) or placebo (PL; n = 10) group. Soldiers were provided with 12 ·day-1 of either BA or PL for 7-days between two intensive weeks of navigational training and restricted sleep. During the intense week prior to supplementation soldiers navigated on average 27.8 km per evening with ~50% of their body mass in their packs for four days. Soldiers returned to base began the supplementation program for a week prior to leaving for a week of intense field training. Fasting blood samples were obtained at before and following the

7-day supplementation period for the anti-inflammatory cytokine IL-10. To complement null hypothesis testing, magnitude based inferences were examined to provide inferences on the true effects BA may have had on IL-10 concentrations compared to PL, calculated from 90% confidence intervals.
RESULTS: Changes in IL-10 concentrations for BA (0.86 pg/ml) were not significantly different (p=0.27) than PL. However, magnitude based inference analysis indicated that the effect of BA supplementation was possibly (57%) more beneficial than PL in increasing IL-10 concentrations.
CONCLUSION: One week of high dose BA ingestion appeared to possibly increase the circulating concentration of IL-10 during intense military training. This appears to be the first study to examine the use of BA as a potential therapeutic aid during intense training.

THE IMPACT OF FLAVANOLS ON PERIPHERAL, CEREBROVASCULAR AND COGNITIVE FUNCTION

PRITCHARD, R.M., RENDEIRO, C., PHILP, A., EDWARDS, F.R., JONES, D., LUCAS, S.J.E.
UNIVERSITY OF BIRMINGHAM

INTRODUCTION: Peripheral vascular dysfunction is a critical risk factor linked with cerebrovascular complications and age-associated cognitive impairments (Iadecola et al., 2016). Effective strategies that can be easily implemented in daily life routines to delay the onset of age-related cognitive decline and neurodegenerative disorders are urgently needed. Flavanols, a sub-group of plant-derived dietary flavonoids, have shown exciting potential to improve vascular health in humans. Cocoa flavanols, in particular, have proven effective at ameliorating human peripheral vascular function both acutely (within 2 hours of intake; Schroeter et al., 2006) and chronically (up to 4 weeks; Sansone et al., 2015). However, the extent to which such peripheral vasculature effects translate to the cerebrovasculature and ultimately impact on brain function has been less explored. In the present study, we aim to assess the acute impact of a flavanol-rich cocoa on both peripheral vascular function and cerebrovascular function in young and older adults, and further investigate whether such systemic and cerebral vascular outcomes may underpin improvements in cognitive performance.
METHODS: An acute, randomised, double-blind, placebo-controlled crossover human trial is currently being conducted in both young and older male adults (18-45 and 65+ years, respectively, n=20 in each group) to assess the impact of a High-Flavanol Cocoa (150 mg of (-)-epicatechin; 1000 mg of total polyphenols) and a Low-Flavanol Cocoa (4 mg of (-)-epicatechin; 140 mg of total polyphenols; matched for all other micro and macronutrients) on: i) Flow-mediated dilation of the brachial artery; ii) CO2-cerebrovascular reactivity of the middle and posterior cerebral arteries (Transcranial Doppler (TCD)); iii) neurovascular coupling during visual stimulation (TCD), and iv) cognitive performance (CANTAB, Cambridge Cognition). All vascular outcome measures are assessed at baseline (fasted) and 2 hours post cocoa ingestion, when plasma bioavailability of flavanol metabolites is known to be maximal.
RESULTS: Currently, a total of 12 volunteers have been recruited and complete sets of data have been collected for 5 participants. The full data set (unblinded) for both the young and older cohorts will be presented at the conference.
CONCLUSION: Data emanating from this study will for the first time establish the physiological impact of well-controlled flavanol interventions on arterial vasodilatory function simultaneously across peripheral and cerebral vascular beds, whilst linking such physiological responses with cognitive outcomes.
References:
Schroeter et al. (2006), PNAS, 103 (4): 1024-1029
Wray & Richardson (2006). Med Sci Sport Exer. 38 (10): 1804-1810
Iadecola et al., (2016) Hypertension. 68(6): e67-e94.
Sansone et al. (2015) Br J Nutr. 114(8): 1246-55.

EFFECT OF CAFFEINE SUPPLEMENTATION AFTER 2-WEEKS OF INTAKE RESTRICTION PERIOD ON 500 M ROWING PERFORMANCE AND CATECHOLAMINES RESPONSES

LEE, J., KU, J., HUR, S., AN, K., KIM, S., NGUYEN, Q.T.
DAEGU UNIVERSITY

INTRODUCTION: We investigated the effect of caffeine intake restriction and then supplement on the impact in 500 M rowing time-trial record and performance relevant indices.
METHODS: Sixteen healthy male participants were recruited, and divided into one of two exercise groups either 2 weeks of caffeine intake restriction group (CRG, n=8; 20±1.0 y; 172.4±3.2 cm; 63.9±4.9 kg), or no caffeine intake restriction group (NRG, n=8; 20±2.0 y; 177.0±3.0 cm; 70.2±10.5 kg). Participants performed 5 minutes warm up rowing at 30% of pre-measured peak power output (PPO). All participants supplemented orally with the first caffeine dose during 5 minutes resting, then rowed for 2.5 minutes (1 minute@30% PPO and 1.5 minutes@60% PPO). Participants conducted strenuous rowing exercise at 40% of PPO until complete exhaustion, and had the second caffeine dose during 5 minutes resting. All participants rowed for 500 M time-trial. Participants in NRG supplemented placebo capsules, and Dosage was 5 mg (Posyko, Korea) per 1 kg of body mass. Blood samples were taken at 3 occasions (@ pre-exercise, after exhausted rowing at 40% PPO, and after 500 M time trial), and used for catecholamines and other indices measurement.
RESULTS: Caffeine intake after exhaustive rowing exercise in CRG did not show a significant improvement time trial record and mean power output during 500 M maximal rowing ($p>.05$). Glucose concentration was higher ($p<.05$) but Ca2+ concentration was lower ($p<.05$) in CRG compared to NRG after 500 M time trial. Both epinephrine and norepinephrine from the blood samples were markedly elevated in both groups, but it did not show notable differences between CRG and NRG. The concentration of various ions (i.e., hydrogen ion (pH), Na+, HCO3-), hemoglobin (Hb), hematocrit (Hct), oxygen saturation (%SO2), and partial pressure of oxygen (PO2) had only significant time effect (but not with group effect).
CONCLUSION: In conclusion, caffeine intake restriction and then re-intake during exhaustive strenuous exercise does not reveal 500 M ergometer rowing record enhancement and relevant physiological and biochemical indices' change. For the future study, there will be interest if exercise and/or sport performance and associated physiological variables are affected by the state of body condition, in which caffeine content in the body is used up and which will concomitantly induce sensitizing of caffeine responses from diverse exercise stimulus.

QUERCETIN SUPPLEMENTATION DECREASES ERYTHROCYTES OXIDATIVE DAMAGE AT RESTING AND AFTER AN ACUTE BOUT OF ECCENTRIC EXERCISE IN HUMANS

DURANTI, G., CECI, R., PATRIZIO, F., BAZZUCCHI, I., SGRÒ, P., DI LUIGI, L., SABATINI, S., FELICI, F.

UNIVERSITY OF ROME FORO ITALICO

INTRODUCTION: Quercetin (Q) functions as antioxidant in vitro, but its effect have been minimally examined in combination with exercise in humans. The purpose of this investigation was to determine the effects of a diet supplemented with 1 g per day of Q for 2 weeks on the erythrocytes oxidative balance before and after an acute bout of eccentric exercise (EE).
METHODS: Fourteen volunteer males were randomly assigned, in a double-blind crossover design, to a placebo or experimental supplemented groups. Blood samples were taken before and after 2 weeks of supplementation under resting and post-exercise conditions. Erythrocytes glutathione (GSH, GSSG, GSH/GSSG), malonaldehyde (TBARs), enzymes antioxidant activities as well as time of hemolysis were evaluated in ex vivo.
RESULTS: Quercertin per se did not affect redox homeostasis but increased the time of hemolysis and decreased TBARs levels. Following the EE the Q group displayed a higher GSH/GSSG ratio and a less pronounced increase in TBARs, compared to placebo group. Moreover, we found that GPx enzyme activity were induced after EE only in Q group, while any significant modification of this parameter was detected in placebo group.
CONCLUSION: In conclusion, the Q supplementation may be used as a countermeasure against oxidative stress inducing, in erythrocytes, a cellular adaptation allowing subjects to better cope with the oxidative stress induced by an acute exercise.

Mini-Orals

MO-PM05 Vascular physiology and Cardio-respiratory fitness

PHYSIOLOGICAL DECOUPLING OF ANKLE AND BRACHIAL BLOOD PRESSURES FOLLOWING ACUTE INTERMITTENT EXERCISE: IMPACT ON THE ANKLE-BRACHIAL INDEX

LOLLI, L., WILLIAMSON, P.J., BATTERHAM, A.M., WESTON, K.L., ATKINSON, G.

TEESSIDE UNIVERSITY

INTRODUCTION: The ankle-brachial index (ABI) is the ratio of ankle and brachial systolic blood pressures, and is a first-line screening test for the diagnosis of peripheral artery disease [1]. Importantly, both resting, and post-exercise, ABI have been reported to provide clinical and prognostic information in middle-aged cardiovascular patients [1]. Nevertheless, there has been no study on the differential effects of exercise on ankle and brachial pressures, specifically in context of the subsequent impact of these differential changes on the ABI itself.
METHODS: Eight men and four women, with mean (SD) age, body mass and maximal oxygen uptake (V̇O2max) of 29.7 (5.0) years, 72.5 (12.5) kg and 39.3 (8.3) ml/min/kg, were block randomized to one of 6 sequences of 2 control and 2 exercise replicates over four periods. A hand-held Doppler ultrasound instrument, with 5 MHz probe, was used to measure ankle and brachial systolic blood pressure at rest and after the second exercise bout. Data (n=11 due to one male withdrawal) were analysed using linear mixed models to quantify mean (95% confidence interval, 95%CI) exercise-control differences in blood pressure responses at ankle and brachial sites, with fixed effects for period, condition, time, and sex, and treatment × sex, treatment × period, treatment × sex × period, and treatment × time interaction terms.
RESULTS: Relative to control, exercise increased brachial systolic blood pressure by 24 mmHg (95%CI: 17 to 30). This contrasted with the trivial mean reduction in ankle systolic blood pressure of -6 mmHg (95%CI: -14 to 2) mmHg. Accordingly, there was an exercise-mediated reduction in the ABI of -0.22 (95%CI: -0.30 to -0.15), which reflected the substantial increase in brachial, but not ankle, blood pressure.
CONCLUSION: Our exercise protocol resulted in an increase in systolic blood pressure only for the brachial site and not the ankle site, which if confirmed in a larger study, would fundamentally question the need to quantify the post-exercise ABI for prognostic purposes.
References: 1. Aboyans V, Ricco JB, Bartelink MEL, et al. Eur Heart J. 2017. doi:10.1093/eurheartj/ehx095.
Contacts
L.Lolli@tees.ac.uk

COMPARISON OF DYNAMIC CEREBROVASCULAR KINETICS AND STEADY-STATE RESPONSIVENESS TO CARBON DIOXIDE

SKINNER, B.D., BURLEY, C.V., LUCAS, R.A.I., YEO, S.H., LUCAS, S.J.E.

UNIVERSITY OF BIRMINGHAM

INTRODUCTION: Cerebrovascular responsiveness to CO2 (CVR) is a common marker of brain vascular health and disease risk (e.g., stroke). A dynamic stimulus-response profile of cerebrovascular function may further our understanding, as in other vascular beds (e.g. lower limb plethysmography). Recently, Billinger et al. (2017) measured cerebrovascular kinetics from rest to moderate intensity exercise; reporting different response kinetics between young and older participants, as well as a clinical population (i.e. stroke). The dynamic response profile to a CO2 stimulus is yet to be explored. Additionally, it remains to be seen if stimulus-response kinetics are associated with established steady-state CVR measures.
METHODS: Data from 31 participants (age – younger: 28.1 ± 11.8yrs, older: 71.2 ± 4.4yrs) were pooled from various studies conducted in our laboratory. All participants had performed 5% CO2 (in air) inhalation for 4 minutes, while some did both 4 and 5 minutes protocols in the same visit. CVR was determined by the % change in middle cerebral artery velocity (MCAVmean) and end-tidal CO2 from baseline to the last 30 s of 5% CO2. As in Billinger et al. (2017), the MCAVmean kinetic response was determined by plotting MCAVmean¬ against time to establish time-to-63% of the steady-state response (τ). The kinetic response was compared between age and between stimulus duration times (4 vs. 5 min) in a young cohort. A Pearson correlation was used to examine any association between τ and CVR.
RESULTS: The kinetic response was similar regardless of age (younger: 24.47 ± 12.69s, older: 29.63 ± 17.61s; P=0.48) though there were large variations within each cohort. CVR was similar between young (3.71 ± 0.93%/mmHg) and older cohorts (3.91 ± 1.12%/mmHg; P =0.65). There was a moderate positive correlation between τ and CVR when all cohorts were pooled (τ: 23.38 ± 12.90s, CVR: 3.49 ± 1.04%/mmHg; r=0.51, P<0.01). Surprisingly, there was a trend for a difference in the kinetic response between CO2 stimulus length (4min:

16.45 ± 6.19s, 5min: 19.86 ± 8.28s; P=0.06), however CVR remained similar (4min: 2.93 ± 0.97%/mmHg, 5min: 3.06 ± 0.71cm%/mmHg; P=0.63).
CONCLUSION: In contrast to Billinger et al. (2017) no differences were found in cerebrovascular kinetics between older and younger cohorts. However, a moderate positive correlation between τ and CVR indicates that speed of "onset" kinetics to a CO2 stimulus are associated with steady-state measures. Further research is warranted to ascertain the reliability and reproducibility of τ.

IMPROVEMENT IN CENTRAL ARTERY VASCULAR FUNCTION FOLLOWING 12 WEEKS OF EXERCISE TRAINING IN A CLINICAL POPULATION.

BUCKLEY, B.J.R.1, WATSON, P.M.1, MURPHY, R.C.1, GRAVES, L.E.F.1, WHYTE, G.1, THIJSSEN, D.H.J.1,2

1: RESEARCH INSTITUTE FOR SPORT AND EXERCISE SCIENCES, LIVERPOOL JOHN MOORES UNIVERSITY, LIVERPOOL, UK. 2: DEPARTMENT OF PHYSIOLOGY, RADBOUD UNIVERSITY MEDICAL CENTER, NIJMEGEN, NETHERLANDS.

INTRODUCTION: It is established that sympathetic nervous system activation elicits central blood vessel vasodilation in healthy subjects, yet vasoconstriction in those with cardiovascular disease (Rubenfire et al. 2000). It is not, however, known whether central artery vasoconstriction during sympathetic stimulation can be reversed in response to exercise training.
Aim: To examine the change in carotid artery reactivity (CAR) following 12 weeks of exercise training in subjects with increased risk for cardiovascular disease (CVD). It was hypothesised that training would (partly) restore the impaired CAR response to sympathetic stimulation.
METHODS: Nineteen individuals with increased risk for CVD (54±16 years) were referred for 12 weeks of exercise training. Measures were collected at baseline and 12 weeks. Cardiorespiratory fitness was estimated via the Astrand-Rhyming test. CAR% (relative change in carotid artery diameter in response to sympathetic stimulation) and flow-mediated dilation (FMD%; relative change in brachial artery diameter to 5-min forearm ischaemia) were measured via Doppler ultrasound. Baseline to 12-week changes were analysed using paired samples t-tests (cardiorespiratory fitness) and Wilcoxon Signed Rank tests (CAR% and FMD%).
RESULTS: Significant increases were observed in cardiorespiratory fitness (95% Confidence Interval (CI) 1.9-5.4, P<0.001), CAR% (95% CI 1.6-4.4, P<0.001), and FMD% (95% CI: 0.8-3.6, P=0.003) following 12 weeks of exercise training. All participants who exhibited carotid artery vasoconstriction at baseline (n=6) demonstrated vasodilation at 12 weeks. No associations were observed between measures at baseline, 12 weeks or baseline-to-12-week change.
CONCLUSION: Carotid artery reactivity, a novel measure of coronary artery function, improves following 12 weeks of exercise training. More importantly, carotid artery vasoconstriction, commonly present at baseline (32%), was reversed to vasodilation at 12 weeks. These findings have important public health implications, as short-term exercise interventions may have profound effects on central artery function in populations with increased risk of CVD.
References: Rubenfire, M., Rajagopalan, S., Mosca, L. (2000). Carotid artery vasoreactivity in response to sympathetic stress correlates with coronary disease risk and is independent of wall thickness. Journal of the American College of Cardiology, 36(7), 2192–7.
Contact: B.J.Buckley@2014.ljmu.ac.uk

CARDIAC AUTONOMIC RESPONSES TO AN ACUTE BOUT OF LOW-INTENSITY RESISTANCE TRAINING WITH HIGH VERSUS LOW-REPETITION VOLUMES IN YOUNG ADULTS

LOPES, W.A.1, NUNES, J.H.C.1, PORTO, F.E.1

1 STATE UNIVERSITY OF MARINGA

INTRODUCTION: Resistante training (RT) has been recommended not only for the general population, but also for different health conditions, including cardiovascular diseases. Despite this, little is known about the impact of this type of exercise on cardiac autonomic control. The manipulation of different variables of RT, such as intensity, volume and muscle groups involved, may induce varied responses in post-exercise autonomic activity. Therefore, the aim of this study was to compare the HRV (Heart Rate Variability) responses induced by RT with different repetition volumes at low-intensity in young adults.
METHODS: Ten young adult men undertook 2 experimental sessions of 5 upper body resistance exercises on different days: (a) 3 sets of 10 repetitions (low-repetitions - LR) and (b) 3 sets of 20 repetitions (high-repetition - HR) at low-intesity (50% of 1-RM). HRV was collected before each sessions, and during a period of 60 minutes after them, in the sitting position, using a portable cardiac monitor. The Mann-Whitney U test was used for comparing the groups, and the Friedman test was used for the analysis of moments.
RESULTS: Ten young adults concluded all the experimental sessions (Age=21.6±1.8yrs, weight=67.3±12.6kg, and height=1.76±0.1m). There was no statistically significant difference in any of the HRV parameters in the pre-exercise condition between the experimental sessions (HR versus LR). The results demonstrated that HR induced smaller parasympathetic activity (ΔHF=-9.6±5.4, p<0.05) and higher sympatho-vagal balance (ΔLF/HF=4.9±4.3, p<0.05) in relation to baseline until 30 minutes after the session. Also, sympatho-vagal balance (ΔLF/HF) was greater for HR compared to LR until 30 minutes after the session (HR=4.9±4.3 versus LR=-0.5±3.9, p<0.05).
CONCLUSION: Although there is controversy regarding the fact that RT at low intensity does not induce cardiac autonomic imbalance after a training session (Kingsley & Figueroa, 2014; Lima et al, 2011; Rezk et al., 2006), a greater number of repetitions seems to be crucial for alterations in cardiac autonomic response after a low intensity RT session. Our study confirmed the hypothesis that a greater number of repetitions of 50% 1-RM could induce a lower vagal cardiac modulation and a higher sympatho-vagal balance when compared to a smaller number of repetitions on the same intensity.
Kingsley DJ, Figueroa A. (2014). Clin Physiol Funct Imaging, 34, 1-10.
Lima AH, Forjaz CL, Silva GQ, Meneses AL, Silva AJ, Ritti-Dias RM. (2011). Arq Bras Cardio, 96, 498–503.
Rezk CC, Marrache RC Tinucci T, Mion D Jr, Forjaz CL. (2006). Eur J Appl Physiol, 98, 105– 112.
Contact: warthurlopes@gmail.com

EFFECTS OF CONSECUTIVE SCUBA DIVING ON BODY COMPOSITION, VITAL CAPACITY, OXYGEN CONSUMPTION, AND CARDIORESPIRATORY FITNESS IN HEALTHY MEN

YU, D.H.1, SIM, N.J.1, KIM, D.J.1, YOU, D.G.1, LEE, H.S.1

DANKOOK UNIVERSITY

INTRODUCTION: Scuba diving is challenging activity to healthy person, and human adapt to the new environmental for efficient survival. Recent findings indicate that a single scuba diving for 2 hours increases lung fluid with an improvement ventilation inefficiency (Zora et

al., 2017), However, little is known about the physiological effects of consecutive scuba diving. Thus, aim of the present study was to examine the effects of consecutive scuba diving on body composition, vital capacity, oxygen consumption, and cardiorespiratory fitness in healthy men.
METHODS: 10 healthy male participated in the study. The subjects performed consecutive scuba diving as immersed 5 m underwater for total 80 minutes (40 min × 2 times) with a 60 min rest between time, five times a week, and for 8 weeks. Body composition (muscle mass and body fat), vital capacity (forced vital capacity; FVC), oxygen consumption, and cardiorespiratory fitness (fitness index; PI) were measured before (pre), immediately after (post), and at 4 (post 1) and 8 weeks (post 2) following the scuba diving.
RESULTS: After consecutive scuba diving, significant ($p < 0.05$) increases in muscle mass, and decreases in body fat and oxygen consumption were observed. The changes in FVC and PI were significantly ($p < 0.05$) improved following consecutive scuba diving as compared with the pre.
CONCLUSION: It has been reported that a significant increase in muscle mass and decrease in body fat were improved cardiorespiratory fitness (Paoli et al., 2017). Moreover, Low cardiorespiratory fitness was related to reduced pulmonary function and oxygen consumption (Dougherty et al., 2018) and impaired body composition (Ozbulut et al., 2013). In the present study, consecutive scuba diving elicited significantly changes in body composition, vital capacity, oxygen consumption, and cardiorespiratory fitness. These results indicate that consecutive scuba diving changes cardiorespiratory fitness by improving the body composition, vital capacity and oxygen consumption.

ASSOCIATIONS BETWEEN CHANGES IN MAXIMAL AEROBIC CAPACITY, ENDURANCE PERFORMANCE AND MUSCULAR ENDURANCE FOLLOWING ENDURANCE-TYPE EXERCISE TRAINING

PAULUSSEN, K.J.M., JONVIK, K.L., DE NIET, M., HORSTMAN, A.M.H., VAN LOON, L.J.C., VAN DIJK, J.W.
HAN UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: The impact of endurance-type exercise training on maximal aerobic capacity (VO2max) has been well established. However, studies that examined the impact of endurance-type exercise on endurance performance and muscular endurance are limited. Hence, it is unknown whether improvements in VO2max are critical for improvements in endurance performance and muscular endurance. The current study aims to assess whether improvements in VO2max induced by endurance-type exercise training are transferred to changes in endurance performance and muscular endurance.
METHODS: Sixty recreationally trained males were recruited to participate in a 12-week exercise program. The exercise program consisted of continuous endurance-type exercise training and interval training for three days per week in a 1:2 ratio. Before and after the 12-week exercise training period, maximal aerobic capacity (VO2max) and maximal workload capacity (Wmax) were assessed during an incremental ramp test on a cycle ergometer. Endurance performance was assessed by a 10-km time trial on a cycle ergometer. Muscular strength was assessed by maximal voluntary isokinetic contractions, whereas muscular endurance was assessed by total workload achieved during 30 reciprocal isokinetic contractions of the upper leg. Pre- and post-training data were analyzed using paired-samples t-tests. Correlations between improvements in VO2max, endurance performance, and muscular endurance were determined by calculating bivariate Pearson correlation coefficients. All data represent mean ± standard deviation. This study is part of a larger project investigating the impact of protein supplementation on adaptations to endurance-type exercise training.
RESULTS: Thus far, 28 subjects (29±7 y, BMI 23.8±2.5 kg/m2, VO2max 46.6±6.6 mL/min/kg, Wmax 324±49 W) completed the training program. The 12-week training program resulted in significant increases in VO2max (11±6 %, $P<0.0001$) and Wmax (12±7 %, $P<0.0001$). The 10-km time trial performance improved by 165±99 s (15±8 %, $P<0.0001$). Maximal voluntary isokinetic contraction at 180 °/s increased by 5.7±10.8 Nm for extension (5±9 %, $P=0.011$) and 3.6±9.2 Nm for flexion (4±10 %, $P=0.049$). The work performed during 30 reciprocal isokinetic contractions increased significantly by 169±209 Kj (6±7 %, $P<0.001$). The increase in VO2max correlated significantly with the increase in time trial performance ($r=0.621$, $P<0.001$), whereas no significant correlations were observed between the increase in VO2max and the increase in muscular endurance performance ($r = 0.321$, $P=0.095$).
CONCLUSION: Endurance-type exercise training increases aerobic capacity, endurance performance and muscular endurance. We speculate that the improvements in maximal aerobic capacity are critical for enhanced endurance performance, but not for enhanced muscular endurance. This may be attributed to the largely anaerobic nature of muscular endurance testing.

AEROBIC CAPACITY AND LEFT VENTRICULAR REMODELING IN AN OLYMPIC TRIATHLETE AND TRIATHLETES OF THE NATIONAL TEAM FOR UNIVERSITY STUDENTS

NAMATAME, H.1, TAYAMA, H.1,2,3, OTSUKI, T.1
1 RYUTSU KEIZAI UNIVERSITY, 2 NTT EAST, 3 NTT WEST.

INTRODUCTION: To obtain significant information for young triathletes, this study investigated aerobic capacity and left ventricular (LV) morphology and function in an Olympic triathlete and triathletes of the national team for university students.
METHODS: Subjects of this study were a male Olympic triathlete (n = 1), male triathletes of the national team for university students (n = 4), and male sedentary university students (n = 2). Maximal oxygen uptake (VO2max) and ventilatory threshold (VT) were determined using incremental cycling to exhaustion (4 min at 100 W with a 30-W increase every 2 min) with monitoring of breath-by-breath oxygen uptake. Indices of LV concentric (wall thickness and mass) and eccentric (end-diastolic dimension and stroke volume) remodeling were measured using M-mode echocardiography (Otsuki T et al., Med Sci Sports Exerc 39: 365-370, 2007). Since the Olympian is an identifiable living person, values are expressed as ratio to mean value of sedentary subjects.
RESULTS: Body weight and lean body weight were slightly higher in the Olympian relative to the student triathletes (1.10 vs 1.02±0.09 and 1.10 vs 1.06±0.08, respectively). Absolute values of VO2max and VT (i.e., mL/min) were greater in the Olympian compared to the student triathletes (1.64 vs 1.48±0.12 and 1.85 vs 1.75±0.20, respectively). Lean body weight was correlated with absolute values of VO2max and VT in the triathletes. There were no differences in VO2max and VT per body weight (relative value, mL/kg/min) between the Olympian and the student triathletes (1.46 vs 1.44±0.20 and 1.63 vs 1.68±0.31, respectively). LV wall thickness and mass, indices of concentric LV remodeling, were greater in the Olympian compared to the student triathletes (1.69 vs 1.47±0.03 and 2.05 vs 1.78±0.28, respectively). There were no differences in LV end-diastolic dimension and stroke volume, measures of eccentric LV remodeling, between the Olympian and the student triathletes (1.09 vs 1.07±0.05 and 2.09 vs 2.08±0.2, respectively).
CONCLUSION: The present results suggest that the Olympic triathlete had higher lean body weight (i.e., higher muscle mass), leading to greater absolute aerobic capacity. In general, athletes with higher muscle mass have less aerobic capacity per body weight compared to athletes with light weight. However, the Olympian have excellent aerobic capacity per body weight, which is comparable to the student triathletes. Greater absolute aerobic capacity may enable the Olympian to finish the swim and the run with less fatigue. In addition, LV

concentric remodeling, commonly developed in strength-trained athletes, was more remarkable in the Olympian than in the student triathletes. Increases in muscle mass and absolute aerobic capacity by strengthening and sprint training may improve performances of young triathletes.

AQUATIC EXERCISE DECREASES ARTERIAL STIFFNESS AND INCREASES POSITIVE EMOTIONS AFTER A TRAINING CAMP

SATO, K.1, KOBAYASHI, R.2

1>INTERNATIONAL CHRISTIAN UNIVERSITY 2>TEIKYO UNIVERSITY OF SCIENCE

INTRODUCTION: Light exercise such as walking, running, and cycling can help reduce increased arterial stiffness. However, little is known about the association between arterial stiffness and aquatic exercise, or about the psychological effects of aquatic exercise after training camps. Therefore, the aim of this study was to investigate the effects of aquatic exercise on arterial stiffness and positive emotions among female athletes after participation in a training camp.
METHODS: The study participants were 16 female collegiate volleyball players who participated in a summer training camp. None of the participants was taking oral contraceptives. As part of the training camp, the players took part in daily volleyball sessions (training for technique or strategy) and non-volleyball sessions (training for physical fitness). One day after the training camp, the aquatic exercise group (AE group; n=6) swam and performed both dynamic and static stretches in the water, while the aerobike group (AB group; n=10) performed moderate-intensity aerobike exercise (corresponding to 50% heart rate reserve) for 30 min. Brachial-ankle pulse wave velocity (baPWV), an index of arterial stiffness, was measured using an automatic waveform analyzer with sensory cuffs wrapped around both brachia and ankles. baPWV was measured before the training camp (baseline), after the training camp, and after water or aerobike exercise. In addition, the psychological effects of the water and aerobike exercises after the training camp were investigated using a questionnaire.
RESULTS: baPWV increased significantly after the training camp in both groups; however, in the AE group, the decreases in baPWV after the aquatic exercise compared with after the training camp were significant ($P<0.05$), whereas in the AB group, no changes in baPWV were seen after the training camp. Positive emotions were significantly increased in both groups. However, the mean change of positive emotions in the AE group was higher than that in the AB group. Specifically, AE group scored 18.7 and AB group scored 10.8.
CONCLUSION: Aerobike exercise did not reduce training camp-induced increases in arterial stiffness, whereas aquatic exercise did. Water pressure squeezes the surface veins and increases venous return, which promotes systemic blood circulation. Therefore, the present findings indicate that aquatic exercise reduces arterial stiffness after a training camp to a greater extent than aerobike exercise. On the other hand, an increase in positive emotions was observed in both groups. These results suggest that aquatic exercise after a training camp reduces arterial stiffness and promotes positive emotions.

INTRODUCING A NOVEL TECHNIQUE TO QUANTIFY CUTANEOUS MICROVASCULAR STRUCTURE AND FUNCTION IN HUMANS

ARGARINI, R., SMITH, K., CARTER, H., HAYNES, A., MCLAUGHLIN, R., GREEN, D.J.

THE UNIVERSITY OF WESTERN AUSTRALIA

INTRODUCTION: Traditional methods used to assess cutaneous microvascular function are limited by an inability to directly visualise and quantify small artery haemodynamics. Optical coherence tomography (OCT) is a novel technology capable of generating images of exceptional spatial resolution. Based on advanced Doppler speckle decorrelation algorithms, we have developed new OCT-based methods to quantify the diameter, velocity and flow through individual microvessels (~10µm). This study aimed to quantify and compare microvasculature responses during hyperaemia using two distinct methods (OCT and laser Doppler flowmetry [LDF]).
METHODS: OCT was used to scan cutaneous microvessels in response to a hyperemic stimulus in 9 healthy people (age 27.6 ± 5.5 yr). Speckle decorrelation images, at a depth of ~500 µm, and cutaneous red blood cell flux (LDF) were obtained from the ventral aspect of the forearm prior to, and 30-seconds following, five minutes of localized ischaemia. Post-processing of OCT measures was performed by two operators, to establish the inter-rater reliability of microvessel diameter, velocity, flow, and density (microvessel recruitment).
RESULTS: OCT outcomes revealed that the hyperaemic stimulus increased cutaneous microvessel diameter (21.77±4.81 to 29.33±5.09µm, $p <0.01$), velocity (58.33±8.03 to 91.22±17.28µm/sec, $p <0.01$), flow (37.33±21.43 to 128.33±63.01pl/sec, $p <0.01$) and density (9.89±5.69% to 40.40±13.99%, $p <0.01$). Red blood cell flux calculated from LDF also increased (19.13±9.99 to 52.04±24.07PU/sec, $p <0.01$). The inter-rater reliability for diameter, velocity, flow and density was 0.960; 0.996; 0.985; 0.989, respectively. A positive correlation was observed between the relative increases in microvascular flow (OCT) and red blood cell flux (LDF) ($r = 0.863$, $p=0.001$).
CONCLUSION: We have quantified, for the first time in humans, the impact of hyperemia on individual microvessel dilation, recruitment and flow. Our findings demonstrate that OCT generates microvascular images and haemodynamic data which correlate with LDF measures. OCT is an accurate and robust non-invasive technique that can be used to quantify microvascular structure and function in humans

THE IMPACT OF EXERCISE INTENSITY ON ACUTE VASCULAR FUNCTION IN HEALTHY YOUNG MEN.

TRYFONOS, A.1, COCKS, M.1, GREEN, D.J.1,2, DAWSON, E.A.1

1. LIVERPOOL JOHN MOORES UNIVERSITY, 2. THE UNIVERSITY OF WESTERN AUSTRALIA

INTRODUCTION: There is controversy surrounding the impact of an acute exercise bout on vascular function. [1] Increases, decrease and no changes have all been reported; and the influence of these changes on future adaptations or whether it represent a transient risk is uncertain. One mediating factor underpinning the acute change is likely to be exercise intensity. [1] Previous work suggests higher-intensities may result in a transient decrease in vascular function. [2] Given the growing interest in high-intensity interval exercise, it is pertinent to determine if there is a difference in the acute vascular response to a 'typical' high-intensity interval exercise (HIIE) bout vs a moderate-intensity continuous exercise (MICE).
METHODS: Fourteen males (22.9±3.9 years, BMI: 25.0±1.8 m2/kg, VO2max: 40.2±5.8 ml/kg/min) performed a randomised counter balanced cross over study completing either HIIE or MICE on two different days. Endothelial function, assessed by brachial flow-mediated dilation (FMD), was measured before and at 10min post-exercise. HIIE consisted of 10 sets on cycle ergometer, 1-min at 90% heart rate reserve (HRR), followed by 1-min recovery, while MICE was 30min continuous exercise at 70% HRR. Difference pre-post and between exercise intensities was determined using mixed-linear model (SPSS 23), covariating baseline diameter. Data are mean±SD and significance $P<0.05$.

RESULTS: There was a significant interaction between time and exercise intensity (P<0.01) with and without baseline diameter covariate. Post-hoc t-tests showed a significant increase in brachial FMD (7.1±2.36 % to 8.74±2.30 %) post-HIIE exercise, with a non-significant decrease (7.25±2.59 % to 6.54±2.11 %) followed the MICE exercise.
CONCLUSION: There was an immediate increase in FMD following HIIE exercise and no change following MICE. This is in contrast to previous research, which typically reports a decrease with higher-intensity exercise. [2] It was thought that the high-intensity exercise may be related to an increase in oxidative-stress, whereas the dose/duration of the exercise in this study may not have been sufficient to elicit large changes. Rather, the increase in FMD could be related to a shear-mediated up-regulation of the nitric oxide system. Given the further conflicting findings, further studies are therefore needed to elucidate the mechanisms which underlie the changes in FMD following acute exercise.
REFERENCES:
1. Dawson, E.A., et al., Effects of acute exercise on flow-mediated dilatation in healthy humans. J Appl Physiol (1985), 2013. 115(11): p. 1589-98.
2. Bond, B., et al., The Acute Effect of Exercise Intensity on Vascular Function in Adolescents. Med Sci Sports Exerc, 2015. 47(12): p. 2628-35.

Mini-Orals

MO-PM11 Ageing

EFFECTS OF PROGRESSIVE STRENGTH TRAINING ON SOLEUS STRETCH- AND H-REFLEX DURING DYNAMIC BALANCE PERTURBATIONS IN YOUNG AND OLDER INDIVIDUALS

ALLONEN, J., WALKER, S., LINNAMO, V., PIIRAINEN, J.M.
FACULTY OF SPORTS AND HEALTH SCIENCES, UNIVERSITY OF JYVÄSKYLÄ, FINLAND

INTRODUCTION: The number of injuries caused by falling accidents is a major problem among older citizens (Korhonen 2014). In addition to weaker force properties, aging leads to longer and weaker voluntary and reflex response after balance perturbation (Lin & Woollacott 2002, Piirainen et al. 2013). The aim of the study was to examine whether progressive strength training (PST) improves dynamic balance control and reflex responses.
METHODS: Four OLDER (2 women and 2 men, 68.5 ± 2.5 years) and eight YOUNG (5 women and 3 men, 24.0 ± 3.6 years) participants completed this study. Subjects performed a 14-week PST intervention. The training consisted of exercises using resistance machines, repetitions ranging 6–12 per set for 2–4 sets. The following measurements were performed before and after the training intervention; (1) maximum voluntary isometric contraction (MVC) of knee extensors and ankle plantarflexors, (2) dynamic balance tests on a sliding force-plate (Piirainen et al. 2013), (3) with concomitant soleus short-latency stretch-reflex (SLR) responses and (4) H-reflex responses (timed during SLR) during the dynamic balance tests.
RESULTS: YOUNG improved MVC results of knee extension (8 ± 11%; P <0,05) and plantarflexion (14 ± 11%; P <0,05), which was not observed in OLDER (knee extension; 14 ± 15%, P >0,05 and plantarflexion 8 ± 16%, P >0,05). SLR responses (normalized to max M-wave) were higher (0.037 ± 0.015) and latensies (44,75 ± 14,73 ms) longer in OLDER than YOUNG (0.022 ± 0.007, P <0.05; 36,25 ± 6,32 ms; P <0,05) at baseline, with no changes after intervention. Displacement after perturbation was higher in OLDER (51.9 ± 8.4 mm) than YOUNG at baseline (33.6 ± 11.0 mm; P <0.05). No changes in dynamic balance, H-reflex or SLR were observed after the training in either of the groups.
CONCLUSION: The main conclusions of the study were; (1) Short progressive strength training intervention does not improve balance control of subjects during sudden perturbation, (2) it does not have effects on stretch- or H-reflex responses of soleus. These findings support previous suggestions, that PST does not necessarily improve balance control properties (Orr et. al 2008), but it should be more power-type training (Piirainen et al. 2014).
REFERENCES:
Korhonen N. 2014. School of Medicine, University of Tampere. Academic dissertation.
Lin SI & Woollacott MH. 2002. Journal of Motor Behavior 34(1): 37-44.
Piirainen JM, Cronin NJ, Avela J, Linnamo V. 2014. J Electromyog Kinesiol. 24(2):246-252.
Piirainen JM, Linnamo V, Cronin NJ, Avela J. 2013. J Neurophysiol. 110(11):2557-62.

TRAINING AND DETRAINING CHANGES ASSESSMENT EXPRESS AS DAILY GAINS AND LOSSES

CORDELLAT, A.1, FORTE, A.2, MONTEAGUDO, P.1, ROLDÁN, A.1, BLASCO-LAFARGA, C.1
UNIVERSITY OF VALENCIA, SPAIN

INTRODUCTION: Analysing the relationship between gains and losses is very useful to assess the real improvements following the training and detraining periods in long term physical exercise programs. However, up to date, the large heterogeneity in exercise and protocols, as well as detraining duration or testing methodology (Lobo, Carvalho, & Santos, 2010) makes difficult to compare these interventions. Our study aims to analyse changes in cardiovascular fitness and neuromuscular function after a 2-years exercise intervention considering the time invested to improve and the detraining period consequences, that is, the ratios: Changes/training days (C/TD) and Changes/detraining days (C/DD).
METHODS: The 6-minute walking test (6MWT) and the 30s-Chair Stand Test (CST) (Rikli & Jones, 2001) were assessed during two training and detraining periods in 89 healthy elderly (74.16±6.27y) following the EFAM-UV© program (Blasco-Lafarga et al., 2016)0. T-test or Wilcoxon pre-post comparisons were applied (5 sample conditions).
RESULTS: Both, cardiovascular fitness and strength, improve for each training period. 6MWT_C/TD: 1st (1.626 m/day, p<0.001; n=42) and 2nd (0.769 m/day; p<0.002; n=24); CST_C/TD: 1st (0.1 rep/day, p<0.001; n=46) and 2nd (0.044 rep/day; p<0.001; n=22). Worsening was also significant. 6MWT_1st C/DD (0.098 m/day, p<0.006; n=38) and 2nd (0.216 m/day, p<0.002, n=21); CST_1st C/DD (0.008 rep/day, p<0.004; n=41) and 2nd (0.022 rep/day, p<0.001, n=21). There were just significant differences between both periods by strength (p=0.012).
CONCLUSION: It is important to reduce the detraining period as years rise, since it is usually too long to keep improvements in physical function in elderly (Leitão et al., 2015). Larger lost in strength might be caused by the decline in neural factors, the first step in strength reduction (Hakkinen, Alen, Kallinen, Newton, & Kraemer, 2000). Our results confirm the elderlies´ need to intensify strength and avoid its

loose during detraining. The C/DT and C/DD indexes could be a new promising method to compare exercise interventions of different nature and duration.

THE RELATIONSHIP BETWEEN ACCELEROMETER-ASSESSED PHYSICAL ACTIVITY AND CT-DERIVED REGIONAL ADIPOSITY MEASURES IN OLDER ADULTS

MARQUES, E.A.1, SHIROMA, E.J.2, FIGUEIREDO, P.1,3, GUDNASON, V.4, LANG, T.5, CHEN, K.6, ARNARDÓTTIR, N.Y.4, BRYCHTA, R.6, EIRIKSDOTTIR, G.4, HARRIS, T.2

1: CIDESD-ISMAI , 2: NIA-NIH , 3: FPF , 4: IHA , 5: UCSF , 6: NIDDK-NIH

INTRODUCTION: While body mass index (BMI) is a standard value used to define obesity, it cannot provide complex information about the age-related adipose tissue redistribution. As a result, there is controversy over the clinical utility of BMI as an indicator of obesity in older adults (Zamboni et al., 2005). In addition, the associations between computed tomography (CT) - derived abdominal and thigh fat measures and physical activity (PA) have never been investigated. Therefore, we examined the association of several indicators of accelerometer-assessed PA behavior and sedentary time with general body composition (BMI and waist circumference (WC)) and abdominal and thigh CT-derived adiposity measures (area and attenuation) in older adults.
METHODS: A population-based cohort of 610 men and women (61.6% women, mean age 80, SD 5 years) participating in the Age Gene/Environment Susceptibility-Reykjavik Study (2007-2011) with complete accelerometer data, abdominal and thigh CT scans, and potential covariates were analyzed. Odd ratios (ORs) and 95% confidence intervals (CIs) comparing the highest to lowest (reference) quartiles of PA measures were estimated by multivariable logistic regression.
RESULTS: Higher total activity volume, moderate-to-vigorous activity (MVA), and 10 minute-bouted MVA were significantly associated with a better general body composition (BMI and waist circumference), lower visceral adipose tissue (VAT) area, and higher VAT attenuation. Only higher bouted MVA was associated with abdominal subcutaneous adipose tissue and thigh composition. The associations between sedentary time and adiposity measures were less consistent.
CONCLUSION: This study extends our understanding of the relationships between PA and body composition. Our results suggest a potentially complex relationship between obesity and PA, showing association with lower risk of obesity defined according to BMI cut-points, and only with some measures of abdominal and thigh adipose tissue depots. Our findings may support the non-consistent link between different fat depots and CVD risk, mortality or mobility limitations in older adults, as recently described (Rosenquist et al., 2013; Murphy et al., 2014a; Rosenquist et al., 2015; Murphy et al., 2014b).
References: Zamboni M, et al. (2005). Int J Obes (Lond) 29:1011-1029.
Rosenquist KJ, et al. (2013). JACC Cardiovasc Imaging 6:762-771.
Murphy RA, et al. (2014a). J Gerontol A Biol Sci Med Sci 69:109-117.
Rosenquist KJ, et al. (2015). J Clin Endocrinol Metab 100:227-234.
Murphy RA, et al. (2014b). Am J Clin Nutr 99:1059-1065.
Contact: emarques@ismai.pt

THE EFFECT OF LEG PRESS AND ELECTRIC STIMULATION EXERCISE INTERVENTIONS ON PREDICTORS OF PHYSICAL CAPABILITY IN OLDER ADULTS

ORESKÁ, L.1,2, SLOBODOVÁ, L.2, UKROPEC, J.2, UKROPCOVÁ, B.1,2, CVECKA, J.1, TIRPÁKOVÁ, V.1, SEDLIAK, M.1,2

1: FACULTY OF PHYSICAL EDUCATION AND SPORTS, COMENIUS UNIVERSITY; BRATISLAVA, SLOVAKIA; 2:INSTITUTE OF EXPERIMENTAL ENDOCRINOLOGY, BMC, SAS; BRATISLAVA, SLOVAKIA

INTRODUCTION: A lower level of individual´s physical capability predictors (e.g walking speed or chair rising) is closely linked with increasing presence of comorbidity and mortality. However, this level can be enhanced by regular exercising. For instance, a preferred walking speed of 0.82 m/s or lower is associated with extremely high risk of mortality, but a preferred walking speed of 1.36 m/s or greater signifies multi-systemic wellbeing. The aim of this study was to determine the effect of leg press exercise and electric stimulation training programs on predictors of physical capability in older adults.
METHODS: A total of 30 healthy active older adults (sex: 12M/18F) took a part in this quasi-experimental study. Subjects were randomized into a leg press group (LP: n = 15, sex: 6M/9F, age: 71.1 ± 4.2 yrs, body weight: 70.13 ± 12.82 kg, BMI: 25.47 ± 3.81) and an electric stimulation group (EMS: n = 15, sex: 6M/9F, age: 69.5 ±3.98 yrs, body weight: 79.5 ± 8.94 kg, BMI: 27.91 ± 3.42). Both groups followed 9-week training programme, three times per week. Before and after the intervention, 10m walking test, chair rise test and knee extension were performed. Data were statistically analyzed by one-way ANOVA with Tukey´s HSD and paired t-test, a significant level was set on $p < 0.05$.
RESULTS: Preferred walking speed was not significantly improved after intervention in both groups (LP: from 1.43 ± 0.20 m/s to 1.43 ± 0.22 m/s; EMS: from 1.24 ± 0.22 m/s to 1.25 ± 0.22 m/s). Maximal walking speed was improved in EMS group only (EMS: from 1.74 ± 0.37 m/s to 1.86 ± 0.31, $p = 0.019$; LP: from 2.07 ± 0.09 m/s to 2.07 ± 0.34 m/s). In the knee extension, there was noted no significant difference after intervention (LP: from 227.64 ±69.13 N/m to 236.36 ± 62.00 N/m; EMS: from 232.76 ± 77.64 N/m to 248.64 ± 65.65 N/m). However, significant improvement in chair rising time was noted in both groups (LP: from 12.27 ± 1.74 sec to10.25 ± 1.21 sec, $p < 0.01$; EMS: from 13.13 ± 2.09 sec to 10.82 ± 1.72 sec, $p < 0.01$). Additionally, 20% of subjects in the LP group (n = 3) and 13.3% of subjects in the EMS group (n = 2) improved their preferred walking speed to 1.36 m/s or greater.
CONCLUSION: Presented findings indicate that both leg press and EMS exercise interventions improve motor abilities, however, not to the same extent. Combination of these two kinds of exercise programmes may have a more beneficial effect on enhancing physical capability in older adults, slowing manifestation of comorbidities and delaying mortality.
This study was funded by APVV-15- 0253 (B.U., J.U., P.T.)

INFLUENCE OF INERTIAL RESISTANCE EXERCISE ON FUNCTIONAL ABILITIES AMONG ELDERLY WOMEN

SPUDIC, D., HADŽIC, V., KARPLJUK, D., PORI, P.

UNIVERSITY OF LJUBLJANA

INTRODUCTION: Sarcopenia and muscle strength loss cannot only be prevented, but the elderly are also able to successfully gain muscle mass, maximum strength and power what also positively influences functional abilities among elderly. Inertial devices, which vital concept represents eccentric overload, give more robust results on muscle functions and present an effective way of resistance exercise

among the elderly. The purpose of the study was to examine practical implication and actual effects of the personally constructed inertial device on functional abilities among elderly women.
METHODS: In the study, in which participated 37 elderly women, we compared the effects of two 8-week programmes of different types of resistance exercise on two groups of elderly women - one taking part in the traditional exercising using kettlebells, the other working with the self-constructed inertial device, adjusted for elderly use. Exercise intensity in the inertial group was relatively adjusted by initial self-developed measurements of maximal provided angular momentum and equlized time under tension. Results of the monitored groups were gathered using Senior Fitness Tests for cardiovascular endurance, leg power, agility and balance Functional reach test and compared to the control group using One-Way ANOVA.
RESULTS: We discovered a statistically important improvement of results of both of the exercise types on the power of the leg extensor muscles tested by the Sit to Stand test. The exercise group using the inertial device has provided us with slightly better results. We have also found an improvement in the Functional Reach Test, the Timed Up and Go Test and the 6-minute Walk Test, but they were statistically unimportant.
CONCLUSION: The resistance exercise using the self-constructed inertial device has proved to be a practical, useful and economical alternative to the traditional resistance exercise among the elderly. In comparison to other studies the self-constructed device used in this research has the possibility of progressively adjusting the intensity of the exercise to an individual. The similarity of movement mechanics in performing squats and sit to stand test was shown in expected improvement, while we havent established that improvement in leg power statistically significantly influences the cardiovascular, balance and agility abilities among the elderly. The main reasons for the above mentioned implications were test-learning in the control group, the participants gender, limited time of exercise intervention and especially the explicit type of contractions, with which we violated the main concept of the Yo-Yo exercise – eccentric overload.

A COMPARISON OF 3 TYPES OF EXERCISE INTERVENTIONS ON REACTION TIME AND AGILITY IN COMMUNITY OLDER ADULTS WITH MILD COGNITIVE IMPAIRMENT

CHOU, J.W., LIN, L.L., YANG, N.H., LI, C.J.

NATIONAL CHENG KUNG UNIVERSITY

INTRODUCTION: Mild cognitive impairment (MCI) is a prodrome of Alzheimer's disease and dementia, and there is a very high proportion of elderly people with MCI who still live in the community. The respond ability is a dimension of the cognitive function. Previous studies had shown that the reaction time was an important indicator for the elderly to maintain daily life function (Burton et al, 2009) and indicated that respond ability can be improved by exercise training, but less were known from the elderly people with MCI. However, it needs to be further confirmed whether the stimulation types due to different modes of exercise cause different effects on the elderly response time. Therefore, this study is aimed to compare the efficacy of multi-component training, resistance exercise and brisk walking on reaction time and agility of community-aged adults with MCI.
METHODS: 99 subjects over 60 years old in the community with mild cognitive impairment were assigned into 4 groups either walking group (n = 27), resistance group (n = 26), multi-component exercise (n= 24) and no-exercise (control) group (n = 22) from 4 community after a pre-test of the Saint Louis University Mental Status (SLUMS) examination. Exercise groups performed 90 minutes of progressive training program of 2 days per week for 12 weeks, included (1) a low-and medium-intensity brisk walking program, (2) moderate-load resistance group performed: included of total body workout by elastic bands, (3)low-and medium-intensity multi-component exercise group : combination of stretching, strength, balance, agility and aerobic exercise, and(4) the control groups performed twice-weekly tablet personal computers course. The elderly were tested the changes of simple response time, simple motor time, and agility and dynamic balance (8-foot up and go) before and after all training. One-way ANCOVA was used to analyze the effect of different exercise patterns on the response time of community-aged adults.
RESULTS: The simplest response time of the resistance training group (-5.36%) was significantly better than the control group (+ 3.96%) and brisk walking group (+ 1.17%) ($p < .05$). The change in the best performance of simplest action time of the multi-component training group (-5.62%) was significantly improved than the control group (+15.18%) ($p < .05$). The whole body agility and dynamic balance of the resistance training group (-10.4%) was significantly better than the control group (+ 7.2%) ($p < .05$).
According to Kovács and Éva (2013) found that 12-month multimodal exercise can improve the balance in individuals aged over 60 years with cognitively impaired. The results of our research were similar to previous studies. Response ability of the elderly declines as cognition aging (Gorus, De Raedt, Lambert, Lemper, & Mets, 2008).
CONCLUSION: In this study, there were similar responded for responsibility and agility between the three exercise types of experimental groups. However, the benefits of walking group was lower than resistance and multi-component training group, the difference which may lie in the training of strength. Therefore, the research suggested that the training should be based on diversified, multi-component, and muscular strength training to improve the performance of responsibility, and selecting an appropriate exercise types for community-aged adults to enhance the daily living skills, and to reduce the risk of falling for older adults with mild cognitive impairment in community.

THE USEFULNESS FOR TUG AND FIVE-METER WALKING TIME TEST ON QOL AND COGNITIVE FUNCTION IN ELDERLY

HOSHINO, S.

NARA WOMENS UNIVERSITY

INTRODUCTION: In order to evaluate the relationship of quality of life (QOL) with physical fitness and cognitive function in the elderly population in Japan, a cross sectional field survey of elderly subjects was conducted.
METHODS: This survey was taken in Nara city and Kawakami village, Nara Japan. The data collected included physical fitness, cognitive function and QOL. As for physical fitness indexes, grip strength (GS), 30-sec chair stand (CS), five-meter walking time (WT), Timed up and go test (TUG), functional reach test (FR), trunk flexion (TF), single leg balance with eyes opened (SLB), and one-minute center of gravity (COG) sway were measured. Cognitive function and QOL were measured with the Stroop / reverse-Stroop test and SF-36 respectively. Moreover the physical activity was caliculated with multipling the metabolic equivalents by exercise duration.
RESULTS: A total of 92 elderly subjected participated to the survey. There were 44 males (74.9±5.3 years) and 48 females (74.4±6.6 years). The associations between physical health parameter "physical functioning" in SF-36 and TUG / WT were highly significant (β=-3.6, $p<.05$ /β=-2.92, $p<.05$) as determined by multiple regression analysis. Especially the difference of TUG ability showed the possibilies of the effect on the reverse Stroop interference and the physical activity.

CONCLUSION: This study indicated the possibilies of the predictor variables for QOL and cognitive function with TUG and walking speed for elderly people.

THE EFFECTS OF 12-WEEK MODERATE-INTENSITY INTERVAL EXERCISE ON NEUROCOGNITIVE FUNCTIONS IN OBESE FEMALE ADULTS

KE-HSIN, C.1, WAN-TIEN, J.2, BOON-SUEN, A.3, CHU-FEN, C.1, HUEI-JHEN, W.2

TZU CHI UNIVERSITY

INTRODUCTION: Obese individuals decline in neurocognitive performance as compared to normal weight individuals. On event-related potentials (ERPs), obese individuals showed smaller amplitude of P3 wave which indicated a poor attention. Currently, interval training is the top one worldwide fitness training trends (Thompson, 2017). Moderate-intensity interval exercise (MIIE) is a combination of aerobic exercise and resistance interval training, which was effectively reducing body weight and percentage of body fat in a shorter time (Chen, Wen, & Ang, 2017). This study was to investigate the effects of 12-week MIIE on neurocognitive functions in obese female adults.
METHODS: The study recruited 10 healthy normal weight (control) (CG, n=10; BMI <25 kg/m2) and 10 overweight/obese (OG, n= 10; BMI ≥25 kg/m2) female adults with the mean age 36.3±3.9 year-old. All participants are required to participate in the 30 minutes supervised MIIE, 5 sessions per week for 12 weeks. During training session, Heart rate (HR) was monitored to ensure that participants reached the target HR zone. Percentage of body fat was measured by dual energy X-ray absorptiometry. The behavioral performance (accuracy rate [ACC] and reaction time [RT]), and ERPs indices were simultaneously recorded during participants performed a go/ nogo task before and after the 12-week of intervention. All participants were asked to maintain their regular dietary and lifestyle.
RESULTS: Body weight significant reduced after the 12-week MIIE in OG (pre: 74.1±10.1kg vs. post: 70.9±9.0kg, p=0.003), whereas no change in CG (pre: 59.7±2.5kg vs. post: 58.7±2.5kg, p=0.183). Percentage of body fat significant reduced after the 12-week MIIE both in CG (pre: 35.2±4.2% vs. post: 31.9±4.6%, p=0.003) and OG (pre: 39.3±4.2% vs. post: 36.6±2.3%, p=0.002). In go/ nogo task performance, there were no significant changes between groups after the intervention in ACC, RT, P3 amplitudes and latency by the RM-ANOVA. Both groups maintained higher ACC in go condition (pre: OG: 99.9±0.24%vs. CG: 99.9±0.21%, p=.63; post: OG: 99.9±0.21%vs. CG: 99.9±0.21%, p=1.00), and nogo condition (pre: OG: 97.8±0.40%vs. CG: 98.8±0.24%, p=.51; post: OG: 99.0±0.17%vs. CG: 98.3±0.21%, p=.39). RT in CG significantly improved (pre: 477.4±75.6 ms vs. post: 430.4±36.6 ms, p=.02), whereas no change in OG (pre: 501.2±90.3 ms vs. post: 463.2±62.7 ms, p=.21) after the intervention. The P3 amplitude in go condition (2.55 ± .34 μV) was smaller than that in nogo condition (5.38 ± .56 μV).
CONCLUSION: The 12-week of MIIE intervention showed a positive effect on improving neurocognitive functions in attention (P3 amplitudes in nogo condition) and reducing percentage of body fat both in obese and normal weight female adults. (MOST 106-2410-H-320-004 and TCMMP 105-03-01 supported the study)
1. Chen, K., Wen, H., & Ang, B. (2017). The Effects of Moderate Intensity Interval Training on Energy Expenditure and Weight Loss in Women. Paper presented at the 2017 FISU World Conference Taipei., Taipei, Taiwan.

INVESTIGATING THE RELATIONSHIP BETWEEN INDIVIDUAL CORRELATES OF PHYSICAL ACTIVITY AND COGNITIVE FUNCTION

LOGAN, N., MOREAU, D., CORBALLIS, P.M.

THE UNIVERSITY OF AUCKLAND

INTRODUCTION: Age-related declines in cognitive function are a major cause for concern in public health. Accordingly, there is considerable interest in developing lifestyle or exercise interventions that can prevent or delay the onset of cognitive decline. The relationship between the P300 component of the event-related potential and levels of habitual physical activity has been well established, and offers a potential marker for cognitive function. However, there are still large underlying questions that remain about the nature of this relationship. This cross sectional study aims to determine the individual correlates of physical activity, such as arterial health, heart rate, electrophysiological function and alpha power, in order to reveal how habitual physical activity levels affect cognitive function.
METHODS: The International Physical Activity Questionnaire and resting heart rates were used to classify participants into two groups – "High Activity" or "Low Activity", based on habitual levels of activity and resting heart beats per minute. Vascular health was also measured via pulse wave analysis to establish a link between self-reported physical activity levels, physiological function, cognitive function, and resting state EEG alpha power. ERPs were recorded during the AX Continuous Performance Task in order to extract P300 responses to stimuli requiring cognitive control.
RESULTS: We confirm earlier reports that ERP amplitude was affected by physical activity, and that those in the High Activity group had lower blood pressures. Furthermore, the variation in heart rate, vascular health and P300 amplitude between groups was modulated by differences in resting EEG alpha.
CONCLUSION: We propose the novel theory that participation in habitual physical activity throughout the lifespan may serve to increase overall alpha power during resting states thus decreasing brain activity, and decrease alpha power during high cognitive loads to increase brain activity for tasks which demand high attentional capacities. These results deepen our understanding on the electrophysiological and cardiovascular correlates of the relationship between physical activity and cognitive function.

EXPLORING BENEFICIAL IMPACT OF PHYSICAL ACTIVITY FROM BODY COMPOSITIONS OF PATIENTS WITH COLON POLYPS IN JAPAN

AOKI, T.1,2, OKAMATO, K.1, OYANAGI, E.1, INOUE, M.2, TERAMOTO, F.1, KREMENIK, M.J.1, YANO, H.1, MATSUMOTO, H.3, SHIOTANI, A.3

1 KAWASAKI UNIVERSITY OF MEDICAL WELFARE, 2 KAWASAKI MEDICAL SCHOOL HOSPITAL , 3 KAWASAKI MEDICAL SCHOOL

INTRODUCTION: It has been known that regular exercise contributes to reducing the risk of colorectal cancer, as well as the prevention of obesity and increase of skeletal muscle mass. Since the progression from adenomatous polyp to cancer has been proposed, it is important to prevent colon polyps leading to the prevention of colorectal cancer. It is reported that a novel myokine (secreted protein acidic and rich in cysteine (SPARC)) may inhibit the invasion and metastasis of tumor during colon cancer development. Moreover, recent meta-analysis suggests that obesity is positively associated with the risk of colorectal cancer. These studies suggest that regular exercise might prevent the incidence of colon cancer and it might be important to improve lifestyle of patients with colon polyps. The aim of our study

was to examine the relationship between colonic polyps and body composition in Japanese patients with positive fecal occult blood test (FOBT).
METHODS: Patients who performed colonoscopy for positive FOBT were included between June 2015 and November 2017. Both men (n=63, 62 ± 10 years of age) and women (n=35, 65 ± 9 years of age) agreed to participate in this study. Body composition, including body fat mass, skeletal muscle mass and visceral fat area were measured using the bioelectrical impedance analysis to evaluate the skeletal muscle index (SMI) and visceral fat index. Measurement of grip strength, nutrient intake and physical activity amount were also calculated.
RESULTS: The subjects consisted of the polyp group (52 men and 26 women) and the control group (11 men and 9 women). Among the men subjects, the mean SMI was significantly lower (8.06 ± 0.25 kg/㎡ vs. 8.72 ± 0.46 kg/㎡, p<0.05) and % body fat was higher (24.1 ± 2.2% vs. 19.9 ± 2.3%, p<0.05) in the polyp group compared to the control group. On the other hand, among the women subjects, the mean level of grip strength in the polyp group was significantly lower than that in the control group (18.7 ± 2.4 kg vs. 26.4 ± 2.3 kg, p<0.01). There was no difference in physical activity between the two groups in both genders.
CONCLUSION: Investigating body composition of patients with colon polyps is important to change their lifestyle and habitual regular exercise may prevent development of colon cancer.

Mini-Orals

MO-MI01 Reliability and Testing

RELIABILITY OF THREE VELOCITY VARIABLES TO EVALUATE VERTICAL JUMP AND BENCH PRESS THROW PERFORMANCE

PÉREZ-CASTILLA, A., GARCÍA-RAMOS, A.

UNIVERSITY OF GRANADA

INTRODUCTION: Vertical jump (VJ) and bench press throw (BPT) are probably the most common exercises used to improve and evaluate ballistic performance (1). The velocity achieved against a fixed load is one of the variables most utilized to evaluate performance in these exercises (2). Since there is still a lack of evidence on which is the velocity variables most reliable during these ballistic exercises, this study aimed to compare the between-session reliability of three velocity variables (mean velocity [MV], mean propulsive velocity [MPV] and maximum velocity [Vmax]) to assess VJ and BPT performance.
METHODS: Data from twenty-one and twenty-three subjects were tested during two consecutive weeks in two variants (concentric-only and eccentric-concentric) of the VJ or BPT exercise, respectively. The two sessions of each variant were performed within the same week with 48-72 hours of rest. Two trials were executed against five different loading conditions (VJ: 17, 30, 45, 60 and 75 kg; BPT: 17, 27, 37, 47 and 57 kg). All testing sessions were performed in a Smith machine coupled with a linear velocity transducer (T-Force System). The MV (average velocity from the start of the concentric phase until the bar reaches the maximum height), MPV (average velocity from the start of the concentric phase until the acceleration of the bar is lower than gravity) and Vmax (maximum instantaneous velocity value reached during the concentric phase) were the calculated variables. A three-way repeated measures ANOVA (variable x variant x load) was applied on individual CV values to assess the differences in reliability (3).
RESULTS: All velocity variables met the criterion for acceptable reliability (CV<10%) regardless of the exercise tested. The three-way repeated measures ANOVA revealed significant main effect for the variable (P<0.001) and variable x variant interaction (P<0.001) in the VJ exercise, as well as for the variable (P<0.001), variant (P=0.002) and load (P=0.003) in the BPT exercise. The main effects revealed that the Vmax was the most reliable variable, followed by MV and finally MPV (CV=2.28%, 3.38% and 3.85% for VJ; 2.14%, 3.18% and 4.27% for BPT, respectively); the concentric-only VJ promoted the differences between variables (CV=3.93%, 4.61% and 2.14% for MV, MPV and Vmax, respectively); the eccentric-concentric BPT (CV=2.41%) was more reliable than the concentric-only BPT (CV=4.02%); and the reliability tended to decrease with the increment of the load during the BPT exercise (from 2.12% to 3.92%).
CONCLUSION: The three velocity variables examined (MV, MPV and Vmax) can be used for the assessment of lower- and upper-body ballistic performance. However, our results also suggest that the most reliable testing procedure would consist on the evaluation of the Vmax during both VJ and BPT exercises.
REFERENCES:
1. García-Ramos A et al. Sports Biomech 2018;17(1):117-130
2. Cormie P et al. Sports Med 2011; 41(2):125-46
3. Pérez-Castilla A et al. J Strength Con Res 2017. In press

EVALUATION STAR EXCURSION BALANCE TEST BY USING BIOMECHANICAL ANALYSE 3D AND FORCE PLATE FORM FOR ATHLETES

HASHISH, K.

FACULTY OF SPORT EDUCATION

INTRODUCTION: Balance is one the most important ability which athletes should possess it .there are many measurements evaluate balance such as Star Excursion Balance Test ability of the lower extremity of individuale to reach maximal distance in each direction by open eyes and closed eyes The purpose of this study is evaluation of
by using biomechanical analyse 3D and force plate form for athelets
METHODS: methods : eleven athletes Bertec force plate <1000hz> and analyse3d software<8 cameras> for date collection . We measured the reach distances in centimeters and averaged 3 reaches in each of the 8 directions while the subjects stood on each leg for data analysis.we choice one trial for each athelet to analyse by simi analyse3d software
RESULTS: the Simi analysed system and force plate form proved The SEBTs is a valid ,sufficient ,not complex and non-expensive on opposite of many other devices for measuring balance
CONCLUSION: Balance is one the most important ability which athletes should possess it. The purpose of this study is evaluation of
by using biomechanical analyse 3D and force plate form for athelets

eleven athletes Bertec force plate <1000hz> and analyse3d software<8 cameras> for date collection the Simi analysed system and force plate form proved The SEBTs is a valid ,sufficient ,not complex and non-expensive on opposite of many other devices for measuring balance

IMU-BASED KNEE JOINT FLEXION TEST AS AN INDICATOR OF SPRINT PERFORMANCE: A PILOT STUDY

NAGAHARA, R.1, WADA, T.1, SHARP, A.2, NEVILLE, J.2

1: NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA 2: SPORTS PERFORMANCE RESEARCH INSTITUTE, AUCKLAND UNIVERSITY OF TECHNOLOGY

INTRODUCTION: There are various field tests used as indicators of strength-power capability of the lower extremities (Nagahara et al., 2014). However, most of them are performed by extending motion of the lower extremities (i.e. counter-movement jump). Because the hip and knee flexion power productions are important for better sprint acceleration performance (Nagahara et al., 2017), a test which can assess lower extremity joint flexion capability would be useful for predicting sprinting performance. The purpose of this study was to investigate whether inertial-measurement-unit (IMU)-based knee joint flexion test could be a predictor of sprinting performance.
METHODS: Sixteen male athletes ran 50-m with maximal effort, during which ground reaction forces were recorded with 54 force platforms. Mean running speed for the entire sprint distance was computed. The participants performed the five-serial left knee flexion-extension movement with prone posture restricting other joint movements, during which changes in shank angle were obtained using the IMU (250 Hz). Based on the segment angle and body segment parameters of each athlete, knee joint moment and power in the sagittal plane were calculated. A correlation coefficient was used to examine the relationship between sprinting performance and knee flexion capabilities.
RESULTS: The mean running speed for the entire distance was 7.86 ± 0.47 m/s. The positive mean knee joint power during the entire test duration (1.15 ± 0.23 W/kg) was significantly correlated with the mean running speed (r = 0.623). However, there was no significant correlation between the negative mean knee joint power during the entire test duration (−0.74 ± 0.21 W/kg) and the mean running speed (r = 0.201). During knee flexion movement, although positive mean knee joint power in the sagittal plane (1.14 ± 0.20 W/kg) was significantly correlated with the mean running speed (r = 0.615), there was no significant correlation between the negative mean knee joint power in the sagittal plane (−0.71 ± 0.19 W/kg) and the mean running speed (r = 0.263).
CONCLUSION: The current results show that IMU-based knee joint flexion test is likely useful for assessing knee joint flexion strength-power capability which is probably important for better sprinting ability. That said, the IMU-based system should be validated for the reliable assessment. Accordingly, further investigation examining the validity and reliability of the IMU-based knee joint flexion test is recommended.
References: Nagahara R, Naito H, Miyashiro K, Morin J.B, Zushi K. (2014). J Sports Med Phys Fitness, 54, 691-699.
Nagahara R, Matsubayashi T, Matsuo A, Zushi K. (2017). Biol Open, 6, 633-641.

POST-ACTIVATION POTENTIATION (PAP) EFFECTS ON 3MT TETHERED RUNNING TEST IN NON-MOTORIZED TREADMILL AND ON VERTICAL JUMP

GAMA, M.C.T.1, MANCHADO-GOBATTO, F.B.1, SOUSA, F.A.B.1, GOBATTO, C.A.1

1: UNIVERSITY OF CAMPINAS

INTRODUCTION: Post-Activation Potentiation (PAP) is a strategy used to increase muscle strength and physical performance (Seitz and Haff, 2016) aiming to obtain physiological and functional benefits specially on high-power exercises like jumping and sprinting (Dello Lacono et al., 2016). Add to this, recent study reported positive PAP responses on endurance running exercise by neuromuscular mechanisms that may counteract the deleterious effects of fatigue from different origins (Del Rosso et al., 2016). The 3-minute all-out test (3MT) is a protocol that can determine, in an only day, the aerobic (EP) and anaerobic (WEP) maximal capacities. So, in order to investigate the effectiveness of PAP responses, this study proposed to verify the effect of this supposed performance strategy on mechanical and physiological parameters of 3MT and vertical jumps.
METHODS: Seven recreationally trained individuals (23±5y-old; 83±8.7kg; 180±5cm; 9.0±2.5%body fat) performed five different tests each one in a consecutive different days. The tests were 1RM back squat test (Vanderka et al., 2016), and non-motorized treadmill in tethered running 3MT (Gama et al. 2017) and maximal vertical jumps (VJ) accomplished after two different 5-min warm-up conditions. Blood lactate (Lac) and creatine kinase (CK) were determined after 3MT (5-min and 24-h, respectively). The warm-up protocols used were of 5-min of motorized treadmill walking at 6 km/h (W1) and this added to PAP protocol (W2). PAP consisted of two series of six back squats at 60% 1RM (Wilson et al., 2013), 2-min rest among them.
RESULTS: 1RM test results was 76.4±18Kg. Among W1 and W2, the results were 354±133, 529±140W (EP, p≤0.05); 60±30, 65±29kJ (WEP); 2162±695, 2554±511W (3MT peak-power, p≤0.05); 17.4±3.0, 17.4±3.0mM (Lac); 350±200, 295±143u/L (CK); 1055±237, 1002±207W (VJ peak-power); 292.8±71.0, 266.9±68.0J (VJ work) and 0.37±0.04, 0.34±0.07m (VJ height). There were product-moment correlation (p≤0.05) between W1 and W2 for EP, 3MT peak-power, VJ peak-pewer, Lac and CK parameters.
CONCLUSION: PAP warm-up (W2) may increase neuromuscular function and optimize activation of the aerobic metabolism, delaying the fatigue process. Also, W2 use suggests not impair anaerobic sources in maximal all-out 3-min and vertical jump efforts, preserving anaerobic capacities.
REFERENCES:
Del Rosso S et al. PLoS One, 11(3), e0150679, 2016.
Dello Lacono A et al. J Sports Med Phys Fitness, 56(12), 1455-1464, 2016.
Gama MCT et al. Int J Sports Med, 38(8), 613-619, 2017.
Seitz LB and Haff GG. Sports Med, 46(2), 231-240, 2016.
Vanderka M et al. J Strength Cond Res, 30(6), 1540-6, 2016.
Wilson JM et al. J Strength Cond Res, 27(3), 854-9, 2013.
CONTACT:
gamacarol@hotmail.com
FINANCIAL SUPPORT:
CNPq, FAPESP (2009/08535-5, 2012/06355-2)

EXPERT VS. NOVICE COMPARISON FOR WALKING AND RUNNING USING THREE-DIMENSIONAL UNCONTROLLED MANIFOLD-APPROACH

MÖHLER, F., MARAHRENS, S., RINGHOF, S., MIKUT, R., STEIN, T.

KARLSRUHE INSTITUTE OF TECHNOLOGY

INTRODUCTION: Movement variability is a fundamental feature of human performance (Bernstein, 1967). However, the function of variability is not yet understood. Opinions differ whether a high level of experience should be accompanied by a low variability or whether a certain degree of variability is desirable (Bartlett et al., 2007). The Uncontrolled Manifold (UCM) approach seeks to understand the nature and function of this variability. According to the UCM, elemental variables (EV) co-vary to stabilize a task-dependent performance variable (PV). Although this approach has already been applied in human locomotion, to date studies are restricted to planar analyses in walking (e.g., Monaco et al., 2018). Therefore, the goal of this study is to compare the step-to-step variability between experts and novices in walking and running using a 3D model of the human body.
METHODS: 13 experts (age: 23.46±3.57 yrs, BMI: 20.6±1.67 kg/m²) and 12 novices (age: 23.92±3.77 yrs, BMI: 21.59±1.45 kg/m²) participated in the study. The criteria for the experts were a minimum of distance covered of 50 km/week and a 10km-record of less than 35 min. The criteria for the novices were a maximum of 1run/week. We collected 20 gait cycles for both groups at 5, 10 and 15 km/h on a treadmill using a Vicon motion capture system. To perform the UCM analysis (Scholz & Schöner 1999), the 3D-center of mass (COM) as PV was calculated as the weighted sum of 17 segments using 50 degrees of freedom on joint level as EV. Following the UCM approach, the deviation to the mean joint configuration was separated in deviations parallel (stabilizing PV) and orthogonal (de-stabilizing PV) to the UCM. Statistical analyses were performed using 2x3 repeated measures ANOVAs.
RESULTS: For the mean values over the gait cycle, analyses showed significant main effects of group and speed and a significant interaction for both parallel (group: $p=0.027$, speed: $p<0.001$, interaction: 0.005) and orthogonal variances (each $p<0.001$). Variances were greater in novices and increased with speed. Besides, a significant speed effect for the UCM ratio was revealed ($p=0.007$).
CONCLUSION: This is the first study performing an UCM analysis with a 3D COM as PV. Our results showed that the differences between the two groups develop with the demand on the subjects: Both orthogonal and parallel variances were greater in novices, which shows that the expert group has less step-to-step variability. The experts might have adopted a more consistent and efficient running style. The differences in the UCM ratio were weaker since both variances showed similar trends of development. Further analyses should investigate the development of these variances over the gait cycle.
REFERENCES:
Bernstein, N. (1967). London: Pergamon Press
Bartlett, R. et al. (2007). Sports Biomech, 6(2), 224–243.
Monaco, V. et al. (2018). Hum Mov Sci, 57, 227–235.
Scholz, J. P., & Schöner, G. (1999). Exp Brain Res, 126(3), 289–306.
CONTACT:
felix.moehler@kit.edu

RELIABILITY OF THE METASWIM METABOLIC CART: AGREEMENT AND REPEATABILITY DURING FLUME SWIMMING

LOMAX, M., MAYGER, B., SAYNOR, Z., MASSEY, H.

UNIVERSITY OF PORTSMOUTH

INTRODUCTION: The Metaswim (MS) is a metabolic cart capable of measuring breath-by-breath pulmonary gas exchange and ventilation during swimming. However, agreement and repeatability data for it are lacking. The aim of this study was to determine 1) the agreement between maximal and submaximal measures of minute ventilation ($\dot{V}_E$), oxygen uptake ($\dot{V}_EO_2$) and carbon dioxide output ($\dot{V}_CO_2$) during front crawl swimming measured using the MS vs. Douglas bag (DB) techniques, and 2) the repeatability of the MS system.
METHODS: Nine swimmers (age: 22 ± 6 years; stature: 1.77 ± 0.06 m; mass: 77.6 ± 8.8 kg; $\dot{V}_O_2$ max: 48.57 ± 13.34 ml.kg-1.min-1) completed two experimental trials in a flume consisting of steady-state swimming (velocity below the gas exchange threshold) and non-steady state progressive intensity swimming to exhaustion. The MS metabolic cart (Cortex, Germany) and DB were used during both trials to determine $\dot{V}_E$, $\dot{V}_EO_2$ and $\dot{V}_CO_2$ during steady-state swimming, whereas only one method was used per trial during non-steady state swimming. The agreement between MS and DB for $\dot{V}_E$, $\dot{V}_O_2$ and $\dot{V}_CO_2$ was assessed using 95% limits of agreement (LoA), bias and random error. As some steady-state data exhibited heteroscedasticity, data were logarithmically transformed, anti-logged and displayed as ratios (bias x/÷ random error). Conversely, peak data are displayed in original units (bias ± random error). Repeatability of both MS and DB between-trials was assessed using the repeatability coefficient (CR). As some data were heteroscedastic, data were logarithmically transformed, anti-logged and expressed as ratio ± CR. Systematic bias was assessed using paired sample t-tests (α=0.05, SPSS).
RESULTS: Compared with the DB method, MS underestimated ($p > 0.05$) $\dot{V}_CO_2$ peak (0.39 ± 1.45, 95% LoA: -1.06-1.84) l.min-1, $\dot{V}_TCO_2$ peak (0.26 ± 1.60; 95% LoA: -1.35-1.86) l.min-1 and $\dot{V}_TE$ peak (9 ± 43; 95% LoA: -34-52) l.min-1. In the two steady-state swims , MS underestimated $\dot{V}_O_2$ by 1.03-1.24 x/÷ 1.51-1.78 (95% LoA: lower = 0.68-0.70, upper = 1.51-1.78), $\dot{V}_TCO_2$ by 0.93-1.15 x/÷ 1.58-1.68 (95% LoA: lower = 0.59-0.70, upper = 1.47-1.91) and $\dot{V}_TE$ by 0.98-1.19 x/÷ 1.48-1.53 (95% LoA: lower = 0.64-0.80, upper = 1.49-1.76). CR for the MS system was either better than, or the same as, DB during steady-state swimming for $\dot{V}_SO_2$ (tests 1, 2; MS: ± 1.13, ± 1.09; DB: ± 1.22, ± 1.09), $\dot{V}_TCO_2$ (MS: ± 1.13, 1.09; DB: ± 1.23, ± 1.09) and $\dot{V}_TE$ (MS: ± 1.13, ± 1.19; DB: ± 1.22, ± 1.09).
CONCLUSION: MS tends to underestimate $\dot{V}_E$, $\dot{V}_EO_2$ and $\dot{V}_CO_2$ during submaximal and maximal swimming compared with DB. However, because of the poor agreement with the DB method, MS and DB cannot be used interchangeably. Nevertheless, the reproducibility of $\dot{V}_E$, $\dot{V}_EO_2$ and $\dot{V}_CO_2$ for MS was at least as good as, if not better than, the DB method and can be used reliably to evaluate $\dot{V}_E$, $\dot{V}_EO_2$ and $\dot{V}_TCO_2$ during swimming.

TEST-RETEST RELIABILITY AND DISCRIMINANT VALIDITY OF A NOVEL SUPINE KNEE JOINT POSITION SENSE TEST TARGETING ACL-INJURED PERSONS

STRONG, A.1, TENGMAN, E.1, SRINIVASAN, D.2, HÄGER, K.C.1

COMMUNITY MEDICINE AND REHABILITATION

INTRODUCTION: Knee proprioception is considered a key factor for rehabilitation outcome following anterior cruciate ligament (ACL) injury. Joint position sense (JPS), representing proprioceptive ability, seems impaired in the knee following ACL injury. However, no gold stand-

ard knee JPS test exists. A reliable and valid knee JPS test would help to individualise rehabilitation strategies by identifying those ACL-injured persons who would most benefit from targeted neuromuscular exercises that aim to improve knee proprioception.
METHODS: The aim was to develop a novel knee JPS test, evaluate test-retest reliability in healthy persons and address discriminant validity as compared to ACL-injured persons. So far, out of 20 planned participants/group, 15 knee-healthy controls (10 men) have performed the JPS test twice one week apart and six persons with a unilateral ACL-reconstructed knee (2 men) have performed the test once. An eight-camera motion capture system (Qualisys, Oqus) provided knee angles and angular velocities. Participants lay supine with legs extended and feet strapped to a custom-built leg flexion/extension device. First, a knee angular velocity of 10°/s was practiced using direct graphical feedback three times per leg and attempted throughout the test. Participants then flexed a leg until a stop sign was displayed on a TV screen. They maintained this position for six seconds and tried to memorise the knee angle (known as the target angle, TA). After returning to the start position they attempted to reproduce the TA, denoted the reproduction angle (RA). The stop sign was activated by a custom-made integrated program when participants reached either 35° or 60° knee flexion. The test was performed five times for each angle on each leg creating four conditions which were performed in a randomised order.
RESULTS: We calculated mean of the absolute error, the difference between each RA and corresponding TA. Preliminary analyses indicate good test-retest reliability for the dominant leg (ICC 0.77, CI 0.28-0.92, SEM 1.48°) and moderate for the non-dominant leg (ICC 0.66, CI -0.02-0.89, SEM 1.14°) of controls. Better reliability was seen for the 35° angle than the 60° angle for both the dominant (ICC 0.86 vs. 0.68) and non-dominant leg (ICC 0.70 vs. 0.50). Discriminant validity will be assessed when more ACL-injured participants have been tested.
CONCLUSION: The moderate to good test-retest reliability of our knee JPS test in controls is promising. The higher reliability of the 35° compared to the 60° angle indicates a need to test additional angles. Discriminant validity analysis will indicate whether our test can differentiate between ACL-injured persons and controls. Clinicians and researchers should apply knee JPS tests with caution until reliability and validity of such tests are established for the population of interest. However, once established they may provide an essential tool for improving rehabilitation outcomes and facilitating return to sport.

VALIDITY OF THE CATAPULT CLEARSKY T6 LOCAL POSITIONING SYSTEM FOR TEAM SPORTS SPECIFIC DRILLS, IN INDOOR CONDITIONS

LUTEBERGET, L.S., SPENCER, M., GILGIEN, M.

NORWEGIAN SCHOOL OF SPORT SCIENCES

INTRODUCTION: Analysis of physical demands is commonly used to maximize physical performance in sports. However, it is only meaningful if the variables have sufficient accuracy. Multiple factors can affect the accuracy of local positioning systems , such as signal type, parameter calculation, signal obstructions and materials surrounding the field of play, and geometry between anchor nodes and mobile unit. The aim of the study was to: <1> determine the validity of position, distance travelled and speed of a commercially available LPS for indoor use. <2> Investigate how placement of the field of play relative to the anchor nodes and walls of the building affect the validity.
METHODS: The LPS and reference system were installed around the field of play. Participants completed five tasks designed to imitate team-sport movements. The same protocol was completed in two sessions, an optimal and a sub-optimal condition. Optimal condition assumed an optimal geometrical setup between anchor nodes and placement of the field of play relative to the anchor nodes and walls of the building were assessed. In sub-optimal condition, the geometrical setup of anchor nodes and placement of the field of play was altered to imitate a space-reduced environment. Raw 2D position was extracted from LPS and reference system for accuracy assessment. Position, distance traveled and speed were compared using the norm of the differences between LPS and reference system. Mean difference, standard deviation, and maximal difference in position were calculated to compare LPS to the reference system.
RESULTS: Mean absolute difference between the LPS and reference system of position estimations was 0.21±0.13 m in optimal setup, and 1.79±7.61 m in sub-optimal setup. Average difference in distance traveled was <2% in all tasks, in optimal condition, while it was <30% in sub-optimal condition. In both optimal and sub-optimal condition, LPS overestimated the distance compared to the reference system. Instantaneous speed showed large differences between the LPS and reference system, for both optimal <≥35%> and sub-optimal condition <≥74%>. There was a direct association between the magnitude of instantaneous speed and mean error. For average speed, the difference was <3%, and ≈15-30% for all tasks in optimal condition and sub-optimal condition, respectively.
CONCLUSION: Anchor node placement and the field of play relative to the walls of the building influence the output of LPS to a large degree. Measures of position, distance traveled, and average speed from the LPS show low errors, and can be used confidently in time-motion analyses for indoor team sports, provided that the placement of anchor nodes are appropriate. For calculating instantaneous speed, the raw data from the LPS is not valid. Application of appropriate filtering techniques to enhance the validity of such data should be investigated.

INTRA- AND INTER-RATER RELIABILITY OF MYSPRINT APP FOR MEASURING SPEED PERFORMANCE IN 30 METERS

BUSCÀ SAFONT-TRIA, B.1, ARBOIX-ALIÓ, J.1,2, AGUILERA-CASTELLS, J.1, MIRADA, S.2, ESPASA, J.3, CASADEVALL, P.1, FORT-VANMEERHAEGE, A.1,2

1: FPCEE BLANQUERNA - RAMON LLULL UNIVERSITY , 2: FCS BLANQUERNA - RAMON LLULL UNIVERSITY , 3: INEF CATALUNYA

INTRODUCTION: Multi-directional sports require consistent abilities in sprinting, pushing and agility(Taylor, et al., 2017). The ability of handball players to develop explosive efforts and powerful pushes is a crucial performance factor (Hermassi et al., 2017). There are several approaches for assessing the sprint ability. MySprint is an accessible smartphone-based application (Romero-Franco et al., 2017) but, to our knowledge, the intra- and inter-observer reliability has not been assessed. For this reason, the aim of this study was to examine the intra- and inter-rater reliability MySprint, when analysing the 30-m sprint performance.
METHODS: Twenty eight elite youth handball players (13 males and 15 females) were recruited to take part in the study (age = 16.1 ± 1.09 yr; height = 1.78 ± 0.91 m; mas = 70 ± 14.45 kg) and completed two maximal 30-m sprints. The two trails were assessed by recording each sprint using an iPad Air (iOS 11.2.5) at 60 fps; Apple Inc., Cupertino, CA, USA) and MySprint app (Apple Inc., Cupertino, CA, USA). Split times of each sprint were observed and scored (frame counting) independently by two raters. The two raters then scored the same videos one week later. Intraclass correlation coefficients from repeated-measures analysis of variance were calculated to determine intra- and inter-rater reliability of each split and the total time.
RESULTS: Intraclass correlation coefficients' demonstrated an excellent inter-rater reliability in each split (ICC ≥ 0.96). The ICC for rater 1 and 2 across the two viewing sessions was excellent for all the splits (ICC ≥ 0.95).
CONCLUSION: These results are in line with Romero-Franco et al., (2017) who demonstrated that the smartphone-based application MySprint may be a reliable screening tool for analysing 40-m sprint when comparing to existing field methods (timing photocells and

radar gun). This research demonstrated that MySprint app shows an excellent intra- and inter-rater reliability for 30-m sprint in all analyzed splits using video images.

VALIDITY AND RELIABILITY OF A 30-S CONTINUOUS JUMPS TEST TO ASSESS ANAEROBIC POWER AND CAPACITY IN YOUNG KARATEKAS

PADULO, J.1,2, CULAR, D.2, ZAGATTO, A.N.3, MILIC, M.2, ARDIGÒ, L.P.4

1:UNIVERSITY ECAMPUS , 2:UNIVERSITY OF SPLIT , 3:UNESP UNIVERSITY , 4:UNIVERSITY OF VERONA

INTRODUCTION: Wingate anaerobic test (WantT), a pedalling exercise, is considered the gold standard to assess anaerobic power (AP; Sands et al., 2004). Yet, WantT was not used to assess anaerobic capacity (AC, i.e., the metabolic energy demand) and may be not appropriate for other exercise such as continuous jumps. No researchers reported any information regarding validity of a continuous jumps test for karatekas. This study aimed at determining validity, compared with WAnT as a reference, and (test-retest) reliability of a 30s continuous jumps test (CJ30) to assess AP and AC.
METHODS: Thirteen young female karatekas (age: 11.07±1.32 years; mass: 41.76±15.32 kg; height: 152±11.52 cm; training experience: 4.38±2.14 years) were tested on three separate sessions. The first and second sessions were used to assess the reliability (ICC) of CJ30, whereas on the third session WAnT was administered. Following CJ30 and WAnT, we assessed AP (w/CJ30, as jump height [JH], fatigue index [Dal Pupo et al., 2014; FI], and blood lactate [BL]; w/WAnT, as mechanical power [P], FI, and BL) and AC (as EPOC).
RESULTS: Large/highly significant correlations were found between CJ30 and WAnT EPOCs (r=0.730, p=0.003), and BLs (r=0.713, p=0.009). Moderate/significant correlations were found between CJ30 and WAnT FIs (r=0.640, p=0.014), CJ30 first four jumps mean JH and WAnT peak P (r=0.572, p=0.032), and CJ30 mean JH and WAnT mean P (r=0.589, p=0.021). CJ30 showed excellent and moderate reliability (ICC) for AP (maximal JH 0.884, mean JH 0.742, FI 0.657, BL 0.653) and AC (EPOC 0.788), respectively.
CONCLUSION: Correlations observed especially in terms of AC between CJ30 and WAnT provide evidence that former may adequately assess anaerobic performance level in young combat sports athletes. CJ30 results a reliable test to assess both AP and AC. Further studies may focus on CJ30 validity and reliability in different-level athletes.
References: Dal Pupo J, Gheller RG, Dias JA et al. (2014) Reliability and validity of the 30-s continuous jump test for anaerobic fitness evaluation J Sci Med Sport, 17(6), 650-655
Sands WA, McNeal JR, Ochi MT et al. (2004) Comparison of the Wingate and Bosco anaerobic tests. J Strength Cond Res, 18(4), 810-815.
Contact: sportcinetic@gmail.com

THE RELIABILITY OF A MODIFIED 505 TEST AND THE CHANGE-OF-DIRECTION DEFICIT IN ELITE YOUNG FOOTBALL PLAYERS.

TAYLOR, J.1, CUNNINGHAM, L.2, HOOD, P.1, THORNE, B.1, TATHAM, R.1, WESTON, M.3

1 - MIDDLESBROUGH FC; 2- SUNDERLAND AFC; 3-TEESSIDE UNIVERSITY

INTRODUCTION: In line with the 'Elite Player Performance Plan' (EPPP) governed by the English premier league, the use of a modified 505 test (M505) (using a 1-m lead-in to the 10-m shuttle component) is compulsory as part of national benchmark fitness testing in leading academies. However, the reliability of this test has not been determined in elite youth football players. Furthermore, the change-of-direction deficit (derived from 505 test time) is proposed to be a better way of isolating COD ability, yet this measure is not used frequently in football. Therefore, this study aimed to assess M505 and COD deficit reliability in elite youth players.
METHODS: A total of 110 players from the Under [u] 12-18 years age groups were recruited (u18 n = 26, u16 n=26, u14 n=39, u12 n=19) from two English Premier League Category 1 Academies. To assess the reliability of the M505 and COD deficit, players completed the M505 twice (two trials on each side) in 7-days with best time recorded for analysis. To calculate COD deficit, best 10-m sprint time recorded during the testing window was subtracted from the M505 time. Players were familiar with the tests, and all were preceded by a standardised warm-up and completed indoors on artificial field turf. Performance times are displayed as mean ± standard deviation. Mean change (%), typical error (CV, %), and intraclass correlation coefficients (ICC) were calculated, with age-group specific thresholds used to quantify the magnitude of mean change and typical error. Standardised thresholds were used to quantify the magnitude of ICC's.
RESULTS: Performance times for the M505 were 2.42 ± 0.08 s, 2.46 ± 0.09 s, 2.59 ± 0.10 s, 2.70 ± 0.12 s for the u18, u16, u14, and u12 groups, respectively. For COD deficit, performance times were 0.70 ± 0.09 s, 0.72 ± 0.09 s, 0.79 ± 0.10 s, 0.82 ± 0.10 s for the u18, u16, u14, and u12 groups, respectively. For the M505, Mean changes (%) were small to moderate (-0.8 to -3.2%) for M505-Left and trivial to small (-2.1 to 0.9%) for M505-Right in all age groups. Typical errors in M505 were moderate to large in all age groups (2.0 to 3.5%), while Intraclass correlation coefficients (ICC) were low to moderate (0.29 to 0.70). For COD deficit, small to moderate changes were observed in COD deficit-Left (-2.4 to -11.3%) in all age-groups, and COD deficit-Right (-7.3 to 3.2%) in the u14, u16, and u18 groups, mean changes in COD-Right were trivial in the u12 group. Typical errors in COD deficit were moderate to large (7.1 to 12.0%), while ICC's were very low to moderate (0.19 to 0.72) in all age groups.
CONCLUSION: The M505 should be used with consideration of the high typical errors in elite youth football players. While COD deficit has been highlighted as a better way of assessing change-of-direction ability, this measure does not appear suitable for use in this population.

Mini-Orals

MO-MI02 Swimming and Handball

STROKE VARIETY IN LONG-TERM DEVELOPMENT OF YOUTH SWIMMERS

STAUB, I., LAUX, S., VOGT, T.

GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: It is possible to compete in different swimming strokes at a single competition. The German Swimming Federation supports stroke variety and underlines the importance of individual medley as a prerequisite for becoming an elite-level swimmer while focussing on big training loads at young ages at the same time (Lambertz, 2014). On the contrary, early stroke specialisation in age-

group swimming is tempting for coaches to gain success at young ages. However, the literature lacks describing the process of specialisation in providing practical implementations (Dormehl & Williams, 2016). In a multivariate analysis of swimming performance, it has been shown that the determinants of success in swimming are non-stroke specific (Saavedra, Escalante, & Rodriguez, 2010). The aim of this study was to analyse German top-100 rankings if a stroke variety in good swimmers is evident.
METHODS: To examine an influence of stroke variety in German competitive swimming the 100 best age-group swimming performances (i.e. long course) of eight subsequent years (2004-2013) were analyzed, focussing on the age-groups from 1993-1995 (male n = 1.862; female n = 1.993). The rankings of all swimmers who got into top 100 at the age of 18 (male n = 842, female n = 574) were traced back to analyse their rankings at earlier ages. The number of strokes achieved by these athletes within the top 100 at each age between 11 and 18 years were counted. Chi-square tests were performed to compare five different ranking clusters (ranking 1-3; 4-10; 11-30; 31-50; 51-100) as well as stroke variety.
RESULTS: Results revealed a significant connection between the ranking and the number of strokes with 11 years from the top-3 ranked 18 year old athletes compared to all other clusters ($p < 0.01$). Similar connections were shown for the stroke variety in all other age groups and ranking clusters ($p < 0.01$).
CONCLUSION: The present findings indicate that successful athletes do not specialize on one stroke over all competitions within a season, supporting previous suggestions of swimming being a late specialisation sport (Baker & Robertson-Wilson, 2003; Balyi, 2001; Sokolovas, 2006).

COMPARISON BETWEEN TWO METHODS FOR ASSESSMENT OF CARDIOPULMONARY PARAMETERS DURING SWIMMING

PINNA, V., PINNA, M., MILIA, R., PALAZZOLO, G., IBBA, G., LOI, A., MAGNANI, S., CORONA, F., CRISAFULLI, A.
UNIVERSITY OF CAGLIARI

INTRODUCTION: Measurements of cardiopulmonary parameters, such as maximum oxygen uptake (VO2max), anaerobic threshold (AT), pulmonary ventilation (VE) and heart rate (HR) are particularly useful to test physical capacity of athletes. However, these parameters should be studied during real swimming, as typical swimming movements can not be simulated in laboratory. Despite several studies has measured gas exchange parameters during real swimming, to date there is no consensus on whether different protocols yield similar results. The aim of this study was to compare two methods of assessment of cardiopulmonary response in elite swimmers during a tethered swimming session with steps of different durations.
METHODS: Six male and three female elite swimmers (ES, Age 19.8±2.7 years, Height 174.3±10.5 cm, Body Mass 65±11.6 kg) were studied. ES underwent two incremental test in the pool using tethered swimming until exhaustion. The two tests were different in step duration: 1kg/min and 1kg/3min. They performed front crawl with free stroke frequency. Cardiopulmonary parameters were assessed by means of a portable metabolic system connected to a modified snorkel device (Pinna et al 2013). Data were collected at rest, at AT, and at maximum workload (Wmax).
RESULTS: The comparison between 1kg/min and 1 kg/3min tests showed a significant difference ($P < 0.05$) in VE at AT (79.6±26.8 vs 60.4±14.4 respectively) and at Wmax (106.2±25.2 vs 97±22.6). Differently, the other parameters were similar between the two tests (VO2max: 52.6±6.4 vs 54.6±6.5, HRmax: 180.2±8 vs 167.5±35.1, VO2AT, 42.6±9.9 vs. 42±6.8, HRAT 156.8±17.5 vs 152.3±11.1). Moreover, the Bland-Altman statistics applied to the two methods did not found out relevant differences in these parameters (VO2AT mean difference: 5.49 %, VO2max mean difference: 1.63 %).
CONCLUSION: Data obtained show that the two different methods to assess cardiopulmonary parameters during swimming yielded similar and interchangeable results. The only significant difference was found in VE. Probably, this outcome can be related to the longer duration of the 1kg/3min test, which could have caused a different breathing pattern in swimmers. It is possible to speculate that during 1kg/3min test swimmers increased stroke frequency, thereby raising VE. This different VE response should be considered when testing physical capacity of swimmers in the pool.
REFERENCES:
Pinna M, Milia R, Roberto S, Marongiu E, Olla S, Loi A, Ortu M, Migliaccio GM, Tocco F, Concu A, Crisafulli A. (2013). J Physiol Sci, 63,7-16.
CONTACT:
virginia.pinna@gmail.com

EFFECT OF SUBJECTIVE EXERCISE INTENSITY CONTROL ON HEART RATE A DURING SWIMMING CRAWL OF FIVE MINUTES

HAMADA, H.1, SAITO, T.2, YOSHIDA, N.1, TAMARI, Y.2, ONODERA, S.2
1:GRADUATE SCHOOL, KAWASAKI UNIVERSITY OF MEDICAL WELFARE , 2:KAWASAKI UNIVERSITY OF MEDICAL WELFARE

INTRODUCTION: To check exercise intensity during swimming use heart rate and Rating of Perceived Exertion (RPE). Previous study reported that there was significant positive correlation between the heart rate and RPE during swimming crawl, and that it is effective as an exercise intensity index (Miyashita et al, 1973). However, there is a specific problem of exercise intensity control during swimming. Swimmers cannot always see the heart rate. They need to understand the Borg scale (Borg, G.A, 1982). We decided to control heart rate by self-control using subjective exercise intensity control. We could consider that swimmers can control physiological responses by subjective exercise intensity control. We assumed that heart rate during swimming could be set by using a subjective exercise intensity control. This study aimed to clarify the effect of subjective exercise intensity control on heart rate during swimming crawl at five minutes.
METHODS: Seven healthy Japanese males volunteered to participate in this study. Their age, height and body weight were 21 ± 3 years, 170.6 ± 3.9 cm, 62.9 ± 4.2 kg, respectively (mean ± SD). All subjects were issued informed consent forms prior to participation in this study. The heart rate at rest measured in the water (Position: standing) Thereafter, the heart rate of 50% Heart Rate Reserve (objective heart rate) calculated by the Karvonen Formula was explained as an instruction to the subjects. The subjects were pulled by a rope and swam swimming crawl five minutes. We measured indices were heart rate, the rotation number of the arm (pitch) and respiratory rate. The heart rate was continuously measured from the start of the experiment. The pitch and respiratory rate were the number of revolutions per minute of arm use.
RESULTS: The measured heart rate of swimming crawl was 138 ± 13 bpm. The heart rate of calculating was 149 ± 14 bpm. The measured heart rate of swimming crawl was significantly higher than the heart rate of objective heart rate ($P < 0.05$). The pitch (1min: 59 ± 11 rpm, 2min: 54 ± 12 rpm, 3min: 52 ± 9 rpm, 4min: 52 ± 9 rpm, 5min: 51 ± 9 rpm) of swimming crawl showed no significant difference. The pitch was constant for five minutes.

CONCLUSION: There is no significant correlation between the difference of objective heart rate and the pitch and respiratory rate. Subjective exercise intensity control can be used for the exercise intensity control of the swimmer. This study suggests to coincided with the objective exercise the intensity when instructor indicates a lower value than objective exercise intensity.The measured heart rate of subjective exercise intensity control was significantly higher than the objective heart rate.
REFERENCES:
Borg G.A. (1982). Med Sci Sports Exerc, 14, 377-381.
Miyashita M, Onodera K. (1973). J Health, Phys Edu Rec, 6, 96-99.
CONTACT:
w6317002@kwmw.jp

INTRA-ABDOMINAL PRESSURES DURING MAXIMAL SPRINT SWIMMING WITH FOUR COMPETITIVE SWIMMING STYLES

MORIYAMA, S.1, KANAZAWA, S.2, KITAGAWA, Y.3, SHIBATA, Y.4, OGITA, F.5

1: TOKYO GAKUGEI UNIVERSITY , 2: UNIVERSITY OF YAMANASHI , 3: JAPAN WOMENS COLLEGE OF PHYSICAL EDUCATION , 4: TEIKYO UNIVERSITY OF SCIENCE , 5: NATIONAL INSTITUTE OF FITNE

INTRODUCTION: Intra-abdominal pressure (IAP) during front-crawl swimming is varied by amount of muscle activity involved in arms stroke and legs kick (Moriyama et al. 2016). Based on this result, it is we hypothesized that IAP would be also varied by swimming style with different muscle activities. However, IAP during competitive swimming styles has not been determined except for front-crawl swimming, yet. Therefore, present study aimed to determine and to compare the IAP in four competitive swimming styles.
METHODS: Eleven female competitive collegiate swimmers (1.60 ± 0.04 m; 53.0 ± 6.9 kg; 20.4 ± 1.0 yrs) performed a 20m maximal sprint swim of butterfly, backstroke, breaststroke and front-crawl. IAP was taken from the difference between minimum and maximum values in each cycle, and was used as the mean values of 2 stable stroke cycles in each swimming style.
RESULTS: Mean IAP values during butterfly (6.4±2.1 kPa) and breaststroke (3.4±0.6 kPa) were significantly higher than those of backstroke (2.6±0.5 kPa) and front-crawl (2.7±0.4 kPa). Moreover, IAP during butterfly was significantly higher than those of breaststroke.
CONCLUSION: It is concluded that IAP is varied by competitive swimming styles. The higher IAP observed in butterfly and breaststroke would be attributed to the enhanced IAP to stabilize trunk associated with the upper body movement that come out on the water surface, which should decrease the effect of buoyant force.
REFERENCE:
Moriyama S, Kanazawa S, Kitagawa, Nagano, Y, Shibata Y, Ogita F. (2016). Comparison of intra-abdominal pressure in maximal arm stroke, leg kick and whole body swimming. 21st Annual Congress of the European College of Sport Science, Book of abstracts, 219.
ACKNOWLEDGEMENT:
This study was supported by Grant-in-Aid for Young Scientists (B), KAKENHI, from the Japan Society for the Promotion of the Science (Grant No. 15K16466).
CONTACT:
moriyama@u-gakugei.ac.jp

INCREASED BODY FAT MAY PROVIDE A BUFFER TO LOW BMD (USUALLY SHOWN IN SWIMMING) IN COLD WATER ULTRA-ENDURANCE SWIMMERS.

MACGREGOR, C.1, DIVERSI, T.2

TOI OHOMAI INSTITUTE OF TECHNOLOGY.

INTRODUCTION: Cold water endurance swims (CWESs) such as the English Channel (EC) crossing, like many endurance sporting events, are increasing in popularity. The EC is seen as the pinnacle in endurance swimming. The average successful cross-channel swimmer takes approximately 13 and a half hours to complete the swim crossing. Prolonged swimming practice has shown to be negatively related to bone mineral density (BMD) in competitive swimmers however to date no study has investigated the effects of training to cross the EC on BMD.
METHODS: 25 (15 male aged 22-70yrs, 10 female aged 27-73yrs) Australian based EC swimmers participated in this cross-sectional study. Participants' height and mass were measured using a standard medical balance scale. Segmental body composition including BMD was measured via dual-energy x-ray absorptiometry (DXA) (Hologic Discovery A, Waltham, MA). The DXA scanning procedure was performed according to the International Society of Clinical Densitometry guidelines. Z scores were then used for the comparison as it is the number of standard deviations a patients BMD differs from the average BMD of their age, sex, and ethnicity.
RESULTS: Slightly higher BMD was noted in all EC swimmers (0.9 to 1.8) however this was shown not to be significant at $P<0.05$) and there was no significant difference between gender or age effects noted. Furthermore when looking at fat mass, compared to average population norms many of the EC swimmers were slightly higher but not significantly different to the general population (12.2%-32.9%)
CONCLUSION: Swimming has been associated with low bone mineral density (BMD) due to the displacement of weight bearing activity (Gómez-Bruton, 2014). Furthermore in a high-performance sports environment including ultra-endurance events, athletes can present with low energy availability (LEA) for a variety of reasons, for example not consuming enough food for their specific energy requirements. High-performance athletes are at risk of LEA, as most sports require high muscle to low body fat ratios. Longstanding LEA can cause unfavourable physiological outcomes which have the potential to impair an athlete's health (Logue,2017).
In preparation for an EC attempt, aspiring EC swimmers invest significant time training (Federation, 2015). Additionally, many aspirants also increase body weight and/or fat mass to a potentially unhealthy level in preparation for the cold water temperature (Klemperer & Thomas, 2014).
While the levels of body fat may increase risks factors associated cardiovascular disease they appear to buffer the effect that swimming is having on BMD in ultra-endurance swimmers. This increase in body fat percentage in long distance swimmers may lead to BMD being preserved in these individuals as they age.
Annett, S., Cassas, K., & Bryan, S. (2016). End Sports Med55-70.
Federation CSP. (2015) annual report.
Gómez-Bruton et.al. (2016) Scan J med & sci in sports,25(6).
Klemperer F, Thomas ES. BMJ. 2014;349:7372.
Logue, et al. (2017) Sports Med,1-24.

MULTIDIMENSIONAL EVALUATION IN CLUB HANDBALL PLAYERS

SAAVEDRA, J.M., HALLDÓRSSON, K., GUÐMUNDSDÓTTIR, M.L., EINARSSON, I.P., KRISTJÁNSDÓTTIR, H.

REYKJAVIK UNIVERSITY

INTRODUCTION: Handball performance is a combination of many factors: constitution-disposition, coordination, strength, endurance, constitution-disposition, nutrition, cognition, tactics, and social and external influences (Wagner et al., 2010). These factors change across the life. Therefore, the aim of this study was to analyse anthropometric, physical fitness, and throwing speed in club handball players of different ages.
METHODS: A total of 150 handball players (12-25 years old, 83 male, 67 female) participated in this study. The sample was divided into four groups in function of official categories of Federation: 12-13 years old (U13), 14-15 years old (U15), 16-17 years old (U17), and 18 years old and older (A team). A multi test battery was used: height, weight, body mass index, arm span, length and width of hand, hand dynamometry, medicine ball throwing (3 kg), countermovement jump (CMJ), 20 m running, T agility test (T-test), Yo-yo IR2 test, throwing speed (throwing at seven meters standing stationary, throwing at nine meters after three steps and throwing at nine meters after three steps and a jump) and pass to wall test. One-way analysis of variance (ANOVA), with a sub-sequent Bonferroni post-hoc test was used to examine differences in physical fitness tests among the four age groups
RESULTS: There was difference in most studied variables. However only among male were differences between U17 and A team in height ($p<0.001$). Only in medicine ball throwing was differences between each group in male and female (A team > U17 > U15 >U13; $p<0.001$); and 20 m running, T-test (U17 < U15 < U13; $p<0.001$). In male, difference between in three youth teams was presented in arm span, hand dynamometry, CMJ, Yo-yo IR2 test, throwing speed at seven meters standing stationary (U17 > U15 > U13; $p<0.001$) and 20 m running, T-test (U17 < U15 < U13; $p<0.001$). In the female, the difference between in three youth teams was presented in CMJ, Yo-yo IR2 test and throwing speed at seven meters standing stationary (U17 > U15 >U13; $p<0.001$) and 20 m running, T-test (U17 < U15 < U13; $p<0.001$).
CONCLUSION: Both sexes in this study develop their physicall fitness in similar way through the youth teams as Ingebrigtsen et.al. demonstrated in their study (2013). All performances gets better with increased age and experience. Only in a power throw (3kg medicine ball) did the performance continue to improve in to adulthood (A-team)
ACKNOWLEDGMENTS.
We would like to acknowledge the collaboration to Ólafur Víðir Ólafsson (HK club) and to Phillip Behncke (BSc internship student) for your implication in the data collection.
REFERENCES: Ingebrigtsen, J, Jeffreys, I, Rodahl, S (2013). J Strength Cond Res 27: 302–309.
Saavedra JM, Kristjánsdóttir H, Einarsson IÞ, Guðmundsdóttir ML, Þorgeirsson S, Stefansson A. (2017). J Strength Cond Res, 10.1519/JSC.0000000000002412.
Wagner H, Buchecker M, von Duvillard, SP, Müller E. (2010). J Sports Sci Med, 9, 15-23.

A COMPARATIVE STUDY OF HEART RATE AND BLOOD LACTATE RESPONSE OF UNDER 21 (U21) AND SENIOR INDIAN HANDBALL PLAYERS DURING ION TRIAL HANDBALL MATCH PLAY

GUPTA, S., GOSWAMI, A.

UNIVERSITY OF WEST INDIES, FACULTY OF MEDICAL SCIENCES

INTRODUCTION: Handball is a fast-flowing team sports that requires strength, speed, flexibility, and endurance. Physiological demand on handball players depends on the position of play, experience, training, and level of competition. This study is aimed to compare the heart rate (HR) and blood lactate response of U21 and senior handball players during selection matches.
METHODS: The participants in this study were 10 junior (U21) (age 19.1±1.2 years) and 10 senior Indian handball players (age 27.4±4.4 years) attending selection camps. HR of the participants was recorded during two selection matches between the U21 and senior teams. HR was recorded continuously at an interval of 5 sec. Blood lactate was measured before match and at 15th, 30th, 45th, and 60th min of the matches. Each match was played for 60 min, divided in two halves, spaced by 10 min interval. All the volunteers played full time. In both the teams there were 4 backs, 4 wingers and 1 each center and circle runner. The senior team won both the first and the second matches by 24-19 and 29-20 goals respectively. VO2max, HRmax, and anerobic threshold HR of the volunteers were measured before the field test was conducted.
RESULTS: Mean heart rate of the U21 players in the 1st and 2nd halves of the matches were 157.3±13.3 and 155±11.7 bpm respectively whereas the respective values in seniors were 154.8±15.2 and 158.5±14.3 bpm. U21 and seniors played 12.8±3.7% and 19.6±5.3% of the total time respectively above the anerobic threshold level. Blood lactate levels of U21 players after warm up, 15th, 30th, 45th, and 60th min of matches were 4.5±0.9, 6.8±2.0, 7.6±1.1, 6.6±2.3, and 5.7±1.2 mmol/L respectively whereas in seniors, respective lactate levels were 3.2±1.4, 8.6±1.7, 9.2±2.2, 8.5±1.9, and 8.2±0.8 mmol/L
CONCLUSION: Senior players had more sprint and/or intense short bursts of run that helped creating more coordinated and effective attack to the opponent team. Probably less experience and less anaerobic training or fitness restricted the movement of the U21 players and as a result they played longer time in the aerobic zone. Blood lactate levels in the handball players suggests a very significant contribution by the glycolytic energy system. Frequent jumps, long throws, and short bursts of running are dependent on the anerobic system for energy supplement. The study concludes that: (1) cardiovascular stress on the U21 and seniors is equally high and (2) anerobic energy supplement is significantly higher in seniors than their U21 counterparts.

DO ADHESION-ENHANCING SOCKS AFFECT MULTIDIRECTIONAL SPEED IN ELITE HANDBALL PLAYERS?

PRAETORIUS, A., RAEDER, C., OHMANN, T., SCHOEPP, C.

BG HOSPITAL DUISBURG

INTRODUCTION: This study examines the effect of an adhesion-enhancing sock (AES) on change of direction capabilities in multidirectional sports. In addition to a compression effect the sole is equipped with a flat rubber coating. This is to achieve shorter change of direction times as well as an improved sprint and jump performance through optimized power transmission between foot and shoe.
METHODS: 24 Players of Germanys 3rd Handball Devision (age M 21,1±SD 4,5; weight M 89,4kg±SD 16kg; height M 188,2cm±SD 6,1cm; BMI M 25,5±SD 3,3; BodyFat M 16,6%±SD 4,9%) were randomized into 2 Groups (GA, GB) using a cross over design. Participants trained specifically for 7h/week with additional athletic training for 2h/w. Recovery status and DOMS was evaluated prior to testing via KEB Scale and DOMS Visual Analog Scale. Both Groups conducted 5m sprints (SP5) followed by 180° COD sprints, using a modified version of the 505 test (505), jump tests, (3 countermovement jumps (CMJ), 15s multiple rebound jumps (MRJ) and 3 bilateral horizontal hops (HOP)) and

nine consecutive Speedcourt protocols (SC) with a work-to-rest ratio of approximately 1:3 (~12-15:45s) consisting of about ten multidirectional CODs over a distance of 30m in random fashion.
For SP5 sprint duration was measured (SP5). For the 505 sprint duration (505u, 505up) and in addition COD deficit (SP5-mod505) were collected for the prefered and unpreferred leg (505defu, 505defup). Jump performance in CMJ was measured as jump height (CMJ-h), reactive strength index for MRJ (MRJ-RSI)and jump distance for HOP (HOP-D). SC performance was expressed as sprint duration (SC-TT)and ground contact time (SC-CT). GA completed all tests wearing AES, GB started testing with standard sport socks. This testing order was reversed after 30 minutes of rest for each group. All measurements were preceded by a standardized warm-up and familiarization trials.
For Statistical Analysis ANOVA's were computed for all variables and effect sizes (Cohen's d) as well as P values are reported.
RESULTS: DOMS in all athletes was 1,5 +/-1,9 on the VAS. Recovery prior to measurements was 12,8+/- 5,0 and 13,3+/- 3,7 on the KEB after the 30 min rest. All Participants therefore were fully recovered and without muscle soreness before conducting the tests. There was no statistical difference in between GA and GB (CMJ-h P.86, d-0,051; MRJ-RSI P.81, d0,065; HOP-d P.86, d-0,05; SP5 P0,95, d0,018; SC-TT P.97, d-0,009; SC-CT P.59, d-0,152; 505u P.94, d0,023; 505up P.06, d-0,144; 505defu P.99, d0,00; 505defup P.99, d -0,160).
CONCLUSION: In this study no definite superiority of performance could be established which would promote the use of AES to enhance COD or sprint and jump performance.
This might partly be contributed to the fact that this study did not assess any measures of fit between shoe and sock that could influence the effectiveness of the AES.
Nonetheless we found high levels of satisfaction within our study population when assessing wearing comfort of AES via a questionnaire.

Mini-Orals

MO-BN09 Sports with patients and individuals with disability

SUBJECTIVE AND OBJECTIVE LEVELS OF PHYSICAL ACTIVITY IN PATIENTS WITH HEART FAILURE WITH PRESERVED EJECTION FRACTION

SCHMIDT, C.1, BOHN, L.1, SANTOS, M.2.3, MOREIRA-GONÇALVES, D.1,2, OLIVEIRA, J.1

1 : CIAFEL , 2: FMUP , 3: CHP

INTRODUCTION: Over the past decade, the prevalence of heart failure with preserved ejection fraction (HFpEF) increased substantial, accounting for approximately 50% of heart failure cases. HFpEF is associated with poor outcomes and pharmacological therapies have failed to improve clinical outcomes. Higher physical activity (PA) levels are associated with greater quality of life and lower risk of hospitalization and mortality in HFpEF patients. Given its importance for the patient's outcome, accurate assessment of daily PA is necessary to make recommendations and interventions. The aim of this study was to compare PA and sedentary time assessed by self-reported and accelerometry in HFpEF patients.
METHODS: This cross-sectional study was conducted with twenty-four stable and well-medicated HFpEF patients. Level of PA was assessed through the IPAQ–Short Form and with accelerometers (7 consecutive days; ActiGraph GTX3). Sedentary time and time spent in moderate to vigorous activity (MVPA) were compared according to gender. Time spent in MVPA derived from IPAQ was merged with self-reported walking and MVPA to compare with objectively measured MVPA (≥2752 counts/minute). Mean differences were examined using the independent-samples t-test and Pearson´s correlation coefficient was used to assess association between the two methods.
RESULTS: Twenty-two patients completed all data collection (age= 76± 6.1; 17 female, and 7 male). Average accelerometer wear time was 6.4±0.9 days and 13.2±1 h/day. IPAQ underestimated sedentary time compared with the accelerometer (253 vs. 392 min.d-1, p=0.001), even when adjusted for gender. Accelerometer-measured MVPA was 19 (±26) min/day with no significant differences between men and women. However, when considering only MVPA occurring in bouts ≥10 minutes, time spent in MVPA was only 1 min/day. Although two methods that are designed to measure the same variable should have good correlation, we did not find correlation between IPAQ and accelerometer measured sedentary time and MVPA, even when adjusted by gender and age. According to IPAQ, 59% of the patients accumulated at least 150 minutes of MVPA (in bouts ≥ 10 minutes), while none met the recommendations when PA was objectively measured. However, if we disregard the bouts of 10 min, 27% of the patients would achieve the recommendations for MVPA.
CONCLUSION: Our findings indicate that patients with HFpEF tend to underestimate sedentary time and overestimate time spent in MVPA. This has important clinical implications as it limits IPAQ-based decisions targeting the management of both sedentary time and MVPA in HFpEF patients. The use of objective measures of PA seems to have a particular importance as self-reported physical activity may show a large discrepancy.
Contact: schmidtcristine@gmail.com

EFFECT OF TRAINING ON EXERCISE CAPACITY IN KIDNEY TRANSPLANT CYCLISTS

DI MICHELE, R., TOTTI, V., CIACCI, S., SEMPRINI, G., MERNI, F.

UNIVERSITY OF BOLOGNA

INTRODUCTION: After transplantation, engaging in regular physical activity and sport is recommended to improve health. The American College of Sport Medicine recommends at least 150 minutes per week of physical activity to maintain health in adults and people with chronic diseases as kidney transplant recipients (KTRs) (1). Apart from this recommendation, there is currently no indication of the amount of training that should be performed by KTRs to achieve improvements in sports performance. The purpose of this preliminary study is to describe the effects of a specific training programme on a selection of performance parameters in kidney transplant cyclists (CKCs).
METHODS: Eight CKCs performed a 6-month combined endurance and strength training programme in addition to their typical training routines. The outcome measures were training volume; fat mass percentage as determined by skinfold thickness measurements; workload and heart rate at the aerobic and anaerobic thresholds, as determined by an incremental cycling test. Furthermore, renal function and lipid profile were assessed. All variables were compared between baseline and post training with repeated-measure ANOVAs. Statistical significance was set at $P < 0.05$.
RESULTS: CKCs trained on overage 3.38±0.74 times per week with 2.95±2.60 hours per session at baseline and 3.75±0.70 times per week with 5.00±4.2 hours per session after 6 months. No differences were found in FM% between pre- and post-training. When classifying the cyclists by training volume (below/above median), CKCs with highest training volume (660±903 minutes per week) showed signif-

icantly increased aerobic (+17.5 W) and anaerobic (+11.5W) thresholds, with unchanged heart rates associated to these thresholds. Renal function and lipid profiles remained stable between pre- and post-training. No adverse event was reported.
CONCLUSION: This study showed that a 6-month combined endurance and strength training is effective to improve performance parameters, besides being well tolerated by CKCs. Although limited to well trained transplanted cyclists, these findings are an early step to understanding the responses of transplanted recipients to training loads typically used by healthy amateur competitive athletes. Future studies are warranted to determine the optimal training parameters to improve the competitive performance in kidney transplant athletes performing different sports at different competitive levels.
References: 1. American College of Sports Medicine, Chodzko-Zajko WJ, Proctor DN et al. American College of Sports Medicine position stand exercise and physical activity for older adults. Med Sci Sports Exerc. 2009; 41(7): 1510-1530.

LENGTH REDUCTION OF LOWER-LEG SPRINT PROSTHESES INFLUENCES PERFORMANCE-RELATED RUNNING BIOMECHANICS

KULESSA, D.J.1, STELZHAMER, R.1, RAPP, W.2, GOLLHOFER, A.1, GEHRING, D.1

1: DEPARTMENT OF SPORT AND SPORT SCIENCE, UNIVERSITY OF FREIBURG , 2: OLYMPIC TRAINING CENTRE

INTRODUCTION: In competitions with disabled athletes it is essential to ensure that the conditions are as fair and comparable as possible. This is achieved by regulations, thus putting the individual disability into perspective. A mandatory length specification of lower-leg sprint prostheses may be a major change for a sprinter, to which adaptations are needed. The following single-case study has been conducted to investigate how the athlete adapts to a prostheses length change of 9cm.
METHODS: Subject of this study was a world-class Paralympic sprinter with below knee amputation of both legs (T43). The athlete performed sprints on an oversized treadmill at his maximal controllable running speed (= 7.0 m/s), under a familiarized and a shortened (-9 cm) prostheses length condition. 3D kinematics of a total of 84 steps were captured with a motion analysis system operating at 200Hz. Spatiotemporal variables, prostheses deformation characteristic and running biomechanics that appear to be performance-related (Brüggemann et al., 2007; Dallam et al., 2005; Folland et al., 2017) have been of primary interest: deformation during ground contact, foot contact time in relation to total step time (duty factor, DF), step frequency per minute (cadence), pelvis rotation during ground contact (PR) and forward trunk lean during gait cycle (FTL). Results are reported in mean values (and standard deviation).
RESULTS: The deformation of the loaded prostheses differed substantially between the two conditions: 68.6 (0.8) mm (short) vs. 71.7 (1.9) mm (familiarized). In comparison to the familiarized prostheses length, the athlete ran with decreased DF 0.27 (0.01) vs. 0.28 (0.01) and increased cadence 214 (1.6) vs. 205 (2.9) steps/min when the prostheses were shortened. Additionally, PR was higher 9.5 (1.5) vs. 6.3 (1.5)° and FTL was lower 2.3 (2.0) vs. 4.8 (1.8)°.
CONCLUSION: The purpose of this single-case study was to evaluate the effect of a length reduction of lower-leg sprint prostheses by 9cm for an elite Paralympic sprinter. The results clearly suggest that performance-related parameters are directly affected by the prostheses shortening. Lower prostheses deformation values indicate possibly impaired energy return. Higher PR and lower FTL suggest a less stable running position (Folland et al., 2017) and a higher risk for breaking impulses with each step. The athlete managed to run the same velocity by increasing the cadence and decreasing the DF to compensate for the lower step length. Hence, it can be assumed that the observed athlete will not be able to immediately achieve the highest performance, but rather the running style and training have to be adjusted permanently. The challenge of adjusting to the various factors should be taken into account when defining individual mandatory prostheses specifications.
REFERENCES:
Brüggemann et al. (2007). Oscar Pistorius expert's report.
Dallam et al. (2005). J Sports Sci, 23(7), 757-64
Folland et al. (2017). Med Sci Sports Exerc, 49(7), 1412–1423.

BENEFITS OF AN ADAPTED PHYSICAL ACTIVITY PROGRAM IN TERMS OF MOBILITY, BALANCE AND QUALITY OF LIFE IN PATIENTS WITH PARKINSON DISEASE.

MASINI, A.1, MARINI, S.1, DALLOLIO, L.1, FANTOZZI, S.1

UNIVERSITY OF BOLOGNA

INTRODUCTION: Parkinsons disease (PD) is a progressive, chronic, degenerative disease that affects the extra pyramidal system, characterized by a degeneration of the mesencephalic nigric neurons associated with striatal dopamine depletion. The average age of onset is around sixty years, manifesting one or more of the following symptoms: tremor, rigidity, bradykinesia and hypokinesia while in the late stages postural instability, loss of balance and walking problems occur.
In spite of various medical and surgical treatments for PD, patients gradually develop significant physical problems. Exercise therapy can maintain the maximum level of mobility, activity, and independence of patients. However, no sufficient evidence are available to support the use of one approach of exercise intervention over another for the treatment of PD (Tomlinson CL. et al, 2013).
The aim of this study is to evaluate the effects of a specific adapted physical activity (APA) protocol in terms of mobility, balance and quality of life in patients with PD.
METHODS: Seventeen patients, aged 50-85 years, diagnosed with PD enrolled in this study. The participants performed two 60-minute sessions a week of physical activity for 5 months and they were evaluated at baseline (T0) and after two months at the end of the program (T1). The APA contained several exercises for static and dynamic balance, and other exercises to increase the mobility and strength.
The outcomes measures assessed were: mobility (sit and reach test, lateral bending, joint ROM and stick test), balance (six-minute-walking test 6MWT, timed-up-and-go TUGT, four-square-step-step FSST, balance error scoring system BESS and Tinetti scale), and quality of life (PDQ-39, scale of fear of falling FES and freezing of gait FOG).
RESULTS: At the end of the study, balance, mobility and quality of life reported significant improvements (p-value <0.05) in the following outcomes: 6MWT (T0 279,47 vs T1 311,8) TUGT (T0 14,1 vs T1 12,91) SIT-UP (T0 8,87 vs T1 10,43) FSST (T0 13,16 vs T1 11,63) BESS (T0 3,68 vs T1 2,5) stick test (T0 18,26 vs T1 13,82) sit and reach test (dx: T0 90,68 vs T1 97,075 sx: T0 90,38 vs T1 95,84) bending (dx T0 52,45 vs T1 50,56 sx T0 51,57 vs T1 49,59) Tinetti scale (T0 20,93 vs T1 24,06) FES (T0 24,31 vs T1 20,44) PDQ-39 (T0 25,05 vs T1 15,38). No injuries were reported during APA.
CONCLUSION: The APA program applied in this study is a safe and effective exercise therapy for patients with PD, especially in term of mobility, balance and quality of life.

References: Tomlinson CL, Patel S, Meek C, Herd CP, Clarke CE, Stowe R, Shah L, Sackley CM, Deane KHO, Wheatley K, Ives N. Physiotherapy versus placebo or no intervention in Parkinsonís disease.
Cochrane Database of Systematic Reviews 2013, Issue 9. Art. No.: CD002817
Contact: Alice Masini alice.masini6@studio.unibo.it

FEASIBILITY STUDY ON DT-MANAGING TRAINING TO IMPROVE THE QUALITY OF GAIT IN PATIENTS WITH PARKINSONS DISEASE.

RUDNIK, S.1, WOLLESEN, B.1, GULBERTI, A.2, BRAASS, H.2, PÖTTER-NERGER, M.2

1: UNIVERSITY OF HAMBURG, 2: UNIVERSITY MEDICAL CENTER HAMBURG-EPPENDORF

INTRODUCTION: Most daily activities require the simultaneous management of sensorimotor tasks while processing external information (dual-task performance). Examples for daily dual-tasks represent walking on a crowded floor while avoiding bumping into people or crossing a street while observing traffic flow. Most patients with Parkinson's disease show deterioration of dual-task performance of daily activities and particularly of gait (Plotnik et al., 2011) resulting in freezing episodes and decreased mobility (Kelly et al., 2011). This study investigates the feasibility of a DT-Managing training in patients with Parkinson's disease to improve their DT walking performance.
METHODS: Five participants (men: 66.2 ± 6.7 years) with chronic Parkinson's disease took part in a DT intervention of four sessions with increasing number of tasks and task difficulty. Demographic data and health characteristics were collected by questionnaires (SF-12, FES-1, FOG, MOCA). The gait performance was measured using a GAITRite ® system (CIR Systems, Inc.,NJ 0741, USA) with six different gait conditions (single task (ST), DT cognitive or manual, triple task; normal and fast gait speed). Data analysis was done by using SPSS 24.
RESULTS: Under ST and DT conditions the gait velocity (ST: pre 1.05 m/s; post 1.1 m/s; DT: pre 0.75 m/s; post: 0.86 m/s) and step length (ST: pre: 58.9 ± 17.05 cm; post: 70.14 ± 23.1 cm; DT pre 45.2 ± 19.4 cm; post: 56.1 ± 9.6 cm) increased from baseline to the final post- training test. For the dual- and triple task condition the gait performance (step length, velocity, cadence) improved between all training sessions. However, the results were not confirmed after post testing without training.
CONCLUSION: The first participants of the feasibility study showed benefits for walking performance under the different task conditions. The performance of exercises including higher attention- and multiple task- performance was difficult for the most of the participants. Nevertheless, the patients rated this kind of training as relevant to maintain their physical functioning for daily activities. To gain the highest impact for motor-cognitive functioning of participants with Parkinson´s disease the DT-training should be adapted to the individuals` motor and cognitive abilities.
REFERENCES:
Kelly, V. E., Eusterbrock, A. J., & Shumway-Cook, A. (2011). A review of dual-task walking deficits in people with Parkinsons disease: motor and cognitive contributions, mechanisms, and clinical implications. Parkinson's Disease, 2012.
Plotnik, M., Giladi, N., Dagan, Y., & Hausdorff, J. M. (2011). Postural instability and fall risk in Parkinson's disease: impaired dual tasking, pacing, and bilateral coordination of gait during the "ON" medication state. Experimental brain research, 210(3-4), 529-538.

CONCURRENT VALIDITY OF AN INSTRUMENTED WHEEL VERSUS A NEW INSTRUMENTED WHEELCHAIR ROLLER ERGOMETER FOR BIOMECHANICAL ANALYSES DURING REHABILITATION AND ADAPTED SPORTS

DE KLERK, R.

UNIVERSITY MEDICAL CENTER GRONINGEN, UNIVERSITY OF GRONINGEN

INTRODUCTION: Lab-based research allows detailed physiology and biomechanics studies to be conducted in wheelchair users under controlled conditions, while the wheelchair-user combination is stationary on a treadmill or wheelchair ergometer. However, lab-based equipment is often customized and may vary in reliability and validity <1>. The University Medical Center Groningen, University of Groningen and Lode B.V. recently developed a new wheelchair roller ergometer, the Esseda. This ergometer is equipped with servomotors and load cells that can be used to both simulate different environmental conditions and capture the performance of the wheelchair user. The purpose of this research was to determine the concurrent validity of the Lode Esseda wheelchair ergometer with a commercially available measurement wheel.
METHODS: A comparison between the measured effective torque of a commercially available measurement wheel and the ergometer during steady-state propulsion at 4km/h was made. Ergometer and measurement wheel data were cross-correlated and filtered. Push-by-push kinetic and temporal parameters such as peak torque and cycle time were determined. Pearson product-moment correlation coefficients were calculated to determine the association between both measurement devices. Agreement between instruments was assessed with the methods of Bland and Altman.
RESULTS: Mean and maximum torque per push measured by the ergometer and measurement wheel showed a high correlation of 0.97 and 0.90. Similar results were found for temporal variables as push time and cycle time correlated with 0.96 and 0.97 respectively. The ergometer overestimated mean torque by 8.2% and maximum torque by 6.4% per push.
CONCLUSION: This comparison study has shown that the Esseda provides similar results on key outcome parameters when compared with a measurement wheel. For the purpose of this initial comparison, the measurement wheel was assumed to be the "golden standard". The Optipush system to be accurate within 3.8-2.1% <2> and comparable to the SMARTwheel <3>. As such, further characterization of the Esseda system parameters and standardized tests with calibrated reference weights will provide definitive information on the accuracy of the ergometer.
<1> van der Woude LH, Veeger HE, Dallmeijer AJ, Janssen TW, Rozendaal LA. Biomechanics and physiology in active manual wheelchair propulsion. Med Eng Phys 2001 Dec;23<10>:713-733.
<2> Guo L, Kwarciak AM, Rodriguez R, Sarkar N, Richter WM. Validation of a biofeedback system for wheelchair propulsion training. Rehabil Res Pract 2011;2011:590780.
<3> Vegter RJ, Lamoth CJ, de Groot S, Veeger DH, van der Woude LH. Variability in bimanual wheelchair propulsion: consistency of two instrumented wheels during handrim wheelchair propulsion on a motor driven treadmill. J Neuroeng Rehabil 2013 Jan 29;10:9-0003-10-9.

MOVEMENT PATTERN AND LOADING DIFFERENCES BETWEEN BILATERAL AND UNILATERAL DROP LANDINGS IN TRANSTIBIAL AMPUTEES

MOUDY, S., TILLIN, N., SIBLEY, A., STRIKE, S.

UNIVERSITY OF ROEHAMPTON

INTRODUCTION: Unilateral transtibial amputees (TTAs) are discouraged by health professionals from participating in sport where jumping is commonly performed as this movement is thought to place TTAs at a greater risk of injury. This stems from the asymmetrical landing technique commonly observed in TTAs as a result of the limited ankle joint motion from the prosthetic limb and a greater load experienced on the intact limb when performing a bilateral landing (Schoeman et al., 2013). This study aimed to explore the intact limb landing mechanics and loading differences between bilateral and unilateral drop landings.
METHODS: Bilateral and unilateral drop landing was performed on a custom-made hanging bar where each participant hung with their heels 30cm off the ground. To assess the landing movement patterns, the ankle, knee, and hip joint motion of the intact limbs (n=6) and the dominant limb of age, gender, and activity level matched controls (n=6) were extracted from initial contact to the end of the absorption phase as determined by the centre of mass power. To assess the load occurring during landing, the vertical ground reaction force (GRF) was extracted for the absorption phase. Statistical parametric mapping paired t-tests were performed between the bilateral and unilateral drop landings for the intact limb and for the dominant control limb.
RESULTS: Results found the intact limb hip joint had a significantly greater magnitude of flexion (p=0.042) in the bilateral landing during the last 10% of absorption. The bilateral GRF was significantly lower (p<0.001) around peak GRF (31-41%) and during the last 12%. No difference in landing condition was found for the ankle or knee joint. The control group, however, performed differently between landing condition in the ankle, knee, and hip joint motion and was accompanied by differences in the GRF. The bilateral landing was associated with significantly faster ankle plantarflexion upon contact (0-13%, p=0.019) followed by significantly greater knee flexion (37-42%, p=0.048; 80-100%, p=0.026) and hip flexion (32-41%, p=0.43; 75-100%, p=0.015). The GRF was significantly lower (p<0.001) in the bilateral landing from 32-100%.
CONCLUSION: A bilateral landing typically results in an equal share of load between-limbs. In a unilateral landing, all the load is experienced by a single limb and would therefore expect to find significant differences between landing conditions. Additionally, movement patterns performed would differ as the landing conditions changed. This is evident by the control group differences between landing conditions. However, intact limb landing mechanics were not substantially different between the bilateral and unilateral landing suggesting that the bilateral landing was in effect a unilateral landing.
Schoeman, M., Diss, C. & Strike, S. (2013) Asymmetrical loading demands associated with vertical jump landings in people with unilateral transtibial amputation. JRRD. 50(10).

EFFECT OF AN EXERCISE PROGRAM ON THE PHYSICAL CONDITION OF CHILDREN WITH ASTHMA AND SYMPTOMS OF BRONCHOSPASM INDUCED BY EXERCISE: PILOT STUDY

ITURRIAGA, T.1, SANZ SANTIAGO, V.2, SANTANA SOSA, E.1, MORALES ROJAS, J.S.1, SÁNCHEZ LORENTE, I.M.1, DIEZ VEGA, I.1, FERNÁNDEZ DEL VALLE, M.3, VILLA ASENSI, J.R.2, PÉREZ RUIZ, M.1

1:UNIVERSIDAD EUROPEA DE MADRID . 2:HUNJ . 3:SIUE .

INTRODUCTION: Physical inactivity and a low adherence to the Mediterranean diet produces alterations in body composition that may determinate a worse control of chronic diseases such as asthma (1), this is one of the most frequent diseases in childhood. Some investigation in animal show the exercise can be decreased an asthma inflammation and bronchial hyperresponsiveness (2), as well as systemic inflammation, which could help control asthma (3)
Objectives: to analyze the effect of aerobic and strength exercise program in asthmatic children with symptoms of bronchospasm induced by exercise, with physical exercise on variables of physical condition and quality of life.
METHODS: Randomized controlled trial with control group that compared their usual physical activity vs. exercise program for 12 weeks, 3 days/week, and 60 min/day. It is assessed the physical condition (ergospirometry on treadmill and strength of peripheral muscles) and quality of life with Pediatric Quality of Life Questionnaire (PAQLQ).
RESULTS: The study included 43 children from 7 to 17 years old distributed in Control Group (CG, n = 27) and Intervention Group (IG, n = 16). The average adherence to the program was 82.8%. In VO2peak in ml · kg - 1 · min - 1 the IG had 3.31 ± 1.51 with respect to the CG that obtained 0.25 ± 0.71 in the interaction time per group was p(txg) = 0.064 with an increase in the IG of with respect to the CG, Statistically significant improvements were observed in all strength parameters evaluated, with more significance in High Row p(txg) = 0.006, Leg Press p(txg) = 0.002 and Hamstrings p(txg) = 0.003. We couldn't see improves in quality of life.
CONCLUSION: Similar studies in children with asthma observe improvements in VO2max in 1 METS approximately what, according to investigations is a considerable improvement for this population (4), also some investigation shows than the strength in the same population improves significantly and recent systematic review are demonstrating an adequate level of physical activity with a protective factor against asthma (5). In relation with PAQLQ the values weren't changed probably because the sample has high results in PRE-PAQLQ, 53,3% of them has controlled asthma with at least two drugs. In conclusion 12 weeks of exercise program improves both, cardiorespiratory level and specially strength level in children with mild-moderate asthma.
(1) Wanrooij VH, Willeboordse M, Dompeling E, van de Kant KD. (2014). Br J Sports Med. 48(13):1024-31.
(2) Silva RA, Vieira RP, Duarte AC, Lopes FD, Perini A, Mauad T, Martins MA et al. (2010). EurRespir J. 35(5):994-1002.
(3) Wärnberg J, Cunningham K, Romeo J, Marcos A.(2010). Proc NutrSoc. 69(3):400-6.
(4) Counil FP, Varray A, Matecki S, Beurey A, Marchal P, Voisin M et al. (2003). J Pediatr. 142(2):179-84.
(5) Eijkemans M, Mommers M, Draaisma JM, Thijs C, Prins MH. (2012). PLoSOne. 7(12): e50775.

ASSOCIATIONS OF LEISURE-TIME, COMMUTING AND OCCUPATIONAL PHYSICAL ACTIVITY WITH SELF-REPORTED MUSCULOSKELETAL PAIN IN YOUNG ADULT MEN

VAARA, J.P., PIHLAJAMÄKI, H., VÄSTILÄ, V., KYRÖLÄINEN, H.

NATIONAL DEFENCE UNIVERSITY

INTRODUCTION: There is limited research examining the association between different physical activity (PA) domains [leisure-time physical activity (LTPA), commuting physical activity (CPA) and occupational physical activity (OPA)] and musculoskeletal (MS) pain. The aim of the study was to assess the association of MS pain across several PA domains.

METHODS: 1613 adult (26±6 yrs.) men participated in the study. Participants were asked to how often they had had low back pain, knee pain and lumbago in the last month, by responding to: a) none, b) 1-7 days, c) 8-14 days, d) more than 14 days but less than daily. A visual analogue scale was utilized (100 mm) for back pain, neck pain, and pain in the upper and lower extremities during the last 7 days. Dichotomised variables were formed: no pain and pain reported. The low LTPA group included: none/some light PA/week, Moderate: vigorous PA 1-2 times/week and High: LTPA vigorous PA ≥3times/week. The Low, Moderate and High CPA groups included 0-15, 16-59 and ≥60 minutes/day walking or cycling to work or study, respectively. Low OPA included: sedentary work, Moderate: walking frequently, High: regularly walking and lifting at work. Regression models were adjusted for age, education, smoking, waist circumference and the other two PA domains.
RESULTS: Moderate and High LTPA groups had a lower likelihood for knee pain during the last month (OR:0.72, 95%CI 0.56-0.93; OR:0.64, 0.49-0.84), and High LTPA had a lower likelihood for pain in the upper (OR:0.70, 0.50-0.97) and lower extremities (OR:0.73, 0.54-0.99) during the last month compared to their respective Low LTPA groups. Moderate LTPA had a higher likelihood for back (OR:1.51, 1.18-1.95) and neck pain (OR: 1.29, 1.00-1.66), and Moderate as well as High LTPA for lumbago during the last 7 days compared to Low LTPA group (OR:1.31, 1.00-1.71), (OR:1.53, 1.15-2.02), respectively.
Moderate OPA had a lower likelihood for pain in the upper (OR:0.63, 0.46-0.86) and lower extremities (OR:0.70, 0.53-0.94) during the last 7 days compared to Low OPA. Moderate and High OPA had lower likelihood for low back pain during the last month (OR:0.67, 0.51-0.90), (OR:0.68, 0.48-0.95), respectively, while High OPA had lower likelihood for lumbago during the last month (OR:0.72, 0.52-0.99) compared to their Low OPA groups. There were no differences in the CPA subgroups.
CONCLUSION: In young adult men, CPA and OPA appear to not be harmfully associated with MS pain. LTPA showed more contentious findings indicating body-region and sport-specific interactions in LTPA behaviour in both negative and positive directions regarding MS pain. In conclusion, CPA is strongly recommended while LTPA requires more focus on its safety and correct performance technique to minimise the risk of MS pain.

Mini-Orals

MO-PM15 Physiology mixed

AN ENRICHED ENVIRONMENT INCREASES LOCOMOTOR ACTIVITY AND INDUSES SKELETAL MUSCLES HYPERTROPHY IN RATS

SUDO, M.

PHYSICAL FITNESS RESEARCH

INTRODUCTION: Enriched environment (EE) has been suggested to enhance exploration, social interaction and cognitive function, which leads to improvements in depression and anxiety-like behavior (Nithianantharajah and Hannan, 2006). However, in contrast to abundant evidence for beneficial effects of EE on brain function, it is less clear whether EE increases locomotor activity due to technical difficulties when rats were housed in groups. Furthermore, little is known about how EE affects skeletal muscle. Thus, the purpose of this study was to assess locomotor activity in EE using a small three-axis accelerometer. We also tested if EE induces skeletal muscle hypertrophy.
METHODS: Wistar rats were housed in the two different housing groups (standard environment (SE) group (N = 8); EE group (N = 8)). EE contained a slope, a small hut, three tunnels, and a running wheel. Locomotor activity was continuously recorded for 32 days using three-axis accelerometers. The accelerometers were subcutaneously embedded in the back. Data were automatically analyzed using a computerized system, and locomotor activity was evaluated during the dark and light periods, respectively. After exposure to each environment for 32 days, the tibialis anterior muscle (TA), extensor digitorum longus muscle (EDL), soleus muscle (Sol), gastrocnemius muscle (Gas), and adrenal gland and thymus were removed and immediately weighted. All experimental data were expressed as mean ± standard deviation. Comparisons were performed using a t-test. The level of significance was set at $P < 0.05$.
RESULTS: Locomotor activity was higher in the EE group compared with the SE group during the dark period (EE: 28194 ± 6087 a.u., SE: 19757 ± 6909 a.u., P=0.032). In contrast, locomotor activity during the light period was not different between the EE and the SE groups (EE: 6704 ± 2313 a.u., SE: 5132 ± 2381 a.u., P=0.234). All hindlimb muscle wet weights per body weight were greater in the EE group compared with the SE group. TA, Sol and Pla muscle wet weights were greater in the EE group compared with the SE group ($P<0.05$, respectively). Especially, the degree of increase in Sol muscle wet weight was greatest and reached up to 10.7% in the EE group. In contrast, EDL and Gas muscle wet weights were not different between the EE and the SE groups. Adrenal gland and thymus weights were not altered in both the EE and the SE groups. These results suggest that the EE increased locomotor activity and induced muscle hypertrophy without stress responses. As far as we know, this is the first study to assess locomotor activity in rats housed in the EE using embedded accelerometers.
CONCLUSION: We conclude that the EE substantially increase locomotor activity and induces muscle hypertrophy in rats.

ELECTROCARDIOGRAPHIC QRS- AND T-WAVE IN MACAU MALE HANDBALL ATHLETES AND NON-TRAINERS

SHI, Q.1, AO, W.1, LO, M.1, KONG, Z.2, ZHANG, H.3, TONG, T.4, NIE, J.1

MACAO POLYTECHNIC INSTITUTE

INTRODUCTION: Intensive sport training is associated with physiologic cardiac remodeling, which are reflected on the electrocardiogram most frequently as an increase of QRS voltages and corresponding changes in T-wave . Because of the partial overlap of ECG signs of cardiac hypertrophy, including changes in QRS- and T-wave, athletes heart is often in the differential diagnosis with hypertrophic cardiomyopathy, which is the leading cause of sports-related cardiac arrest in young athletes. However, this aspect has not obtained the full observation in the Macau athletes. Therefore, we examined the effect of handball training on the computerized ECG QRS- and T-wave obtained in amateur Macau athletes.
METHODS: Computerized 12-lead resting ECG was obtained in 37 handball male players and 59 matched sedentary male controls with a normal cardiovascular physical examination and without family and personal history of heart disease. Electrocardiogram measurements included voltages and durations in all 12 leads to calculate QRS- and T-wave.
RESULTS: For QRS-wave, the Macau handball athletes had significantly greater S duration in V6 and QRS duration in II, III, aVR, aVF, V4, V5 and V6 compared with controls . Further, Macau handball athletes also had significantly deeper in S amplitude V6 compared with controls . For T-wave, the Macau handball athletes had significantly lower T wave amplitude in III and V1 and greater T wave amplitude in V5

and V6. The athletes also had greater positive percentage of T wave area in I, V4-V6 and greater negative percentage of T Wave area in V1 compared with controls .
CONCLUSION: Though the criteria for abnormal QRS amplitude have been recommended for pre-participation exams of athletes, the criteria have not considered specificity on sport event and ethnic group. This descriptive study, which shows that QRS- and T-wave differences exist between Macau handball athletes and controls, is a pioneering step toward the development of sport- and ethnic-specific criteria for abnormal ECG findings. Although the significance of these changes in QRS- and T-wave is no clear, it is important to bear in mind the existence of these changes when testing athletes. In the future research, sport- and ethnic-specific ECG criteria for abnormal ECG findings should be developed to obtain a more useful approach to ECG screening in athletes.
*The study was supported by a research grant from Macau Polytechnic Institute

REGULAR MODERATE INTENSITY AEROBIC EXERCISE DOES NOT AFFECT VASCULAR OUTCOMES DURING PREGNANCY: A PILOT STUDY

BRISLANE, A., JONES, H., LOW, D.A., HOLDER, S., HOPKINS, N.D.

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Cardiovascular diseases (CVD) are the leading cause of morbidity and mortality during pregnancy, with vascular impairments potentially playing a key role in the pathology. Exercise training can improve vascular outcomes in healthy and clinical populations, however the effect of regular exercise on vascular function and structure in pregnant women is not known. The aim of this study pilot study was therefore, to determine the impact of a 6 month exercise intervention on vascular function and structure in previously inactive pregnant women. It is hypothesised that engaging in an exercise intervention during pregnancy will enhance vascular function and structure.
METHODS: Ten healthy pregnant women were recruited to a control (CONT; N=6 33•0.5 years, BMI 22.4kg/m2) or exercise group (EX; N=4 31.5• 0.6 years, BMI 23.8•2.1kg/m2) at 13-15 weeks gestation. Participants were assessed at the end of trimester 1(T1), 2(T2) and 3(T3). Vascular ultrasound was used to assess flow mediated dilation (FMD) of the brachial (BFMD) and femoral (FFMD) arteries. Pulse wave velocity (PWV) was calculated using applanation tonometry. Aerobic capacity was estimated using the Astrand submaximal cycling protocol. Physical activity (PA) was measured over 7 days using accelerometry. The exercise intervention consisted of 3x15 minute weekly exercise sessions in trimester 2 (T2), progressing to 4x30 minutes in trimester 3 (T3). Data were analyzed for main effects of group and time using repeated measures ANOVA.
RESULTS: There were no time, group or interaction effects for BFMD (T1: 9.2•2.1%, T2:6.7•0.9%, T3: 9•5%, P=0.76), FFMD (T1, 6.5•3.4%, T2, 6.2•2%, T3, 2.4•1.9%, P=0.18) or PWV (T1, 5.3•0.43m/s, T2, 4.3•0.7m/s, T3, 5.2•1.7m/s; p=0.59). No differences in aerobic capacity were evident (T1, 47.4±5ml/kg, T2, 43.4±3.3ml/kg, T3, 39.1±3.5ml/kg, p=0.22). No differences were observed for physical activity (T1, 330±87mins/d; T2, 296±52mins/d; T3, 271±16mins/d.
CONCLUSION: Our findings suggest that engaging in a moderate intensity aerobic exercise intervention during trimesters 2 and 3 of pregnancy does not affect vascular outcomes during pregnancy. It is plausible that the hormonally induced hemodynamic adaptations which occur during pregnancy cannot be overridden by moderate intensity exercise, however further research is needed to confirm this hypothesis.

EFFECTS OF 16-WEEK OF TRACK AND FIELD ACTIVITIES IN PHISICAL EDUCATION STUDENTS' PERFORMANCE.

RUSSOMANNO, T., BATISTA, A.L., SILVA, R.B.N.

UNB UNIVERSIDADE DE BRASILIA

INTRODUCTION: Physical education students have in their program practical and theoretical lectures, which load can variate depending on the semester changing their life style and performance. Based on this information, the aim of this work was to analyze the effect of track and field practical activities sessions in the students' performance for 16 weeks.
METHODS: The sample consisted of 44 students, 27 males (age=21.41 ±2.34 years, weight=75.14 kg ±11.70 kg, height=174.46 cm ±5.91cm) and 17 women (age=22.29 ±5.70 years, Weight= 58.18kg ±6.75kg, Height=162.10cm ±6.31cm). Twice a week for 16 weeks these students practiced 2 hours of track and field activities. Four tests were applied pre and post these16 weeks of activities to evaluate their effects over performance: 50 meters run, horizontal jump, vertical jump and medicine ball throwing. The session was divided in 4 parts, 10 minutes of warming up, 45 minutes of basic training (coordination, velocity, power, aerobic), 45 minutes of specific track and field events (running or jumping or throwing) and 20 minutes of leisure activities. The results were shown by mean values and standard deviation. ANOVA test for repeated measures ($p \leq 0.05$) were performed to assess the difference between the pre and post tests using the SPSS v.25 software. The study was conducted according to the ethics regulations.
RESULTS: For the 50 meters run test the results were (pre: 6.47m/s±0.89m/s, post: 6.98m/s±0.90m/s), for the vertical jump (pre: 41.44cm±10.45cm, post: 47.50cm±12.87cm), for the horizontal jump (pre: 1.90m±0.36m, post: 1.85m±0.42m) and medicine ball (pre: 4.49m±1.14m, post: 4.30m±1.06m). Significant difference was found in the 50 m, vertical jump and medicine ball test ($p \leq 0.05$). There was no significance difference in the horizontal jump.
CONCLUSION: The study showed that the intervention promoted performance maintenance in physical education students and also some significant improvements with an increase in speed in the 50m test and also in the vertical jump. One suggestion is that great part of the course content were activities related to running and jumping (80%), moreover 20% of the course content was related throwing events which may have led to a significant decrease in medicine ball throwing performance. The authors suggest that and increase in upper limbs stimulus can improve the performance of throwing test. The horizontal jump test didn't show significant difference, probably due to a lack of coordination that is required to improve in this test. On the other hand, the vertical jump test showed a significant performance improvement once coordination is not mandatory for improvement in this test.
The results showed that a 16 weeks course with 2 sessions of 2 hours per week can improve physical education students' performance. However future studies may be done to evaluate students from other faculties and also include aerobics tests.

EXERCISE BEHAVIOURS OF PREGNANT MOTHERS DO THEY FOLLOW ESTABLISHED GUIDELINE

BHATTACHARYYA, M.

UNIVERSITY HOSPITAL LEWISHAM

INTRODUCTION: Pregnant women are encouraged to be physically active throughout pregnancy, with recommendations to participate in at least 30 min of aerobic activity on most days of the week, in addition to perform strength training of the major muscle groups 2-3 days per week, and also pelvic floor muscle training. Obesity before and during pregnancy is associated with adverse effects for mother and child, but little is known about physical activity and consumption patterns, among reproductive-aged women in urban area of the English county. The assessment of physical activity during pregnancy is crucial in perinatal care. Unfortunately, there is a lack of study to identify patterns of physical activity of pregnant reproductive-aged women and patient's perception on physical activity during pregnancy.
The aim of the audit was to describe the mode, frequency, duration, and intensity of physical activity of pregnant women, to explore whether these women reached the recommended levels of activity as outlined by Chief medical officer in UK, and how these patterns have changed during pregnancy.
METHODS: During the consultation, as a part health promotion the patients were asked about physical activity. This study included a cross-sectional sample of at less than 13 weeks [n=134], mid trimester [n=29], advance trimester [n=27] pregnant women and postnatal mothers [n= 45], mean age 28.6 years .
RESULTS: 90% of pregnant mothers reported decreased physical activity level during pregnancy, particularly in care giving, outdoor household, and recreational activity with advancement of pregnancy. Women who were active during the second and third trimesters reported higher levels of activity in all modes of activity than those were inactive during pregnancy. 93% of patients did not reach the recommended level of physical activity as outlined in UK chief medical officer's guideline. These data suggested that self-reported physical activity decreased from the second to third trimester and only a small proportion reached the recommended level of activity during pregnancy. There was further decrease of physical activity/exercise during the postpartum period.
Women in the exercise group had significantly lower blood glucose and resting pulse compared to the non-exercise group.
Lack of Physical activity also associated with increased consumption behaviours among pregnant women and increased BMI. Among 18-45-year-old women, exercise and fruit/vegetable consumption were associated with healthy weight control.
CONCLUSION: The majority did not reach the recommended level of physical activity. Although most women reported some type of physical activity during pregnancy periods, the overall physical activity decreased during and after pregnancy. Child and adult care giving, indoor household, and recreational activities constituted the largest proportion of total reported activity and no dedicated routine for doing physical exercise. Women who were active during the second and third trimesters reporte

FITNESS LEVEL AND HEALTH STATUS OF A FITNESS CENTRE'S CUSTOMERS. A PILOT TEST

SANCHEZ-LORENTE, I.M.1,3, ITURRIAGA-RAMÍREZ, T.1,3, LÓPEZ-FERNÁNDEZ, J.2,3, DÍEZ, I.1, AYUSO, M.3, PÉREZ, M.1, FERNÁNDEZ-ELÍAS, V.E.1, JIMÉNEZ, A.2,3

1 UNIVERSIDAD EUROPEA DE MADRID, 2COVENTRY UNIVERSITY, CIRAL. 3 GO FIT LAB.

INTRODUCTION: Physical activity and its relationship with health is recognized throughout the world, as well as the need to increase levels of physical activity to improve health status. However, physical inactivity is a major public health problem that must be addressed. Therefore, international institutions have promulgated physical activity guidelines to address the potential risks of sedentary lifestyles and physical inactivity that exist in todays societies. However, it is necessary to evaluate if the population follows these guidelines and to what extent it affects their physical fitness and health levels. The main goal of this pilot study was to widely assess the physical fitness and health levels of population that is regularly enrolled in physical fitness centres.
METHODS: Fifty-six healthy participants voluntarily enrolled in this study (32 males age 34,03 ± 8,11 and 24 females age 36,13 ± 10,81). Cardiovascular risk was assessed by body composition, cholesterol and triglycerides blood levels. Physical activity levels in METS/w were estimated using the GPAQ questionnaire. Integral health status using the PSS-10 questionnaire and quality of life using the SF36 questionnaire. Also, the sleep quality was analysed through the PSQI questionnaire and the adherence of the Mediterranean Diet was evaluated using the PREDIMED questionnaire. Physical fitness was assessed by measuring VO2peak, bench press 1RM estimation test, leg press 1RM estimation test.
RESULTS: Body fat was 15,1 ± 5,7% in male and 26,1±7,6% in female. CHOL: 183,3±27,3 mmol/l and 93,87±30,9 mmol/l. TG: 113,41±53,7 mmol/l and 106,33±33,1 mmol/l. METS/w: 5092±2646,7 and 4207,5±2163,1. PSS-10: 15,94±8,19 and 18,04±8,34. SF-36: 87,43±6,83 and 83,13±12,97. PSSQI: 3,45±1,84 and 4,17±2,05. Predimed: 9,5±1,8 and 8,5±2,2. VO2peak: 52,9 ± 9,5 ml·kg-1·min-1 and 41,2 ± 8,5 ml·kg-1·min-1. Coef Bench Press: 0,902±0,25 and 0,451±0,1. Coef Leg Press: 2,411±0,51 and 1,888±0,49.
CONCLUSION: These outcomes provide relevant information about the characteristics of the fitness centres customers evidencing that those who regularly exercise in fitness centres meet the international guidelines for physical activity and have a suitable overall health and physical fitness levels. However, these findings cannot be widespread for all fitness centre costumers due to low participants sample assessed. Future studies regarding fitness centres participants health and fitness status need to be addressed.
References: Blair SN. et al. Am J Clin Nutr. 2004; 79:913S-20S.
Morris C. et al. Mol. Nutr. Food Res.2013; 57: 1246–1254
Ortega FB. et al. Int J Epidemiol. 2011; 40: 701-711.

ELECTROCARDIOGRAPHIC Q-WAVE, ST-SEGMENT AND J POINT IN MACAU MALE HANDBALL ATHLETES AND NON-TRAINERS

NIE, J.1, LIN, H.2, LAI, H.1, KONG, Z.3, TONG, T.4, ZHANG, H.5, SHI, Q.1

MACAO POLYTECHNIC INSTITUTE

INTRODUCTION: Regular, intense exercise causes structural, functional, and electrical cardiac adaptations, which are considered benign and comprise the clinical constellation of findings known as the athlete's heart. Thus electrocardiogram changes in athletes are common. The different type exercise training causes the change may have the distinctive . Different types of sports tend to give rise to distinct ECG forms of the athletes heart such as Q-wave, ST-segment and J point. However, this aspect has not obtained the full observation in the Macau athletes.

METHODS: Computerized 12-lead resting ECG was obtained in 37 handball male players and 59 matched sedentary male controls with a normal cardiovascular physical examination and without family and personal history of heart disease. Electrocardiogram measurements included voltages and/or durations in all 12 leads to calculate Q-wave, ST-segment and J point.
RESULTS: The results showed that Macau handball athletes had significantly higher J value in I, V4, V5 and V6 lead than control group . But there were not significant differences in other parameters measured between the two groups 0.05>.
CONCLUSION: The findings from the present study suggest that handball training in Macau may lead to higher J values in cardiac lateral wall leads of ECG. High J value is one of indicators for diagnosing acute myocardial infarction . Based on our current data, clinicians should be aware that high J value is not exclusive to acute myocardial infarction, but can be observed even in trained athletes. This could be a potential error source, which interferes with diagnosing acute myocardial infarction. Thus, the result of the study can facilitate ECG interpretation for screening young handball athletes.
*The study was supported by a research grant from Macau Polytechnic Institute

Mini-Orals

MO-PM07 Physical activity / Sedentary behaviour

THE INTERGENERATIONAL TRANSMISSION OF IMPLICIT AND EXPLICIT ATTITUDES TOWARD PHYSICAL ACTIVITY AND SEDENTARY BEHAVIORS

ESCRIVA-BOULLEY, G., BOICHÉ, J.

LABORATORY EPSYLON

Introduction: The lack of Physical Activity (PA) and Sedentary behaviors (SED) during childhood represent a major health concern. These behaviors seem to be affected by explicit and implicit attitudes. Research showed that children' behaviors and attitudes toward health-related behaviors are associated to those of their parents. Only two studies (Guidetti, et al., 2012 ; Sherman, et al., 2009) investigated this intergenerational transmission of attitudes toward health-related behaviors (food and smoking). These studies showed that children's attitudes were predicted by those of their parents. The purpose of this study was to explore associations between parents' PA and SED, as well as explicit and implicit attitudes toward these behaviors, and their children's behaviors and attitudes.

Methods: 96 parent (Mage=42.43, N♀=68)-child (Mage=11.46, N♀=41) dyads completed an implicit association test (IAT) to assess implicit attitudes. The IAT was presented on a computer in blocks. Blocks where PA were paired with positive adjectives (e.g., good, fun), and SED with the negative adjectives (e.g., bad, boring) were labeled "compatible", while when these pairings were reversed blocks were labeled "incompatible". The order of presentation of compatible and incompatible blocks was counterbalanced across participants. DW-Scores (reaction time and error) were calculated.

Dyads completed questionnaires assessing behaviors and explicit attitudes. Questions to assess behaviors were: "During the last 7 days, on how many times did you do physical activities/sedentary behaviors?". Explicit attitudes were assessed using the same adjectives than in the IAT. Items were rated on a 4-point Likert-scale following the stems: "Do you think that practicing PA/SED almost every day is…". The score of explicit attitudes were calculated by subtracting PA scores by SED scores.

Results: Parents' PA was positively correlated to their children's PA (r=.30; p=.01). There was no significant parent-child association, neither for SED nor explicit nor implicit attitudes (-.04.71). Parents' explicit attitudes were negatively associated to children' SED (r=-.22; p=.05).

Conclusion

This study aimed at investigating links between parents' and children's behaviors and attitudes toward PA and SED. Both parents PA and explicit attitudes seem associated with their childrens behaviors. Future studies need to promote healthy lifestyle to all family members.

References: Guidetti, M., Conner, M., Prestwich, A., & Cavazza, N. (2012). The transmission of attitudes towards food: twofold specificity of similarities with parents and friends. British journal of health psychology, 17, 346-361

Sherman, S., Chassin, L., Presson, C., Seo, D., & Macy, J. (2009). The intergenerational transmission of implicit and explicit attitudes toward smoking: Predicting adolescent smoking initiation. Journal of Experimental Social Psychology, 45, 313-319

RELATIONSHIP BETWEEN PHYSICAL ACTIVITY LEVELS AND DEPRESSION IN WOMEN BETWEEN THE AGES OF 35 AND 50

PEHLIVAN, A., KAZAN, N.

HALIC UNIVERSITY

The purpose of this study is women between the ages of 35-50, to determine whether there is a relationship between physical activity and depression. The sample of the study 2015–2016 Istanbul Metropolitan municipality art and vocational training courses (ismek), who are educated in the field of art and sports between the ages of 35 and 50 individuals was created from adult volunteers. Sample group simple coincidence sampling technique. Depression developed by Beck in 1961 to determine the level of the sample group of Turkish validity (r=74) and reliability(α=80) Beck depression scale has been used work made by Hisli(1989). Individuals to determine their level of physical activity a questionnaire was used to determine the level of physical activity developed by Pehlivan. In order to reveal the relationship between physical activity and depression levels of the group surveyed, the questionnaire was used SPSS for Windows statistical analysis of the data obtained from X version. The research statistical analysis t-test and ANOVA were evaluated. As a result of the study, depression scores of individuals who play sports do sports with individuals who dont it was found that there is a statistically significant relationship between the scores ($p<0.05$). To participate a physical activity of medium difficulty in in past three yerars at least is another factor that has a significiant relationship with depression ($p<0,05$). Additionally, there is no significant relationship between the degree of difficulty of the sport and depression ($p> 0,05$).

MANY OF OVERWEIGHT CHILDREN AT 12 YEARS OLD ARE STILL OVERWEIGHT WITH POOR PHYSICAL AT 18 YEARS OLD: A LONGITUDINAL STUDY IN TAIWAN

TSENG, W.C.1, NOSAKA, K.2, SHIANG, T.Y.3, TANG, J.C.3, TSENG, K.W.1, CHEN, T.C.3

1: UNIVERSITY OF TAIPEI, 2: EDITH COWAN UNIVERSITY , 2: NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: A cross-sectional study has shown that childhood overweight or obesity is carried into adulthood with increased risk of developing health problems (Dietz 1998 Pediatrics). A study reported that the level of physical fitness (PF) was negatively correlated with body mass index (BMI) in Taiwanese youth between 9-18 years old (Huang & Malina 2007 MSSE). It seems that child obesity is a cause of obesity in adulthood; however, no longitudinal study has investigated this in a large scale. The present study examined whether children categorised as overweight at 12 years old would be still in the same category when they were at 18 years old, and whether PF would be lower for overweight than normal weight students.
METHODS: Height, body mass and four PF tests [60-s sit-ups (SU), standing long jump (SLJ), sit-and-reach and 800-m or 1600-m run/walk (ENDUR)] data of 5985 Taiwanese students (3080 females, 2905 males) who took the measurements every year from 2007 to 2013 were extracted from the national data base. They were classified into three BMI categories based on the national percentiles; underweight: BMI < 5th percentile, normal: 5th < BMI < 85th percentiles, and overweight: BMI ≥ 85th percentiles. The same students were followed from 12 to 18 years old, and the number of students who had in the same or different categories for the 7 consecutive years were counted. Differences in PF among the three BMI categories were compared with a mixed-design two-way ANOVA.
RESULTS: Among 5985 individuals, 592 males (20%) and 395 females (13%) were classified as overweight, and 444 males (15%) and 596 females (19%) were classified as underweight at 12 years old. At 18 years old, 242 males and 242 females were still overweight, and 189 males and 175 females were still underweight in the each group at 12 years old. When compared overweight and normal weight groups, ENDUR (male: 531 ± 97 vs 494 ± 89 s, female: 305 ± 50 vs 280 ± 45 s), SLJ (male: 205 ± 26 vs 220 ± 27 cm, female: 145 ± 22 vs 156 ± 24cm) and SU (male: 42 ± 9 vs 44 ± 9 cm, female: 30 ± 9 vs 33 ± 9 cm) showed poorer fitness for the overweight ($P<0.05$) for all ages (the data above are for 18 years old).
CONCLUSION: It should be noted that 41% of males and 61% of females who were categorised as overweight at 12 years old were still in the same category when they became 18 years old. This suggests that approximately 50% of children continued to be overweight for 7 years. Overweight children had lower PF, and this was consistent between 12 and 18 years old. It has been reported that overweight children have less exercise time and greater sedentary time than normal weight cohort (Herman et al. 2014 Pre Med). Thus, it is necessary to make overweight children more active, and help them to reduce their weight at early age.

PHYSICAL ACTIVITY AS A MEDIATOR OF THE ASSOCIATIONS BETWEEN PERCEIVED PHYSICAL ENVIRONMENTS AND ADIPOSITY IN CHINESE YOUTH

WANG, J., LAU, W.C.P.

CHINA INSTITUTE OF SPORT SCIENCE

Objective: Chinese youth have showed the alarmingly high rate of obesity and low rate of engagement in sufficient physical activity . Environmental supports are important for creating changes in PA and obesity. This study examined whether PA mediated the relationship of physical environments related to PA with adiposity >.
Methods: A cross-sectional study was conducted in 661 Chinese youth <41.3% males> aged 13-18 years. Four environmental settings related to PA were measured with the questionnaire, including the home, neighborhood, school, and convenient facilities or within a 5-minute walk/drive from your school of home>. Perceived physical environments related to PA were assessed two indicators for each setting: perceived availability of environmental resources and perceived importance of environmental resources <5-Likert scale from not at all important <1> to very important <5>>. The validated Chinese version of Physical Activity Questionnaire for Older Children was used to access students' PA. Mediation analysis was completed using bootstrap methods.
Results: The prevalence of overweight was 11.8% including 1.5% obese respondents. Four environments related to PA did not show the significant associations with neither PAQ-C nor BMI, thus, they were excluded from the final models. Home environment <$\beta = 0.16$>, convenient facilities <$\beta = 0.10$>, and perceived importance of the school environment <$\beta = 0.16$> significantly predicted the PAQ-C score which indicated the higher engagement in PA. Perceived importance of the neighborhood environment predicted the PAQ-C with marginal significance. PAQ-C negatively predicted BMI <$\beta = -0.13$>. The percentage of the total effect of three physical environments related to PA on BMI mediated by PAQ-C was 37.5%, 72.2%, and 45.7%, respectively.
Conclusion: Findings suggest that PA is a mechanism by which several environmental correlates may affect youth's adiposity. Planning for improvement in environments is a health strategy to achieve favorable effects on PA and weight status.

LEISURE TIME ACTIVITIES AND THE LIFE OF CHINESE PEOPLE

SHI, J.

GUANGZHOU SPORT UNIVERSITY

Leisure Time Activities and the Life of Chinese People
SHI Jie-qi, Guangzhou Sport University

石洁琦（Diane Shi）

Objective: To show the effects of the sedentary behaviors of the leisure time activities on people's health and provided a recommendation on the types and amounts of physical activity needed to improve and maintain health according to the current situation in China.
Evidence: The author used the data from Chinese General Social Survey of 2015, and the methods of factor analysis and regression analysis to show the different healthy stage of Chinese people with different leisure time activities favor. The author also reviewed existing consensus statements and relevant evidence from primary research articles and reviews of the literature.
Process: After analyzing the relationship between the health and different kinds of leisure time activities based on the data from CGSS, the author points out the health problems of Chinese people and provides the suggestions by reviewing all the existing relevant studies.
Summary: Sedentary behaviors have been proved harmful for one's physical health. Some kinds of leisure time activities aren't physical activities. Chinese people spend their leisure time like watching TV, going out for movie, shopping, reading, going to concert, visiting relatives, visiting friends, listening music at home, physical exercise, watching sport games, doing handwork and surfing the Internet. The effects of the sedentary behaviors of the leisure time activities on people's health are showed in this study. Different kinds of leisure time activities have different relationship with social attitude, status identification, social insurance, household income of a person. The author

used the data from Chinese General Social Survey of 2015, and the methods of factor analysis and regression analysis to show the different healthy stage of Chinese people with different leisure time activities favor. The author also provides a recommendation on the types and amounts of leisure time activity needed to improve and maintain health for Chinese people after reviewing the world research trend of sport and health.
Key words: leisure time activities, living quality, subjective well-being, Chinese
Email: 632294160@qq.com
shijieqiwen@163.com

SEDENTARY BEHAVIOUR AND QUALITY OF LIFE IN PORTUGUESE ADULTS

VIEIRA, P.N.1, COUTINHO, S.R.2, SANTOS, T.3,4, RAPOSO, F.1, MARTINS, S.S.1

1-UNIVERSIDADE EUROPEIA, LAUREATE INTERNATIONAL UNIVERSITIES, LISBON-PORTUGAL; 2-NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY; 3-WILLIAM JAMES RESEARCH CENTER - WJRC, ISPA; 4-AVENTURA SOCIAL FMH/UL

INTRODUCTION: Sedentary behaviour is associated with risk for disease incidence and mortality in adults (Biswas, 2015), however international public health guidelines offer no recommendations regarding sedentary time. Research is needed to analyse this dose-response association between sedentary behaviour and health outcomes (Bouchard, 2015), especially the link with mental health and quality of life (Gibson, 2017). The aim of this study was to examine associations between sedentary behaviour and health related quality of life across week days and weekend days.
METHODS: 390 adults (49.5% women), mean age 36.2yrs (range 18-66) and BMI 24.4kg/m2 (range 18.8-34.3) fill out subjective measures of sedentary behavior (sitting minutes per day), quality of life (SF12 Health Survey), and physical activity (7-day recall). Average weekday and weekend day sitting time, quality of life physical and mental health, and minutes of moderate or vigorous physical activity per week were computed. Three groups of sedentary behavior (Group 1 = <3hrs/day; Group 2 = 3-7hrs/day; Group 3 = >7hrs/day) were compared using ANCOVA with physical activity included as a covariate.
RESULTS: Average sitting time on a weekday was 4hrs 11mins (SD=3hrs 7mins) and on a weekend day was 3hrs 54mins (SD=2hrs 29mins). Results showed a negative main effect ($F(2,383)=5.48$, $p=.005$) for weekend day sitting time on quality of life physical health. Planned contrasts identified individuals in group 1 had higher physical health than individuals in groups 2 and 3 ($p<.05$). Perceived mental health quality of life showed no differences between planned contrasts. No main effects were found for weekdays sitting time ($p>.05$).
Conclusions:
Weekend days sitting time below 3 hours per day is negatively associated with better perceived physical health, but not on weekday. This is a preliminary version of an ongoing larger study, which will include a complementary analysis, comparing individuals meeting and not meeting physical activity recommendations, within sedentary behaviour groups. This will give further insight on the association between sedentary behaviour and health related quality of life.
References:
Biswas A, Oh PI, Faulkner GE, et al (2015). Sedentary time and its association with risk for disease incidence, mortality, and hospitalization in adults: a systematic review and meta-analysis. Ann Intern Med; 162(2):123-132.
Bouchard, C; Blair, SN; and Katzmarzyk, PT (2015). Less Sitting, More Physical Activity, or Higher Fitness? Mayo Clin Proc; 90(11):1533-1540.
Gibson A-M, Muggeridge DJ, Hughes AR, Kelly L, Kirk A (2017). An examination of objectively-measured sedentary behaviour and mental well-being in adults across week days and weekends. PLoS ONE 12(9).

RELATIONSHIP BETWEEN SITTING TIME, PHYSICAL ACTIVITY AND MUSCLE STRENGTH OF OFFICE WORKERS IN TOKYO

SATO, K.

TOHOKU UNIVERSITY

Introduction: Sitting time has been considered as an independent risk factor for cardiovascular diseases, as well as mental disorders such as depression. Increase in sitting time also affects physical functions such as a decreased cardiovascular fitness and muscular strength. Office workers, who spend their work time at offices, may be at a higher risk of lower muscle strength or decreased physical activity.
To examine if physical activity and muscle strength of office workers are associated with sitting time at workdays, we examined sitting time and daily step counts of office workers for more than 20 workdays and measured knee extension strength at the baseline.
Method
The study participants were 30 office workers working at an office located in the center of Tokyo who gave full informed consent to the study (18 males, 12 females, average age 42.96 years ± 8.89, average height 168.67 cm ± 7.39, average body weight 65.17 kg ± 10.75). The study protocol was approved by the institutional review board of Tohoku University Graduate School of Medicine (2017-1-578). At baseline, body height, body weight, maximal isometric knee extension strength were measured. For physical activity measurement, the participants were asked to wear Fitbit Charge 2 TM armband (Fitbit. Inc. San Francisco, CA) continuously during the study period. Step count was used as a measure of physical activity. Sitting time was calculated from the data acquired from the armband subtracting bed time from total sedentary time. Steps counts, number of floors ascended, were also used in the analyses. Isometric knee extension strength was standardized as weight bearing index (% BW). The study period was 46 days from October 26, 2017 to December 11, 2017, and participants who have records for more than 20 workdays.
Based on the obtained median value, the subjects were divided into long sitting group (Group L) and short sitting group (Group S) for comparison.
Result
The average isometric maximum knee extension muscular strength (%BW) was 75.93 ±20.04.
The average number of total steps per day was 7661 steps ± 2090 steps. (ranging from 3745 steps up to 11797 steps). The average number of daily step counts was 8202 steps and 7254 steps for Group L and S, respectively, and hence, no significant difference was observed ($p=0.24$).
No significant difference was observed in the average muscle strength between Group L (72.80 %BW) and Group S (80.41 %BW) ($p=0.29$).
Conclusion
Longer sitting time was not associated with lower step counts nor decreased muscle strength for office workers working in Tokyo.

Mini-Orals

MO-SH01 Physical education

THE EFFECTS OF WEB-BASED INTERVENTION PROGRAM ON PHYSICAL EDUCATION TEACHERS' AUTONOMY-SUPPORTIVE AND CONTROLLING BEHAVIOUR

TILGA, H., HEIN, V., KOKA, A.

UNIVERSITY OF TARTU

THE EFFECTS OF WEB-BASED INTERVENTION PROGRAM ON PHYSICAL EDUCATION TEACHERS' AUTONOMY-SUPPORTIVE AND CONTROLLING BEHAVIOUR

Tilga, H.1, Hein, V.1, Koka, A.1

1: UT (Tartu, Estonia)

Introduction: Self-determination theory-based interventions have, overall, shown to be effective in helping socialising agents such as teachers to learn how to support their students' autonomy (Su & Reeve, 2011). In most of the previous interventions autonomy-supportive and controlling behaviours have considered as unidimensional constructs. Therefore, in line with studies dealing the autonomy-supportive and controlling behaviour from physical education teachers as multidimensional, the purpose of the present study was to investigate whether a web-based intervention program led to changes in (a) teachers' self-reported multidimensional autonomy-supportive and controlling behaviour and (b) students' perceptions of their teachers' respective behaviours.

Methods: A total of 28 teachers aged 28-66 and their 321 students aged 11-15 were randomised into either an experimental group, in which teachers were trained via four-weeks web-based programme to be more autonomy-supportive and less controlling, or a control group. The teachers' self-reported behaviour as well as students' perceptions of autonomy supportive behaviour from their teachers with dimensions of organisational, procedural, and cognitive autonomy support (Tilga et al., 2017) and controlling behaviour with dimensions of negative conditional regard, intimidation, and controlling with grades (Hein et al., 2015) were measured at baseline and again nine weeks later.

Results: The intervention led to positive changes in teachers' self-reported organisational ($F<1, 12) = 14.48$, $p < .00$), procedural ($F<1, 12) = 6.88$, $p = .02$), and cognitive autonomy-supportive behaviour ($F<1, 12) = 10.64$, $p < .00$), but not in teachers' self-reported controlling behaviour. The students in the experimental group reported their teachers to be more autonomy supportive in all dimensions ($Fs<1, 185) = 8.92$ to 14.89, $ps < .02$), but less in intimidating ($F<1, 185) = 4.25$, $p = .04$) and controlling with grades behaviours ($F<1, 185) = 10.41$, $p < .00$) at follow-up compared with students in control group.

Discussion: The results of this study suggest that a designed web-based intervention program for physical education teachers to enhance their autonomy-supportive and minimise controlling behaviour was effective. Our multidimensional and detailed approach in promoting teachers' autonomy-supportive and minimising controlling behaviours might increase the likelihood that teachers change their behaviour, which, in turn, may facilitate students' psychological needs satisfaction and motivation towards physical education.

References: Hein V, Koka A, Hagger SM. (2015). J Adolescence, 42, 103–114.

Tilga H, Hein V, Koka A. (2017). Meas Phys Educ Exerc Sci, 21(4), 244–255.

Su YL, Reeve J. (2011). Educ Psychol Rev, 23(1), 159–188.

Contact: E-mail: henri.tilga@ut.ee

HOW PHYSICAL EDUCATION TEACHERS` AUTONOMY SUPPORTIVE BEHAVIOUR IS RELATED TO OBJECTIVELY MEASURED PHYSICAL ACTIVITY AMONG ADOLESCENTS

KALAJAS, H.

UNIVERSITY OF TARTU

ABSTRACT

HOW PHYSICAL EDUCATION TEACHERS` AUTONOMY SUPPORTIVE BEHAVIOUR IS RELATED TO OBJECTIVELY MEASURED PHYSICAL ACTIVITY AMONG ADOLESCENTS

Kalajas, H. 1, Koka, A.1, Hein, V. 1, Tilga, H.1, Raudsepp, L. 1.

1: UT (Tartu, Estonia)

Introduction: The physical activity (PA) level of children among Estonian and other European countries is insufficient for good health (Konstabel et al., 2014). According to self-determination theory (SDT; Deci & Ryan, 2000), an autonomy-supportive environment is assumed to satisfy needs for autonomy, competence, and relatedness, which in turn fosters autonomous motivation and thus influences engagement in PA. The purpose of the current study was to apply SDT to test the relationships between perceived autonomy support from physical education teachers (PE), the satisfaction of psychological needs (i.e. competence, autonomy, relatedness and novelty), autonomous forms of motivation, and leisure-time moderate-to-vigorous physical activity (LT MVPA) of Estonian adolescents.

Methods: Students (n=254) aged 12-15 participated in the study. An accelerometer (ActiGraph GT3X) was used to monitor LT MVPA. The participants filled questionnaires regarding SDT variables. The structural equation modelling was used to examine the hypothesized relationships among the study variables.

Results: The hypothesized model showed a good fit with the data: $\chi2 = 143.83$, $df = 86$; $CFI = 0.98$; $RMSEA = 0.052$. Students' perceived autonomy support from teachers was related to their need satisfaction for autonomy, competence, relatedness and novelty in PE. Students` autonomy and competence need satisfaction were positively associated with students' intrinsic motivation in PE. Students' intrinsic motivation in PE was positively related to students' LT MVPA. PE teachers` autonomy supportive behaviour was indirectly related to LT MVPA through competence need satisfaction and students' intrinsic motivation ($\beta = 0.20$, $p = .03$; $CI95 = 0.02$-0.59).

Discussion: Present findings partially support the applicability of SDT among Estonian adolescents. Students who reported higher PE teachers` autonomy supportive behaviour felt more that their basic psychological needs and novelty satisfaction were met. Students who were intrinsically motivated through competence need satisfaction were more engaged in LT MVPA. Our findings are in line with results of the study by Wang (2017) which show similar relations between autonomy support from PE teachers, the three basic psychological needs and autonomous motivation for LT MVPA. Findings of this study provide a valuable insight into the feasibility of SDT to understand Estonian adolescents` behaviour towards physical activity.

References: Konstabel K, et al. (2014). Int J of Obesity, 38, S135-S143.

Deci EL & Ryan RM (2000). Psychol Inq, 11(4), 227-268.

Wang L (2017). Eur J of Sport Sci, 17:4, 453-461.
Contact: E-mail address: Hanna.Kalajas@ut.ee

DISTRACTION VERSUS INTENSITY - THE IMPORTANCE OF NON-MAJOR SUBJECTS ON ACADEMIC PERFORMANCE IN SCHOOL

WOLLSEIFFEN, P.1, VOGT, T.3, STRÜDER, H.K.1, SCHNEIDER, S.1,2

1 GERMAN SPORT UNIVERSITY COLOGNE, 2 UNIVERSITY OF SUNSHINE COAST MAROOCHYDORE, QUEENSLAND, AUSTRALIA

INTRODUCTION: Non-major subjects in primary schools, such as arts, music and/or sport are regarded to be important not only for a wider general education but also to support concentrativeness and receptivity. The aim of this study was to compare the influence of a class of aerobic exercise and an arts class on brain cortical activity and possible effects on cognitive performance (Booth et al., 2014).
METHODS: Electro cortical activity using electroencephalography of sixteen school children (8-10 years) was recorded before and after (1) an aerobic exercise class and (2) an arts class. Performance in a standardized assessment of educational attainment (VERA-3) was assessed following both classes.
RESULTS: A significant decrease of cortical activity was measurable in all four lobes after exercise but not art classes. No changes in cognitive performance were obtained.
CONCLUSION: We propose that non-major subjects play a major role in school education and are of major relevance to increase pupils concentrativeness and receptivity. Although a straightforward effect on cognitive performance (Hillman et al., 2009) could not be shown in this study, the neurophysiological effect of exercise (Schneider et al., 2009) should be further evaluated with respect to different kinds of cognitive performance (e.g. creativity, knowledge acquisition) as well as its outlasting effects.
References:
Booth JN, SD Leary, C Joinson, AR Ness, PD Tomporowski, JM Boyle, et al. Associations between objectively measured physical activity and academic attainment in adolescents from a UK cohort. Br J Sports Med 2014;48(3):265-70.
Hillman CH, MB Pontifex, LB Raine, DM Castelli, EE Hall, AF Kramer. The effect of acute treadmill walking on cognitive control and academic achievement in preadolescent children. Neuroscience 2009;159(3):1044-54.
Schneider S, V Brummer, T Abel, CD Askew, HK Struder. Changes in brain cortical activity measured by EEG are related to individual exercise preferences. Physiol Behav 2009;98(4):447-52.
Contact:
p.wollseiffen@dshs-koeln.de

THE IMPACT OF CLASSROOM-BASED PHYSICAL ACTIVITY ON STUDENT'S MOTIVATION AND WELL-BEING.

BJØRKELUND, O.A., JAKOBSEN, L., CHRISTIANSEN, K.D.

AALBORG UNIVERSITET

Objective: Classroom-based physical activty has been recommended as a promising strategy for increasing physical activity levels and academic achievement. However, little is known about how classroom based physical activity breaks affect student motivation and well-being behaviour.
Design: A classroom based intervention study applying mixed method.
Setting: Classroom based physical activity was implemented in four public high school classes in one public school in Jylland area, Denmark, during winter and spring 2016. In total, 167 students were included in an eight-week intervention period.
Method:
The students were divided into either a classroom physical activity intervention group or a control group , depending on their teacher's ability and willingness to implement physical activity into the classroom. A questionnaire was distributed to all students at the end of the eight-week intervention period. Additionally, students in the intervention group completed a questionnaire during the intervention, and eight students participated in a semi-structured interview after the trial period.
Results: Overall, the data analyses support the link between physical activity breaks, motivation and well-being among the students in the intervention group. The students reported to enjoy the physically active breaks in the academic lessons, which can contribute to provide better conditions for academic learning.
Conclusion: The present study offers unique indication that the effect of integrated physical activity in academic lessons seems to be beneficial for students learning.
Keywords
Physical activity intervention, high school students, motivation, well-being, mixed-methods.

APPLYING TREATMENT EFFECTS MODEL TO INVESTIGATE PUBLIC AMENITY EFFECT ON PHYSICAL ACTIVITY OF THE ADOLESCENTS

YEH, C.

NATIONAL CHI NAN UNIVERSITY

Prevalence of childhood obesity has been increasing worldwide, especially in developing countries. For most of the Asian countries, the education system highly emphasizes on knowledge education which requires long sedentary time in the classrooms. On the other hand, physical education is seriously neglected. Physical activity is one of the most cost-effective ways to maintain healthy bodyweights. More importantly, regular physical activities help adolescents develop healthy adulthood. Therefore, the purpose of this study is to investigate the causal relationships between PA levels and PA environment. The data were collected from 1,165 junior high school students <597 males and 567 females> by face-to-face interview in the metropolitan area of Taichung, Taiwan. This data include locations in which PA were conducted, purposes of PA, and socioeconomic characteristics. The data of residential PA environment is objective and estimated by Geographic Information System . The level of physical activity in the past 7 days was estimated by the short version of International Physical Activity Questionnaire . The statistical examination of Hausman test indicates that there is an exsiting endogeneity between the location and the level of PA. Accordingly, we use the objective PA environment as the instrumental variable to adjust for the endogeneity problem. The Treatment Effect Model and Bivariate Probit Model are applied for the regression analysis in this study.
The results show that the more schools adjacent to the residential neighborhood of the adolescents, the more likely the adolescents choose schools as their PA amenity. Compared to adolescents who do not use schools as the PA amenities, the adolescents performing

PA at schools have higher amounts of PA. Additionally, using schools for PA amenity is also one of the important factors to achieve the PA level recommended by the Ministry of Health and Welfare. As can be seen, schools are very important PA amenities to the adolescents. One possible reason can be that schools are relatively more secured and familiar environment for their usage. Conclusively, this study suggests that the most effective approach to promote PA in adolescents is to provide the facilities for their PA needs and the accessibility to these facilities in schools. This would help to develop regular PA and achieve sufficient amount of physical activity for long-term health.

PROPOSED MEASUREMENT OF SPORT EDUCATION (SE) INTERVENTION ON STUDENTS' PERCEIVED PHYSICAL LITERACY (PL) AND PHYSICAL ACTIVITY (PA) LEVELS IN UNIVERSITY REQUIRED PHYSICAL EDUCATION (PE)

CHOI, S.M., LEUNG, F.L.E., SUM, K.W.R., YUEN, P.Y., NG, S.K.R., TANG, T.M., HO, W.K.R.

THE CHINESE UNIVERSITY OF HONG KONG

INTRODUCTION: The concept of PL has been discussed after Whitehead (2001) inspiring scholars to investigate on how it impacts on every individual. The QPE Guidelines reinforced its importance on the education of students and the outcome of structured PE curriculum. However, there is no further supplement on the pedagogical model for PE teachers to develop students as physically literate individuals. In response to this situation, a teacher education institute organized workshops focusing on operationalize PL through SE in Hong Kong (Sum et al., 2016). University students are at the stage of early adulthood in the PL journey, required PE courses can provide the last structured PA for them to develop and establish their positive attitude towards PA. After that, future active lifestyle will be planned by their own. Therefore, this proposed presentation will suggest how to measure the effect of SE to their perceived PL and PA levels. The goals of SE have been suggested to contribute to the attributes of PL. By dividing teams and assigning roles, it could motivate students from team success (Wallhead et al., 2013). By amending rules, students are easier to develop movement competence and confidence. The quality of leadership can enhance the PL attribute of self-expression and communication with others through SE.
METHODS: The effect of perceived PL will be investigated by using randomized controlled trial from one of the university in HK which provides required PE lessons to their students. PE teachers will participate in a one-day continuing professional development workshop focusing on how to plan and teach SE curriculum. Scores from perceived PL will be recorded by a questionnaire by using Perceived Physical Literacy Instrument (PPLI) in baseline measurement (Sum et al., 2016). Estimated sample size of 400 participants will be recruited in the SE program and control group respectively. A random sub-sample of 100 participants will wear accelerometers (Actigraph GT3X+) to measure PA levels for at least 8 hours per day, in 7 consecutive days. Lesson will be videotaped and coded with System for Observing Fitness Instruction Time (SOFIT). Demographic information of participants such as age, gender, studying major and sports participating level and SES will also be investigated.
RESULTS: To compare with control group, the perceived PL and PA levels of intervention group is expected to increase more significantly.
CONCLUSION: With the SE curriculum to develop students as physically literate individuals, they will be expected to participate in lifelong PA which is contributed to their long-term health. The intervention will explore the effect on perceived PL and PA levels which will establish the importance on PL development through SE curriculum in HK at tertiary level and extend to primary and secondary schools. This study will also help PE teachers to assess students' self-perception on PL and PA levels which enhance student learning and teaching effectiveness by re-designing the PE curriculum.

CURRICULAR WORKLOAD OF SINGAPORE'S PHYSICAL EDUCATION TEACHERS – A STUDY OF PHYSICAL AND PHYSIOLOGICAL INDICATORS

JOHARI, M.R., MUKHERJEE, S., KEE, Y.H., VAN MECHELEN, W.

NATIONAL INSTITUTE OF EDUCATION, NANYANG TECHNOLOGICAL UNIVERSITY

INTRODUCTION: Physical education teachers (PETs) spend high energy levels due to the their unique occupational demands involving physical activity and sport participation, dynamic lesson supervision, coaching and refereeing, travel between locations, equipment setup and dismantling, demonstrating skills and techniques and play and practice with students. This study determined the curricular workload of Singapore's PETs.
METHODS: 152 PETs (male 116, female 36) across 21 primary (Pri) and secondary (Sec) schools in Singapore volunteered to participate. Physical activity-based measures of workload like activity intensity and step count during curriculum time were assessed using triaxial accelerometry over one working week (5 days) each during either half of the school year. The Freedsons adult VM3 classification cutoffs were used to categorise the activity intensity. Heart rate (HR) monitoring was also done simultaneously to determine the physiological strain.
RESULTS: The mean daily PE teaching time was 3.59 hours for Pri (range 120-360 min) and 3.08 hours for Sec (range 120-360 min) school PETs. The time spent at moderate-to-vigorous intensity activity (MVPA) during the school hours was 55.74 min amongst Pri and 61.74 min amongst Sec PETs. This amounted to 71% and 81.5% of their total daily MVPA time respectively. Time spent at low-intensity activity during school hours was 380.4 mins for Pri and 418.7 min for Sec PETs. The daily mean sedentary time during school hours was 55.74 min for Pri and 109.42 min for Sec PETs. Step count accumulated during curriculum time accounted for 70.6% and 82.5% of total daily step counts for Pri and Sec PETs respectively. The mean HR during non-sedentary times was 102.4 and 101.78 beats per minute (BPM) for Pri and Sec PETs respectively. Majority of both Pri (64.5%) and Sec PETs (80%) achieved HR above 120 BPM during the curriculum time with 17.5% and 6.5% of Pri PETs achieving HR above 140 and 150 BPM respectively and 35.5% and 18% of Sec PETs achieving HR above 140 and 150 BPM respectively.
CONCLUSION: Physical demands and physiological strain of curricular workload in Singapore PETs is substantial and was found to be similar to that reported in other physically demanding occupations like construction, forestry and farming. Prolonged exposure to heavy workload with high energy expenditure can enhance the risk of musculoskeletal (MSK) injuries and dysfunction, degenerative conditions like knee osteoarthritis, lower back problems and greater work absenteeism. These potential outcomes can adversely affect the quality of content delivery in PE, quality of life and continuity of PETs' professional career. Our findings emphasise the need for longer-term studies in this area and for the policymakers to deliberate on the measures to further optimise the curricular workload demands imposed on PETs with the aim to preserve their MSK health and wellness and consequently the quality of PE delivery in schools.

PHYSICAL ACTIVITY IN ALL-DAY ELEMENTARY SCHOOLS

KURITZ, A., MESS, F.

UNIVERSITY OF KONSTANZ

Physical activity in all-day elementary schools
Kuritz, A.1, Mess, F.2 1: University Konstanz (Konstanz, Germany), 2: TUM (München, Germany)
Introduction: German government forces the development of all-day schools, especially in elementary schools, with the objective of better education, compatibility of family and career, and social equivalent opportunities. This change implicates a massive impact on children´s environment and behavior. Regarding Public Health the question arises if a higher amount of time spent in school has any influence on physical activity (PA) and therefore an altered possibility of reaching the WHO activity guideline of 60 minutes MVPA per day. Especially extracurricular activities with active content may help to increase children´s PA in comparison to leisure time spent not in school (Kuritz et al., 2016).
Methods: PA of 512 children from 11 German elementary schools with half-day and all-day programs was measured from June to August 2017 via accelerometry. Children carried activity monitors (GT3X, GT3X+) from ActiGraph® for one week during waking time. In addition, we used a paper-pencil survey for further information about anthropometry, school issues, and activity patterns. Data which met the necessary wear time (Rich et al., 2013), including 5 days of school, was analyzed on persons´ level (n=453). For analyses PA variables MET, sedentary time and MVPA time per day were checked for after-school program attendance (number of days, amount of minutes per week) and compared with children attending half-day schools.
Results: In this sample 307 children attend an after-school program on at least one day during the week, 146 are in half-day school. On average children are in after-school program on 3.15 days a week for 519.3 min/week or 157.49 min/d, respectively. There is no difference in overall MET between children attending half-day school and those who spend at least one day in an after-school program ($F(1,425)=.05$, $p=.82$). Regarding overall PA variables there cannot be found any significant effects in correlation with number of days and amount of minutes attending all-day school. Number of days and length of attendance in after-school program is (highly) positive correlated with MVPA per day (relative value) measured in these program (up to $r=.44$), but negatively correlated with MVPA per day (relative value) measured in leisure time (up to $r=.67$)
Discussion: It seems that type of school – half-day or all-day – has no effect on overall PA. It can be supposed that there might be a transition of high level PA (MVPA) from leisure time to after-school program. This transition might help to increase health related PA for all children, independent of familiar background or social status (Schuna et al., 2013).
References: Kuritz A, Dinkelacker M, Mess F. (2016). Ger J Sports Sci 46(3), 162-178.
Rich, C, et al. (2013). PLoS One 8(6): e67206.
Schuna, JM Jr, et al. (2013). J Sch Health 83(2). 105-111.
Contact: arvid.kuritz@uni.kn

Mini-Orals

MO-PM08 Training and testing

RELATIONSHIP BETWEEN QUADRICEPS AND GASTROCNEMII MUSCLE ARCHITECTURE AND PEAK POWER EXERTED DURING ALL-OUT WINGATE TEST.

CORATELLA, G., LONGO, S., RAMPICHINI, S., LIMONTA, E., BISCONTI, A.V., CÈ, E., ESPOSITO, F.

UNIVERSITY OF MILANO

INTRODUCTION: : Muscle architecture enhances muscle function. Particularly, longer fascicle can exert high-speed contractions while wider pennation angle (PA) and muscle thickness (MT) are correlated to greater force. Since it was shown that sprint performance in running (Kumagai et al., 2000) and in swimming (Nasirzade et al., 2014) was influenced by muscle architecture, the current investigation aimed to evaluate the relationship between MT, PA and fascicle length (FL) in quadriceps and gastrocnemii and sprint performance in cycling.
METHODS: Fifteen recreational cyclists volunteered for this study. Sprint performance in cycling was identified as an all-out Wingate (45s) test and peak power (W/kg) was calculated. Ultrasound was used to measure FL, MT and PA in rectus femoris, vastus lateralis, vastus medialis, vastus intermedius, gastrocnemius lateralis and gastrocnemius medialis. Pearson's coefficient was used to calculate correlations.
RESULTS: MT and PA were correlated ($p<0.05$) with peak power in rectus femoris ($r=0.762$ and $r=0.691$, respectively), vastus lateralis ($r=0.642$ and $r=0.627$), vastus medialis ($r=0.786$ and $r=0.590$), vastus intermedius ($r=0.602$ and $r=0.621$), gastrocnemius lateralis ($r=0.705$ and $r=0.589$) and gastrocnemius medialis ($r=0.520$ and $r=0.658$). No significant correlation was reported in FL.
CONCLUSION: CONCLUSIONS: The capacity to increase the force production enhancing both MT and PA seems to be predominant in a power all-out cycling task.
REFERENCES:
Kumagai, K., Abe, T., Brechue, W. F., Ryushi, T., Takano, S., & Mizuno, M. (2000). Sprint performance is related to muscle fascicle length in male 100-m sprinters. Journal of Applied Physiology (Bethesda, Md. : 1985), 88(3), 811–6.
Nasirzade, A., Ehsanbakhsh, A., Ilbeygi, S., Sobhkhiz, A., Argavani, H., & Aliakbari, M. (2014). Relationship between sprint performance of front crawl swimming and muscle fascicle length in young swimmers. Journal of Sports Science and Medicine, 13(3), 550–556.

DIFFERENCES IN PHYSIOLOGICAL RESPONSES TO RECUMBENT SYNCHRONOUS HANDBIKE ERGOMETER VERSUS ASYNCHRONOUS ARM CRANK ERGOMETER IN SPINAL CORD INJURED AND ABLE-BODIED MEN

OVIEDO, G.R.1,2, ÁLAMO, J.M.3, NIÑO, O.A.4, TRAVIER, N.5, SOTO-MONTAÑEZ, C.A.3, GUERRA-BALIC, M.1, JAVIERRE, C.3

1 FPCEE BLANQUERNA, URL. 2 TECNOCAMPUS MATARÓ-MARESME, ESCS . 3 UNIVERSITY OF BARCELONA . 4 UNIVERSITY OF CUNDINAMARCA . 5 CATALAN INSTITUTE OF ONCOLOGY

INTRODUCTION: In people with spinal cord injury (SCI), both the position and the type of exercise can influence the physiological response during a maximal cardiopulmonary exercise test (CPET) (1;2)

PURPOSE: to compare the physiological responses in a group of adults with and without SCI by performing a CPET on an asynchronous arm crank ergometer (seating position) vs a CPET on a recumbent synchronous hand-bike (HB) ergometer.
METHODS: Ten adult men with SCI (35±9 y) and 11 able-bodied adult men (AB) (35±9 y) participated in this study. All participants performed a maximal CPET in seating position on an asynchronous arm crank ergometer (ACr) (Angio, Lode, Netherlands) and another CPET on a recumbent synchronous HB (Shark RS, Quickie, Germany). The following maximum values were evaluated: Peak power, oxygen consumption (VO2 peak), expired CO2 (VCO2), respiratory quotient (RQ), ventilation (VE) and heart rate (HR).
RESULTS: The repeated measures ANOVA showed a significant interaction between group and test condition was found for peak power (p=0.001). Post hoc independent t-tests revealed that the SCI group achieved higher values of peak power (157.5±43.9 vs 101.3±22.8 W), VO2 peak (2.93±0.79 vs 1.94±0.52 L/min), VE (113.21±28.55 vs 78.19±20.99 L/min) and HR (167±17 vs 148±19 beats/min) than the AB group during the HB test (all p≤ 0.05). The AB group achieved higher values of RQ than the SCI group on both tests conditions (HB test: 1.35±0.18 vs 1.13±0.10; ACr test: 1.19±0.09 vs 1.10±0.09) (all p ≤ 0.05). Post hoc paired t-tests showed that the SCI group achieved lower values of peak power during the ACr test respect the HB test (136.50±43.23 vs 157.50±43.98 W) (p=0.002). The AB group achieved lower values of VO2 peak (1.94±0.52 vs 2.26±0.58 L/min) and HR (148±19 vs 158±28 beats/min) on the HB test respect the ACr test (all p≤0.05). On the contrary, they achieved higher values of RQ (1.35±0.18 vs 1.19±0.09) on the HB respect the ACr test (all p≤0.05).
CONCLUSION: This study shows that there were no differences in the VO2 peak achieved by adults with SCI when performing a CPET in seating or recumbent position, however, it seems that they are more efficient when performing a CPET on a recumbent ergometer. On the other hand, adults without SCI achieved higher values of VO2 peak during the CPET in seating position, which could be due to the fact that they were able to recruit and activate more muscle mass during the exercise in seating position than during the recumbent position. Future studies with larger sample size are needed to corroborate the results obtained in the present study.
References: 1. Abel, T. et al. (2003). Handbiking: Physiological Responses to Synchronous and Asynchronous Crank Montage. doi.org/10.1080/17461390300073401
2. Arnet, U. et al. (2012). Shoulder load during handcycling at different incline and speed conditions. doi.org/10.1016/j.clinbiomech.2011.07.002

THREE-MINUTE ALL-OUT TEST IN SEMI-TETHERED FIELD TRACK RUNNING: IS THERE A PROTECTIVE ANTICIPATORY EFFECT?

SOUSA, F.A.B., RODRIGUES, N.A., ARRIVAS-FILHO, R., SANTOS, D.G., MANCHADO-GOBATTO, F.B., GOBATTO, C.A.
UNIVERSITY OF CAMPINAS; EINSTEIN INTEGRATED FACULTIES

INTRODUCTION: A procedure to evaluate aerobic and anaerobic parameters in one single session had gained attention in sports sciences. However, the protocol demands all-out intensity to be maintained during three-minutes, and an anticipatory effect caused by the knowledge of performing such hard task may reduce performance (Noakes et al., 2005; Sousa et al., 2017). This study aims to investigate the occurrence of a protective anticipatory effect during a three-minute all-out test performed in the running track.
METHODS: Eight recreational runners (age = 20 ± 5 years; height = 1.72 ± 0.14 m; BM = 68.8 ± 13.1 kg) had power values recorded over all-out three-minute and thirty second running efforts in separated occasions. Six of them performed an extra test session to access the three-minute test reliability. All sessions were performed using a semi-tethered prototype to enable power measurement in the horizontal plane (Sousa et al., 2015). The prototype resistance was set to 18% of the runner's body mass. Maximum power (Pmax30s), mean power (Pmean30s) and decay slope were analyzed considering the first 30 seconds of the three-minute test and compared with the 30-second session. For the three-minute test, the aerobic parameter – end power (EP) – was obtained as the average power in the last 30 seconds. The anaerobic parameter (W') was obtained as the integral of power over time, discounted the portion related to the aerobic metabolism. Further, maximum power (Pmax), mean power (Pmean) and covered distance were calculated for the three-minute test to evaluate test-retest reliability. After normality check (Shapiro-Wilks), comparisons were performed using paired Student's t-test, and absolute agreement ICC. Significance was set at $P < 0.05$.
RESULTS: Pmax30s (723 ± 83 vs 687 ± 123 W; P = 0.30), Pmean30s (544 ± 74 vs 495 ± 108 W; P = 0.16) and slope (-11,7 ± 4,9 vs -9,9 ± 3,6; P = 0.06) were not significantly different between thirty second and three-minute tests, all with significant ICC-A (range between 0.51 and 0.83). Regarding reliability, covered distance (623.5 ± 58.1 vs 607.0 ± 77.1 m; P = 0.49) was not statistically different and presented significant agreement (ICC-A = 0.68). Further, EP (191 ± 41 vs 211 ± 47 W; P = 0.10), W' (10.8 ± 2.5 vs 11.9 ± 5.0 kJ; P = 0.56), Pmax (597 ± 146 vs 626 ± 176 W; P = 0.21) and Pmean (252 ± 46 vs 280 ± 71 W; P = 0.09) were also not statistically different and had significant agreement (ICC-A between 0.79 and 0.95), except for W' (ICC-A = 0.47).
CONCLUSION: Results suggest reasonably test-retest reliability for the procedure, except for W'. Further, no anticipatory effect influenced power values in relation to the thirty-second effort. FAPESP 2013/16710-7; CNPq 461559/2014-5.
References: Noakes TD, St Clair Gibson A, Lambert EV. Br J Sports Med. 39(2):120-4, 2005.
Sousa F, Dos Reis I, Ribeiro L, Martins L, Gobatto C. J Hum Kinet. 49:245-56, 2015.
Sousa FAB, Vasque RE, Gobatto CA. PloS one. 12(6):e0179378, 2017.
Mail: filipesousaef@gmail.com; cgobatto@gmail.com

A NEW REPEATED RAMP CYCLE TEST TO ASSESS THE RECONSTITUTION OF W' FOLLOWING FULL DEPLETION

CHORLEY, A.
UNIVERSITY OF CHESTER

INTRODUCTION: Within the framework of the critical power (CP) model, the expenditure and reconstitution of work above CP (W') allows a cyclist to perform repeated supramaximal efforts. Whilst models of W' reconstitution exist, they are based on intermittent exercise protocols and do not account for individual characteristics other than CP. To date there are no test protocols for assessing the W' reconstitution characteristics of individual cyclists. The purpose of this study was to examine the reliability of a new repeated ramp test (RRT) protocol for assessing the partial reconstitution of W' following full depletion and to assess the fit of an existing W'bal model (Skiba et al 2012).
METHODS: After habituation and baseline testing of CP, 20 healthy active adults, consisting of trained cyclists (n = 9; age 43 ± 15 years; $\dot{V}O_2$max 61.9 ± 8.5 mL/kg/min) and untrained (n = 11; age 36 ± 15 years; $\dot{V}O_2$max 52.4 ± 5.8 mL/kg /min) performed two RRT on a cycle ergometer separated by 2-4 days. The RRT consisted of a 5-min warm-up at 100 W followed by three repeated ramps (20 W/min) to exhaustion, interspersed with 2-min recoveries at 50 W. W' reconstitution during each recovery was calculated as the work done above CP in the subsequent ramp. Gas exchange data was collected throughout and blood lactate concentrations were taken at the end of each ramp phase.

RESULTS: Inter-trial relative reliability of W' reconstitution was evaluated by intraclass correlation coefficients (ICC) for the group (≥ 0.859), trained (≥ 0.940) and untrained (≥ 0.768) sub-sets. Absolute reliability was evaluated with typical error (TE) and coefficient of variation (CV) for the group (TE ≤ 559 J; CV ≤ 9.2%), trained (TE ≤ 301 J; CV ≤ 4.7%), and untrained (TE ≤ 720 J; CV ≤ 12.4%). Intra-trial differences of W' reconstitution between the 2-min recovery periods were significant ($p < 0.05$), despite no differences ($p > 0.05$) in the measurements of $\dot{V}O_2$ or blood lactate. The observed minimal detectable changes of 475 J (1st recovery) and 368 J (2nd recovery) can be used to monitor changes in the rate of W' reconstitution in individual trained cyclists. Predicted values of W' from the W'bal model significantly ($p < 0.05$) underestimated remaining W' at the end of each recovery period despite overestimating W' at the end of each depletion.
CONCLUSION: In conclusion the RRT is both reliable for discriminating between individuals based on the high ICCs, and for assessing the efficacy of longitudinal or intervention studies (training or acute) due to the low TE & CV values, particularly for trained cyclists. CV values are lower than traditional W' studies due to the reduced impact of the variability of CP in the test design. The differences in intra-trial recoveries demonstrate a fatiguing effect on W' reconstitution which is not accounted for in the W'bal model, which does not provide a good fit for the RRT involving full depletion of W'.
References: Skiba, PF, Chidnok, W, Vanhatalo, A, et al (2012). Med Sci Sports Exerc, 44, 1526-1532.

DOES DIFFERENT TYPES OF TRAINING INFLUENCE THE VO2 AND MUSCLE DEOXYGENATION KINETICS IN SUPRAMAXIMAL RUNNING?

REIS, J.F.1,2, CURTO, D.2, ALMEIDA, N.2, ESPADA, M.3, ALVES, F.B.2

1UNIVERSIDADE EUROPEIA, LAUREATE INTERNATIONAL UNIVERSITIES, LISBON, PORTUGAL; 2FACULTY OF HUMAN KINETICS, UNIVERSITY OF LISBON; 3 SCHOOL OF EDUCATION, POLYTECHNIC INSTITUTE OF SETÚBAL, PORTUGAL

INTRODUCTION: For the same increment in work rate, individuals with slow overall oxygen uptake kinetics will rely on a greater extent on non-oxidative metabolic pathways to meet the energy demands of the exercise task, reaching early fatigue. The literature shows that endurance training induces a speeding of the initial VO2 and muscular oxygen extraction kinetics. However, the specific characteristics of training that optimizes said parameters is not yet clearly established.
We aimed to compare the effects of 4 weeks of continuous (CT) and low volume high intensity interval training (HIIT) on the oxygen uptake (VO2k) and muscle deoxygenation kinetics in transitions from rest to supramaximal running.
METHODS: Eighteen active subjects, with no endurance training background were randomly assigned to complete 12 sessions of CT (24–32 min in the heavy domain) or HIIT (6-8 x 30 s running at 120-2% MAV, interval rest of 30 s) over a 4-wk period (CT n=9; mean±SD; 24.1±4.0 yr.; 63.5±10.1 kg; height 1.71±0.8 m and HIIT n=9; 25.8±6.0 yrs; 68.4 ± 10.4 kg; 1.71 ± 0.07 m). Before (PRE) and after (POST) the intervention period, subjects completed on the treadmill an incremental test and two square wave transitions to 110% of the maximal aerobic velocity (MAV) until exhaustion. In all tests, pulmonary VO2 was collected breath-by-breath (Metamax3b, Cortex, Germany) and deoxy-hemoglobin [HHb] data of the vastus lateralis was determined by near-infrared spectroscopy (NIMO, Nirox srl, Brescia, Italy). The parameters of the VO2k and [HHb] kinetics were determined using a monoexponential model.
A two-way (time by group) ANOVA with repeated measures for time determined the effects of the interventions on the physiological variables. When the analysis revealed a significant effect, paired-samples t-tests was used.
RESULTS: Both training modalities improved relative peak oxygen uptake (VO2peak) ($F=12.5$, $p<0.01$) and MAV ($F= 17.1$. $p<0.01$) (4.2±6.5 and 6.0±5.9% with CT and 13.4±13.3 and 3.1±3.3% with HIIT, respectively) without significant differences between groups. However, the time to exhaustion at 110% MAV was not affected by training (CT: 132.9±29.7 vs 121.7±30.4s and HIIT:125.3±21.9 vs 125.5±17.8s, for PRE and POST, respectively).
The mean response time of VO2k was not affected by either training modalities (CT: 26.5±3.6 vs 25.3±4.0s; HIIT: 28.2±7.2 vs 26.2±3.0 s, for PRE and POST, respectively). Similar responses were obtained for the effective time constant of [HHb] kinetics (CT: 24.0±7.1 vs 23.5±6.8 s; HIIT: 30.5±10.7 vs 26.0±12.4 s, for PRE and POST, respectively)
CONCLUSION: Four weeks of either CT or HIIT were not sufficient to induce changes on both oxygen and muscle deoxygenation kinetics in supramaximal running. The dissociation between changes in VO2peak and these parameters seems to reflect the different underlying mechanisms regulating these adaptations.
However, since CT and HIIT provoked comparable improvements in VO2peak and MAV, the later seems to be a more time-efficient approach.

COMPARISON BETWEEN CARDIAC FUNCTIONAL MITOCHONDRIAL ADAPTATIONS TO FREE RUNNING WHEEL AND HIGH INTENSITY INTERVAL TRAINING

BELEZA, J.1, ALBUQUERQUE, J.1, SANTOS-ALVES, E.1, RIZO-ROCA, D.1, ASCENSÃO, A.1, TORRELLA, J.R.2, MAGALHÃES, J.1

1: LABORATORY OF METABOLISM AND EXERCISE , RESEARCH CENTER IN PHYSICAL ACTIVITY HEALTH AND LEISURE , FACULTY OF SPORT, UNIVERSITY OF PORTO, PORTO, PORTUGAL. 2: DEPARTAMENT DE BIOLOGIA

INTRODUCTION: Animal studies have long tradition on biomedical studies. Accordingly, exercise physiologists have been using different models of rodents to mimic the physiological and biochemical impact of exercise both on systemic and at different level of cellular organization. In this context, researchers have used a model of free running wheel (FRW) in the last years. However, despite the widespread use of FRW as an exercise stimulus, there is a lack of knowledge regarding the truly physiological and biochemical impact of this model on voluntarily exercised animals. Furthermore, taking into account the animal's behavior on the FRW, this model is characterized by short bouts of exercise performed at high speed interspersed by long lasting pauses and moments of low intensity that mimics the exercise bouts performed during sessions of high intensity interval training (HIIT). However, considering its use also in animal studies, scarce data still exist about the overall exercise intensity and metabolic impact of an HITT training session.
The aim of this work is to characterize and compare some of the cardiac mitochondrial function adaptations induced by both FRW and HIIT exercise models.
METHODS: Wistar rats (n=18) with 7-8 weeks old were assigned into Sedentary (SED), FRW and HIIT groups (n=6/group). The maximal oxygen consumption (VO2max) was assessed in the beginning of the protocol. FRW animals had free access to running wheel throughout the entire protocol. The animals from the HIIT group were exercised 5 days a week during 12weeks. The HIIT protocol started with 5 minutes at low speed (60% of VO2max) for warm up, thereafter the rats were submitted to 4 bouts of 4 minutes at 85-90 % of VO2max with 2 minutes of active recovery at 60% of VO2max. Respiratory chain complex I, II activities were determined.
RESULTS: After 11 weeks of protocol, no alterations were found in complex I and II-related state 3 and 4, while an increase in the Respiratory Control Ratio (RCR) of the animals that had access to the running wheel (3.89±0.14 vs. 5.20±0.25; $p<0.05$) and the animals that

perform HIIT training (3.89±0.14 vs. 5.42±0.37; p<0.05) using substracts for complex I was observed. The HIIT training induced an increase in complex II-related RCR compared with SED (3.86±0.17 vs. 2.98±0.19; p<0.05) and FW groups (3.86±0.17 vs. 3.24±0.05; p<0.05). The efficiency of complex I ATP synthesis was higher in the animals that perform HIIT training (4.22±0.31 vs. 3.20±0.20; p<0.05; 4.22±0.31 vs. 3.24±0.16; p<0.05), while no alterations was found in complex II.
CONCLUSION: Both models of exercise (FRW and HIIT) seem to induce an improvement in cardiac mitochondrial function; however, exercise intensity seems to play an important role in cardiac mitochondrial adaptations as the alterations induced by HIIT are more extensive than those associated to FRW.
FUNDING:
POCI-01-0145-FEDER-016690; UID/DTP/00617/2013
CONTACT:
jmsbeleza@gmail.com

CHANGES IN HEART RATE AND OXYGEN UPTAKE AMONG JUMPERS USING A LONG JUMP ROPE EXERCISE

YOSHIDA, N.1, WADA, T.2, TAMARI, Y.2, HAMADA, H.1, SAITO, T.2, FURUMOTO, K.3, NOSE, Y.4, NISHIMA, K.5, YOSHIOKA, A.6, YAMAGUCHI, H.7, ONODERA, S.2

1: GRADUATE SCHOOL, KUMW , 2: KUMW , 3: KUSA , 4: YWU , 5: HIT , 6: OU , 7: KIU

INTRODUCTION: Jump rope exercise is a means of health promotion. Users of a short rope (in which the same person both turns the rope and jumps) maintain a heart rate of 166-198 bpm (Quirk JE et al., 1982) and have oxygen uptake of 38.3-49.9 ml/kg/min (Quirk JE et al., 1982), while optimum rotation speed jumping about 92-100 times per minute (Yamaguchi et al., 2001). We proposed that using a long rope (turned by two people while a third person jumps) could promote health in multiple people at once; however, neither the turner nor the jumper is performing the same exercise as the user of a short rope. Previously, we clarified the exercise intensity of turners using a long jump rope. At 70 rpm, the turners heart rate was 109 ± 14 bpm, the oxygen uptake was 12.1 ± 2.1 ml/kg/min, and exercise intensity was moderate (Yoshida et al., 2015). The present study aimed to clarify the exercise intensity of the person jumping over a long jump rope.
METHODS: Six healthy Japanese males volunteered to participate in this study. Their ages, heights, body weights, and body mass index were 26 ± 3 years, 168.8 ± 4.9 cm, 66.7 ± 12.9 kg, and 23.4 ± 4.1, respectively (mean ± SD). All subjects signed informed consent forms prior to participation. The exercise task required the subjects to jump twice during each rotation of the rope, with a rotational speed of 70 rpm. The experimental protocol called for sitting on a chair for five minutes, followed by three minutes of exercise and five minutes of sitting on the chair again for recovery. The jump rope used (length 10 m) was certified by the National Recreation Association of Japan. Measurement indices were heart rate, oxygen uptake, rating of perceived exertion (RPE), systolic blood pressure (SBP), and diastolic blood pressure.
RESULTS: The heart rate was significantly higher at 2 and 3 minutes during exercise than at 1 min during exercise (p<0.05). The heart rate at 3 minutes during exercise was 182 ± 19 bpm. The oxygen uptake at 3 minutes during the exercise was 40.6 ± 6.3 ml/kg/min. The RPE was significantly higher during exercise than at rest (p<0.05). The RPE at 3 minutes during the exercise was 18 ± 3. The SBP was significantly higher immediately after exercise than during rest or even after the five minutes of recovery (p<0.05). These results suggest that using a long jump rope is a relatively high-intensity, high-risk exercise. This is because while a person using a short jump rope controls both the turning and the jumping, the jumper using a long rope must be attentive to and synchronised with the turners motion; accordingly, it was suggested that the long jump rope exercise for promoting health has high risk.
CONCLUSION: This study revealed that jumping over a long rope is a demanding, high-intensity exercise.
REFERENCES:
Quirk JE, et al. (1982). Med Sci Sports Exerc 14, 26-29.
Yamaguchi H, et al. (2001). Kawasaki J Med Welf Vol. 10, No. 2, 329-333.
Yoshida N, et al. (2015). Kawasaki J Med Welf Vol. 24, No. 2, 257-260.
CONTACT:
w6314001@kwmw.jp

THE PHYSICAL RESPONSE TO BOXING-SPECIFIC TRAINING MODALITIES.

PAGE, R.M., GREIG, M., FINLAY, M.J.

EDGE HILL UNIVERSITY

INTRODUCTION: This study examined the differences in the physical response elicited from a contemporary Boxing Specific Exercise Protocol (BSEP) performed using a punch bag and a pad routine.
METHODS: Fourteen male elite amateur boxers (Mean ± SD; age= 22 ± 2 yrs; height= 176.9 ± 7.3 cm; mass= 78.8 ± 8.7 kg;; VO2max= 55.94 ± 5.96 ml·kg-1·min-1; HRmax= 191 ± 4 beats·min-1) were recruited. The BSEP comprised 3x3 minute rounds, with a one minute passive recovery period interspersing each round. Average (HRave) and peak (HRpeak) heart rate, average (VO2ave) and peak oxygen consumption (VO2peak), Blood lactate (BLa) concentrations, rating of perceived exertion (RPE), and both tri-axial and uni-axial PlayerLoadTM metrics were recorded during the completion of each trial. The PlayerLoadTM metrics were recorded at both the cervical and lumbar spine.
RESULTS: Blood lactate concentration increased significantly across each round, with significantly higher values recorded in the pad trial (pad= 2.7 ± 0.8 mmol·l-1; bag= 2.3 ± 0.9 mmol·l-1). A similar response was also identified for the HRave (pad= 160 ± 9 beats·min-1; bag= 150 ± 16 beats·min-1) and VO2ave data (pad= 38.0 ± 0.31 ml·kg-1·min-1; bag= 34.40 ± 1.06 ml·kg-1·min-1). A significant main effect for time was also recorded for the RPE data; however, there was significant differences between trials. Conversely, the Tri-axial (PLTotal) and medial-lateral (PLML) data was higher in the punch bag trial. There was also a main effect for time for all of the PlayerLoadTM metrics. PLTotal, PLML, and vertical PlayerLoadTM were all significantly higher in the lumbar region when compared to the cervical region.
CONCLUSION: The BSEP elicited a fatigue response across rounds in both trials, thus confirming its validity. With implications for boxing-specific conditioning, the pad routine was identified as being more physiologically demanding, but less mechanically demanding than the bag routine.

ENERGY BALANCE DYNAMICS DURING SHORT-TERM CROSSFIT TRAINING

SCHUBERT, M.M., PALUMBO, E.

CALIFORNIA STATE UNIVERSITY SAN MARCOS

INTRODUCTION: CrossFit is a form of high-intensity functional training that focuses on training across the entire spectrum of physical fitness. Workouts typically encompass strength, power, endurance, and flexibility into single movements or exercise sessions. CF has been shown to improve a number of indicators of fitness and health. However, to date, no information assessing energy balance in response to CF training exists. It is important to explore this topic to garner information for the purposes of weight management or manipulating changes in body composition . Thus, the purpose of this study is to investigate energy balance dynamics using objective measures during 1 week of CF training.
METHODS: Healthy men and women , with ≥ 3 months CF experience, had body composition assessed via air displacement plethysmography before and after 1 week of CF training. During the training period, participants wore ActiHeart monitors to assess total energy expenditure , activity energy expenditure , CF energy expenditure , and time spent in various physical activity intensities. Energy intake was assessed from TEE and changes in body composition using established equations. Data were analyzed with descriptive statistics, independent t-tests, and repeated-measures analysis-of-variance.
RESULTS: Results revealed expected sex differences for most body composition and energy balance variables; however, no major differences between men and women were present when energy balance data were adjusted for fat-free mass. CF EE averaged 605 ± 219 kcal per 72 ± 10 min session. Participants attended 4.5 ± 1 sessions per week; thus, weekly CF EE was 2723 ± 986 kcal. Sedentary time accounted for ~54% of the participants' daily activity; MVPA was 169 ± 50 minutes per day. Crucially, this suggests participants were completing MVPA above and beyond the ~70 min CF sessions. Participants as a whole were in an energy deficit , but energy availability levels were in acceptable ranges.
CONCLUSION: Results of the present study indicate that CF training can account for a significant portion of daily activity energy expenditure, but does not cause compensatory changes in energy intake or non-CF physical activity when examined over a 1 week period. Furthermore, the weekly expenditure is within levels shown to induce clinically meaningful weight loss in overweight/obese populations. Thus, CF may offer an enjoyable avenue for weight management and manipulation of body composition.

INTRAMUSCULAR INJECTION OF HYPERTONIC SALINE INDUCES EXERCISE-INDUCED PAIN AND DECREASES TIME TO TASK FAILURE IN MALES

SMITH, S.A., MICKLEWRIGHT, D., MAUGER, A.R.

UNIVERSITY OF KENT

INTRODUCTION: Exercise-induced pain (EIP) tolerance is proposed to be a determinant of endurance performance (Mauger, 2013). However, inadequate methods for inducing EIP are often used in research, and this has made this notion difficult to examine. Despite a relatively limited application to both exercise and performance, the intramuscular injection of hypertonic saline has been suggested to be a method that closely replicates EIP. The aim of the present study was to use this experimental pain model to assess the effect of EIP on time to task failure (TTF) of a sustained submaximal isometric contraction.
METHODS: Nine male (25 ± 4 yr, 1.81 ± 0.71 m, 81.8 ± 11.7 kg) and six female (22 ± 2 yr, 1.68 ± 0.77 m, 61.4 ± 5.9 kg) recreationally active participants completed six conditions separated by 2-7 days. All exercise tests were performed on an isokinetic dynamometer set up for the right leg. The final three visits required participants to perform a single leg isometric TTF of the knee extensors at 10% of their maximal voluntary contraction. They performed this task in in the presence of exercise-induced pain (induced via a 1 mL intramuscular injection of hypertonic saline (5.85%) into the vastus lateralis), a placebo (a 1 mL intramuscular injection of isotonic saline (0.9%) into the vastus lateralis) or no injection.
RESULTS: At rest, hypertonic saline produced a mean pain intensity of 32.9 ± 11.7 on the 0-100 visual analogue scale which lasted 290 ± 81 s. Initial analysis revealed that TTF was not significantly different between the pain, placebo and no injection conditions (670 ± 415 vs. 750 ± 353 vs. 725 ± 385 s, respectively). However, as female's TTF was significantly longer than males and outlasted the duration of EIP induced by the injection, a secondary analysis on a male only sample was performed. Here, a significant difference was found between conditions, with hypertonic saline causing significantly ($P = 0.007$) shorter TTF (454 ± 356 s) compared to the placebo condition (633 ± 363 s), and a difference from the control condition (533 ± 320 s) that approached significance ($P = 0.056$).
CONCLUSION: The primary finding from the present study suggests that an increased EIP decreases TTF, provided that the elevated pain is present for the duration of the task. This is consistent with previous literature which demonstrated a similar finding in the tibialis anterior at 80% MVC (Graven-Nielsen, Svensson and Arendt-Nielsen, 1997). Future work utilising the intramuscular saline experimental pain model should seek to match exercise task time to the duration that pain is induced by the saline.

Mini-Orals

MO-BN10 Sport technology

COMPARISON OF ENERGY EXPENDITURES OF WALKING FROM A SMARTWATCH AND K4B2

CHOW, H., HO, C., CHIANG, W., WANG, J.

NATIONAL CHENG KUNG UNIVERSITY

INTRODUCTION: Promoting older adults to engage in physical active lifestyle is beneficial in reducing medical cost and important in public health. As the wearable device has been the top trend in fitness industry in 2015 and 2016, and walking being the most common physical activities for seniors, this study aims to measure and compare the energy expenditures from a smartwatch (iNCKU) with a potable metabolic system (K4b2) while performing walking.
METHODS: Sixteen older adults (8 men, 8 women) who are above 65 years old completed this study. The participants weared iNCKU smartwatch (tri-axial accelerometer sensor inside) on the left wrist and were equipped with K4b2 system on the chest and covered with the facemask. The protocols were walking on the treadmills at 3.2 kph and 4.0 kph speed for three minutes each.

RESULTS: The energy expenditures from iNCKU watch are 5.44±2.24 Kcal for 3.2Kph and 6.56±2.36 Kcal for 4.0Kph while the data from K4b2 are 9.36±2.69 Kcal and 9.82±2.86 respectively. The results from iNCKU watch and K4b2 were significantly different according to on-way ANOVA analysis.
CONCLUSION: The results revealed that smartwatch underestimate the energy expenditures from K4b2. The reason could be attribute to that the sensor of smartwatch on the wrist is insufficient to accurately detect the complex physical activity, especially movements performed in the lower limbs, i.e. walking. It is suggested that a better algorism is needed or placing more sensors are necessary to provide feedbacks of energy expenditures for seniors while walking.

ANALYSIS OF PERCEIVED COMFORT IN COMPAK SPORTING COMPETITION

MONZONI, R., LONZI, B., LUCERTINI, F., ALUIGI, M., MARI, F., BANCI, L., VIGNAROLI, M., FEDERICI, A.
UNIVERSITÀ DEGLI STUDI DI URBINO CARLO BO

INTRODUCTION: Comfort perceived by the shooter is influenced by several factors including the recoil of the shotgun and the number of shots fired in a certain time. In general, the recoil of a shotgun is influenced by its own weight and by the presence or absence of recoil reduction systems. On the other hand, a clay shooting sport such as Compak Sporting consists of two 25 clays series per day, for a total of 200 clays in 4 consecutive days. In this discipline over&under shotgun is widespread.
In this study the perceived comfort is investigated in terms of exertion and ache produced by shotgun recoil on shooter using skin temperature responses, pain and effort scales.
METHODS: A Compak Sporting simulated competition was carried out using three over&under shotguns (model 828U, Benelli Armi S.p.A., Urbino, Italy): two hunting shotguns (weight 3019 g) differing in the presence (S1) or absence (S2) of 'Progressive Comfort System' (damping device) and one sportive (weight 3564 g) without damping device (S3).
6 male subjects (age 26.8±4.6 yrs; BMI 22.9±1.5 kg/m2) with a minimum of 4 years shooting experience were recruited. Each shooter fired with all shotguns and was blinded to which one was firing with. Shooting sessions were separated by 30 days of rest. The onset of fatigue or pain was investigated by means of two different approaches. Infrared thermography images (IR) was used as an objective measure to analyse the presence of any injuries on the upper trunk. In contrast, a subjective measure of pain and exertion was performed through Visual Analog Scale (VAS) and Rate of Perceived Exertion (RPE). The evaluation tests were carried out before and after two shooting series, per four consecutive days. One-way ANOVA was used to compare VAS, RPE and temperature variations within the interface area between the shotgun and the shooter, which was formerly identified inside the infrared images.
RESULTS: The evaluation tests showed these results: VAS=2.2±1.7; RPE=6.8±0.5; IR=0.43±0.26°C for S1; VAS=6.0±1.5; RPE=7.8±0.5; IR=0.82±0.5°C for S2; VAS=2.5±1.5; RPE=6.7±0.6; IR=0.36±0.32°C for S3. Using a heavier shotgun (S3) or one with a damping device (S1) led to a significantly ($p<0.02$) reduced temperature increase compared to a light shotgun (S2). The same trend was observed through subjective measures: both VAS and RPE confirm a significant reduction ($p<0.02$) in pain and exertion perceived by shooters using S1 and S3 compared to S2.
CONCLUSION: Objective and subjective measures of comfort perceived by the shooter in a simulated competition show the same tendency. In general, a heavier shotgun or one lighter but equipped with a damping device causes a lower recoil than that produced by a light shotgun. This results in less effort and pain experienced by the shooter leading to an improved perception of comfort. These finding are well supported by both quantitative (IR) and qualitative (VAS,RPE) data with strong statistical significance.
Corresponding author: Riccardo Monzoni, riccardomonz@gmail.com

VALIDITY AND RELIABILITY OF HEART RATE MEASURED FROM FOUR WRIST WORN ACTIVITY MONITORS

FLOOD, T., THOMPSON, J.E.S., BLACKER, S.D., MYERS, S.D.
UNIVERSITY OF CHICHESTER

INTRODUCTION: The development of heart rate (HR) measurement using photoplethysmography (PPG) in commercially available wrist-worn activity monitors provides the potential to quantify physical activity using cardiovascular strain. The HR measured via wrist-worn activity monitors which use PPG has not been compared to the validated approach of a chest worn HR monitor. Aim: to investigate the accuracy, reliability and repeatability of four commercially available, PPG based activity monitors during treadmill exercise.
METHODS: Following ethical approval, four male and five female physically active participants volunteered (Age 29 ± 4 years; Height 168 ± 9 cm; Body Mass 67.4 ± 10.2 kg; Body Mass Index 23.6 ± 1.9). Participants completed four trials, on each occasion they wore a Polar (RS400) chest worn HR monitor, and two randomly assigned wrist-worn activity monitors in a crossover design. The four activity monitors were Garmin VivoActive HR (GV), Fitbit Surge (FS), TomTom Touch (TT) and TomTom Runner (TR). All monitors were fitted to manufacturers' guidelines. Participants completed a five-minute seated rest, then walked at 2 km·hr-1 on a treadmill, the speed increased by 2 km·hr-1 every 5 minutes and they transitioned to running at between 6-8 km·hr-1. Speed continued to increase by 2 km·hr-1 until voluntary exhaustion.HR was recorded continuously throughout. Data were analysed using Bland Altman Limits of Agreement (LoA) and Pearson's product moment correlations (r). Statistical significance was set $p<0.05$ and the minimum clinically acceptable difference between the 'gold standard' chest strap and wrist worn devices was selected a-priori as ± 5 bpm.
RESULTS: In comparison to the RS400 the mean bias • 95% LoA were; FS -3 ($P<0.001$) 24, -29 bpm, GV -3 ($P<0.001$) 30, -36 bpm, TT -14 ($P<0.001$) 26, -54 bpm, TR -9 ($P<0.001$) 23, -41 bpm. For the TR 55% of data points fell within ± 5 bpm, followed by FS with 45% and GV & TT with 41%. Test-retest data showed RS400 to have the strongest positive correlation ($r=0.977$), followed by FS ($r = 0.946$), TR ($r = 0.935$), TT ($r = 0.918$), GV ($r = 0.900$).
CONCLUSION: The GV and FS wrist-worn activity monitors showed the strongest agreement with the 'gold standard' chest worn HR monitor. However, all wrist-worn activity monitors underestimated HR compared to the chest-worn and 95% LoA for all devices showed large variation which was far outside the minimum clinically acceptable difference of 5 bpm. Our data shows physical activity level is likely to be underestimated when quantified using HR measured with a wrist worn activity monitor and should be interpreted with caution.

THE PHYSIMAX SYSTEM - A NOVEL PORTABLE MOTION ANALYSIS SYSTEM FOR ASSESSING THE LANDING ERROR SCORING SYSTEM (LESS) TEST

DAR, G., YEHIEL, A., CALE BENZOOR, M.

UNIVERSITY OF HAIFA

INTRODUCTION: The landing error scoring system (LESS) assesses the quality of a landing after a jump. The quality of the jump is usually evaluated using a three dimensional (3-D) motion analysis system or a two-dimensional (2-D) video analysis visually rated by a clinician. However, both methods have disadvantages.
The aim of this study was to examine the concurrent validity of a novel portable motion analysis system (PhysiMax System) in assessing the LESS score by comparing it to video analysis.
METHODS: The study population included 48 healthy participants (28.45±5.61 years), each performing the LESS test while two video cameras and the PhysiMax simultaneously recorded the jump. The Physimax system automatically evaluated the LESS. Subsequently, the examiners scored the test by viewing the video recordings, blinded to the PhysiMax results.
RESULTS: The mean LESS score, using the video recordings and the PhysiMax was 4.77(±2.29) and 5.15(±2.58), respectively (ICC=0.80, 95% confidence intervals 0.65-0.87, mean absolute differences 1.13 (95% confidence intervals; 0.79-1.46). The results indicate a high consensus between the methods of measurement.
CONCLUSION: The Physimax systems main advantages are portability, objective evaluation and immediate availability of results. The system can be used by athletic trainers and physiotherapists in the clinic and in the field for jumping assessment.

ACCURACY OF THE MICROEYE® AND CONTINUMON® MICRODIALYSIS DEVICE FOR CONTINUOUS REAL-TIME BLOOD LACTATE THRESHOLD DETERMINATION

LEE, B.J., DOHERTY, J., HILES, A.M., CARNEY, D., O'CONNELL, M.C.

UNIVERSITY OF CHICHESTER

INTRODUCTION: Exercise physiologists use lactate-derived endurance markers to predict and compare endurance ability and to prescribe training zones to athletes. There are many different blood lactate markers proposed in the literature, however each relies on constructing a lactate curve from discrete measurments, usually obtained towards the end incremental work bouts. Here we compare blood lactate indices obtained using traditional blood sampling methods to those obtained using a novel peripheral intravenous microdialysis device and online in vitro diagnostic lactate biosensor system which provides a continuous real-time reading of blood lactate.
METHODS: Ten male volunteers (age 30 ± 9 years; stature 176 ± 9 cm; mass 77.8 ± 8.6 kg) completed one experimental visit. An 18-gauge Teflon catheter was inserted into an antecubital vein, and a Probe Scientific MicroEye® PME012 microdialysis device inserted into the catheter. The MicroEye® was perfused at 1mL/hour with 0.9% sodium chloride containing a small quantity of anticoagulant (Fondaparinux). The outlet of the MicroEye® was connected to the inlet of a ContinuMon® lactate flow cell, for continuous lactate monitoring, which was inserted into a wireless battery-operated ContinuMon® module worn on the participant's wrist. The sensor signal was transmitted to a laptop running proprietary software. A second 18 g catheter was introduced into a peripheral vein in the contralateral forearm for reference blood sampling using a YSI 2300 Stat analyser. Venous blood was sampled at 10-minute intervals throughout 30 minutes of rest, and at the end of each stage of an incremental cycling test and analysed immediately. The incremental cycling test consisted of five 3-minute stages, beginning at 70 watts and increasing by 35 Watts per stage. Power output at lactate threshold (LT), initial rise of 1 mmol.L-1, Dmax, and 4mmol.L-1 of Bla were determined using the R-Lactate R statistics package. Paired t tests were used to assess differences between the thresholds determined from the MicroEye and venous blood samples.
RESULTS: Blood lactate at the end of the 30 minute rest period was 0.54 ± 0.19 and 0.51 ± 0.16 mmol.L-1 for the venous and MicroEye samples (p = 0.56). Power output at lactate threshold was 139 ± 21 and 136 ± 23 watts (p = 0.76); at initial rise of 1M = 163 ± 44 and 162 ± 59 watts (p = 0.96); at Dmax 173 ± 42 and 184 ± 47 (p = 0.10, and at 4mmol.L-1 231 ± 26 and 233 ± 25 (p = 0.73) for the venous and MicroEye samples respectively.
CONCLUSION: The lactate threshold indices obtained from the MicroEye(R) microdialysis cathetar and ContinuMon(R) continuous lactate monitoring system matched those obtained using traditional sampling methods analysed using the R-Lactate open source software. The ability to continuously monitor blood lactate in real time could be a useful tool for applied practioners monitoring training load, and those interested in exercise metabolism.

THE USE OF GPS AND MOBILE PHONE APPLICATIONS (APPS) BY ROAD RUNNERS

SALGADO, J.V.V.1, RUSSOMANNO, T.G.2, KAWASAKI, G.M.3, MORAES, G.H.M.3, ANDRIES, O.J.3

[1]UNIVERSIDADE DO ESTADO DE MINAS GERAIS – UNIDADE DIVINÓPOLIS, [2] UNIVERSIDADE DE BRASILIA, [3] UNIVERSIDADE ESTADUAL DE CAMPINAS.

INTRODUCTION: Road races have become one of the most popular sporting events in the world. The significant increase in the number of athletes, especially amateurs, diversified the segment of specific sporting articles for runners, among them the way of monitoring activities in real time. The aim of this study was to verify the prevalence and evolution of the use of Global Positioning Systems (GPS) and mobile phone application system (APPs) to monitor sports activities by street runners for two consecutive years (2013 and 2014) in the same annual event.
METHODS: The study consisted in applying a self-filling survey. The survey was applied during the registration of the runners at the road race "Volta da Unicamp". The road race involves 5km and 10 km race. Descriptive statistic was used to evaluate the results.
RESULTS: 882 runners of both sexes with mean age of 36.15 (±10.18) years participated in the study. It was observed that 41.16% of the runners used GPS and 30.95% used mobile phone APPs and 53.28% reported using both GPS and APPs. Between the first and second year, the use of GPS showed a growth of 27.04% among the individuals who reported the use, while the use of APPs showed a growth of 65.69%. Of the individuals who receive guidance from a professional in the prescription of training, 46.54% use GPS and 41.33% use APPs. The practice time of the modality was 4.24 (±5.41) years for those using only GPS and 2.56 (±3.25) years among those who used only APPs.
CONCLUSION: The technological advance experienced in the last decades contributed significantly to the development of equipment that allows the investigation of the demands associated to the process of sports preparation, optimizing the design of training and recovery procedures. It can be inferred that factors such as costs, access to technology and information have contributed to the growth of the use of these technologies in the practices of road racers. The use of technological resources tends to grow even more, especially in the APPs,

and these resources can be an important tool for athletes self-control of training, as well as a facilitator for coaches to monitor several variables of the prescribed activities.

EVALUATION OF PERCEIVED SPEED ERROR DURING WALKING AND RUNNING IN A VIRTUAL ENVIRONMENT

PERRIN, T., KERHERVÉ, H., FAURE, C., CATTOZZO, G., BIDEAU, B., KULPA, R.

UNIV RENNES

INTRODUCTION: The development of new virtual reality (VR) devices such as Head Mounted Displays (HMD) increases opportunities for applications at the confluence of physical activity and gaming. Recently, the fields of sport and fitness have turned to VR including locomotor activities, to enhance motivation and exercise adherence. However, the relevance of such tools depend on the ability of these systems to provide realistic immersive feelings, specifically depending on depth and speed perception. The objective of this study is to estimate the error between actual and perceived locomotor speed in environment (VE).
METHODS: Eleven healthy people (4 female, 7 male) with normal vision or a correction device participated in the experiment. The experiment consisted in walking and running on a motorized treadmill (h/p/Cosmos) from 3 km/h to 11 km/h with 0.5 km/h increments in a randomized order, while wearing a HMD (HTC Vive) displaying a virtual racetrack surrounded by columns placed at regular intervals. Participants were instructed to match VE with what they perceived was their actual locomotion speed (LS), using a handheld Vive controller (modifying optic flow). For each trial, we collected the speed of optic flow (OFS) adjusted by participant in 0.02 km/h increment. In order to control the effect of chance we removed best and worst trials for each participant. Correlation coefficients (r), bias, smallest detectable difference (SDD) and typical error of the estimate (TE) were calculated in the standard manner.
RESULTS: There was likely no learning effect as observation rank and error were not correlated (r=0.12). OFS slightly underestimated LS (bias: -0.04±0.24) but the two were highly correlated (r=0.82; y=0.90x+0.68) and TE (1.6±1.1 km/h) was likely not greater than SDD (0.6±1.1 km/h).
CONCLUSION: The main result of our study was that participants were able to match OFS to actual LS. Unlike previous literature from the early 2000 using previous generation of HMD, we found that OFS was not perceived to be slower or faster, despite the relatively large standard deviation in TE. A secondary finding was that OFS estimation was not affected by locomotion speed. Therefore, modern HMD can be used to create immersive feelings of self-motion during active exercise, and further to generate new consumer experiences of training.

RELIABILITY AND VALIDITY OF MY JUMP APP USING A 720P 30FPS IPHONE 4 CAMERA

LOH, T.C.1, CHEAH, B.C.2, SANAWI, M.3, LOO, L.H.3, BEAVEN, C.M.4

NATIONAL SPORTS INSTITUTE

INTRODUCTION: Countermovement jump (CMJ) is one of the commonly used approach to assess lower limb power and force production (Markovic et al., 2004). My Jump app was scientifically validated using an iPhone 5s (Balsalobre-Fernández et al., 2015). Nevertheless the developer only mentioned the measurements are slightly less accurate on other older devices. Thus, the purpose of this study was to determine reliability, validity, and the agreement between the My Jump app using a 720p 30fps iPhone 4 camera and a force platform for measuring CMJ.
METHODS: 50 sub-elite athletes (18 females and 32 males) were recruited to participate in this study. Mean age of the athletes was 17.0 ± 3.0 years old with mean weight of 60.7 ± 9.8kg and mean CMJ height of 37.24 ± 8.82cm. Each athlete performed CMJ three times on the force platform (400 Series Performance Force Plate, Fitness Technology, Adelaide, Australia) while being recorded at approximately 1.5m away from force platform by using the iPhone 4 with the My Jump app. Height of the CMJ using the app was calculated between two frames selected in which the first frame where both feet were off the ground for take-off phase and subsequently took the first frame where at least one foot was touching the ground during landing phase, as described by Balsalobre-Fernández et al. (2015). The force curve was inspected through a computer software (Ballistic Measurement Software, Fitness Technology, Adelaide, Australia) to verify the jump. The means flight time and mean height of the 3 jumps from the force platform and the app were obtained and compared using intraclass correlation coeffifient (ICC), Bland-Altman plots, and Pearson correlation coefficient (r). Cronbach's α and coefficient of variation (CV) were used to analyse the reliability of the app when measuring the three CMJ for each subject.
RESULTS: ICC showed high agreement between the 2 instruments for both flight time (ICC = 0.922, CI = 0.863 – 0.956, $p < 0.001$) and jump height (ICC = 0.941, CI = 0.893 – 0.967, $p < 0.001$). The mean differences for flight time between the two instruments was 5.86 ± 4.58ms, while the mean differences for jump height between the two instruments was 1.03 ± 0.52cm. The Bland-Altman plot showed no proportional bias of the data for both the flight time and jump height. The Pearson correlation showed significant correlation between the app with the force plate for flight time ($r = 0.861$, $r2 = 0.741$, $p < 0.01$) and jump height ($r = 0.895$, $r2 = 0.800$, $p < 0.01$). The My Jump app showed good reliability for the CMJ for flight time ($\alpha = 0.923$, CV = 3%) and jump height ($\alpha = 0.944$, CV = 7%).
CONCLUSION: Almost identical mean difference between equipment (1.1 ± 0.5cm) reported by Balsalobre-Fernández et al. (2015). This study showed high validity and reliability of the My Jump app even with the iPhone 4 that has only a 30fps video camera, which can be used as a field testing or monitoring tool.

A BIOMECHANICAL STUDY OF 5 WEEKS AUDIBLE STIMULUS GOLF COACHING ON THE EFFICACY OF GOLF SWING LEARNING FOR NOVICE GOLFERS

XIA, Z., YOO, K., LIU, Y.

SHANGHAI UNIVERSITY OF SPORT

INTRODUCTION: The traditional golf teaching mostly depends on coaches' individual empirical pedagogy and lacks scientific studies. It was reported that audible stimulus could improve the motor learning efficiency in many sports. Therefore, the purpose of the study was to explore whether the audio stimulus could improve the movement quality for novice golfers in golf swing learning after 5 weeks golf lessons.
METHODS: Twenty-four male novice young participants finished 5 weeks golf swing lessons using 7-iron club. An audible stimulus teaching device was applied to the teaching with acoustical guidance group (TG, N=13). The same coach separately taught another group which had NO acoustical guidance (NG, N=11) using the same teaching program. After 5 weeks golf learning process, ten Vicon infrared cameras and two Kistler force plates were used to collect the kinematic (100Hz) and kinetic (1000Hz) data of all the participants during swing phase. The variation of center of mass (COM) and center of pressure (COP) during downswing to follow throw phase were com-

pared to evaluate motion efficiency between two groups. Also, the ball and club variables from Trackman Doppler radar device were used to measure golf performance. The T-test of independent sampler was used to analysis differences between the two groups.
RESULTS: During downswing to follow throw phase, (1) Trackman data showed that TG golf performance was significantly better than NG in the club speed, face angle, ball speed, carry distance and flight time (65.66±5.66 vs 57.64±6.41mph, P = 0.004; 4.44±2.52 vs 7.70±2.80°, P = 0.007; 87.10±9.04 vs 73.21±6.59mph, P < 0.001; 105.23±16.57 vs 78.50±13.46yards, P < 0.001; 4.41±0.68 vs 3.48±0.59s, P = 0.002); (2) the COM mean velocity (lead-trail) and COP mean velocity (lead-trail) of participants in TG were faster than NG (0.49±0.06 vs 0.48±0.05m/s, P = 0.43; 1.58±0.60 vs 1.44±0.58m/s, P = 0.57); (3) the COM-COP inclination mean angle velocity (anterior-posterior and lead-trail) in TG was faster than NG (17.78±4.73 vs 17.55±5.03°/s, P = 0.91; 43.54±11.96 vs 38.62±13.19°/s, P = 0.35); and the COM-COP inclination angle normalized jerk in TG was lower than NG (2516.10±1215.97 vs 2765.42±1056.57, P = 0.60; 1935.49±748.96 vs 2134.91±776.66, P = 0.53).
CONCLUSION: The current study has identified that the audible stimulus as a golf coaching method could have a positive influence on the golf performance for novice golfers. It may be expected to build a prominent neuromuscular reflection in learning movement for the participants. Although the differences of results were not significant between two groups, the higher tendency of outcomes in TG was found to compare with NG. The high value of velocity of COM, COP and COM-COP inclination angle could support the golf performance outcomes based on the proximal-distal system in golf swing. And the lower normalized jerk value of COM-COP inclination angle may represent smoothness on the swing. So, the current study may acknowledge that the efficacy of audible stimulus as a golf coaching strategy has patent for novice golfers.

Mini-Orals

MO-PM24 Strength

EFFECT OF ALTITUDE STRENGTH TRAINING ON NEUROMUSCULAR FUNCTION

ŠTIRN, I., TOMAŽIN, K., SMAJLA, D., STROJNIK, V., PADIAL, P., ALMEIDA, F., MORALES-ARTACHO, A., BONITCH-GONGORA, J., DE LA FUENTE, B., CALDERÓN, C., PÉREZ-CASTILLA, A., FERICHE, B.

DEPARTMENT OF PHYSICAL EDUCATION AND SPORT. UNIVERSITY OF GRANADA, SPAIN; FACULTY OF SPORT UNIVERSITY OF LJUBLJANA; HIGH PERFORMANCE CENTRE OF SIERRA NEVADA,UNIVERSITY OF LJUBLJANA, FACULTY OF SPORT

INTRODUCTION: Altitude training has been widely used in sports, mainly to improve endurance; however, altitude resistance training (RTH) has recently became a growing area of interest Recent reviews on the topic reported different conclusions: Ramos-Campo et al. (2018) reported that although RTH improved muscle size and strength, this strategy did not provide significant benefit over similar training in normoxia. However, Feriche et al., (2017) pointed out that terrestrial altitude conditions may have potential of improving the ability to perform power actions as has also been confirmed by Hamlin et al, 2015.
The aim of this study was to analyze the effect of a power-oriented RTH intervention at moderate altitude on neuro-muscular function.
METHODS: Twenty elite judokas were mobilized to participate in the study and divided in the control (C - sea level, n=11) and experimental (A – altitude 2320 m, n=9) group. Both groups executed 6 physical training session/week (3 resistance training alternated with three metabolic sessions) in the morning from Monday to Saturday. In the afternoon, technical Judo training sessions were performed from Monday to Friday. The physical training were exactly the same for both groups.
Maximal knee extension torque (MKT), the level of muscle activation (LA) assessed by interpolated twitch technique and the amplitude (TWA) and contraction time (TWCT) of a single twitch were measured a week pre and a week post intervention. Repeated measures ANOVA was used to analyze the results.
RESULTS: No statistically significant differences between groups were found in neither of the observed variables: MKT - 318.7 ± 61.6 Nm vs. 319.7 ± 58.6 for A, 294.6 ± 62.6 vs. 307.1 ± 68.7 for C (P(group*intervention) = 0.437); LA - 94.4 ± 3.5% vs. 92.1 ± 4.7% for A, 92.7 ± 9.5% vs. 92.4% ± 5.5 for C (p = 0.521); TWA – 83.3 ± 22.1 vs. 84.9 ± 15.3 for A, 78.9 ±17.9 vs. 87.7 ± 18.2 for C, (p = 0.424) and TWCT – 53.8 ± 4.4 vs. 58.1 ± 6.6 for A, 53.8 ± 6.2 vs 53.1 ± 5.6, (p=0.077).
CONCLUSION: Our results showed no differences in measured variables pre and post intervention neither for the experimental or control group. The absolute torque values as well as high muscle activation level measured prior the intervention imply that our subjects were highly trained athletes already as they enter the study. Perhaps this was the reason that their performance over the three weeks of experimental strength training period did not improve. Results obtained do not support the thesis that the potential effect of the moderate altitude on explosive movement can be explained by changes in these neuro-muscular variables.
In conclusion, our result showed no difference in obtained neuro-muscular function parameters after three weeks of RT at sea level or at moderate altitude in highly trained athletes.

A COMPARISON OF PERIODIZATION MODELS IN TRAINED ADOLESCENT AMERICAN FOOTBALL PLAYERS.

GAVANDA, S., GEISLER, S., SCHIFFER, T.

IST HOCHSCHULE

INTRODUCTION: Periodization is the systematic structuring of training variables. It is well documented that periodized resistance training is effective for increasing muscle mass, strength and sports performance. Besides the traditional model there are two commonly used periodization models in strength training. The non-linear or undulating periodization which offers weekly or daily variation of training variables (daily undulating periodization = DUP) and block periodization (BLOCK) with only little variation of intensity, volume, frequency and rest for usually a certain number of weeks. It is still unclear if there is a superior model for athletes with different training backgrounds. The purpose of this study was to compare the effects of DUP and BLOCK resistance training with equated volume on strength, performance and body composition in well trained adolescent American Football players.
METHODS: Eighteen resistance trained male subjects (age: 16.94 ± 0.8 years, weight training experience: 1.39 ± 0.80 years) were randomly assigned to either BLOCK (n = 8) or DUP (n = 10) intervention group. Pre- and post-testing consisted of body composition analysis (BIA), muscle thickness assessment via ultrasound (M. rectus femoris [RF], M. vastus lateralis [VL] and M. triceps brachii [TB]) and tests for performance (1-RM back squat [BS] and bench press [BP], medicine ball put [MBP], CMJ and 40-y dash). The 12-week training programs consisted of 3 full-body workouts per week with the periodization model applied on BS and BP.

RESULTS: There were no significant ($p < 0.05$) differences in pre-test values between groups. Significant time effects were seen for RF ($p = 0.001$), BS ($p = 0.000$), BP ($p = 0.044$) and 40-y dash time ($p = 0.007$). No significant time by group effects have been observed.
CONCLUSION: These finding suggest that both periodization models may be equally effective for increasing performance and muscle thickness in trained male adolescent American football players.

EFFECT OF SUPERVISION AND STRENGTH TRAINING OPTIMIZATION DURING MAXIMAL STRENGTH AND FOLLOWED BY POWER TRAINING

PELTONEN, H., KOSKINEN, O., AHTIAINEN, J., AVELA, J., HÄKKINEN, K.
UNIVERSITY OF JYVÄSKYLÄ

INTRODUCTION: Exercise supervision and individually tailored training programs have major effects on improvements in neuromuscular performance capacity due to strength training. The benefits of the supervision has been shown earlier (Mazzetti et al. 2000), but the effects of the individual optimized strength training is more complicated to investigate. In addition, the methods and parameters of optimization could be varied based on training backgrounds and the goals of the individuals (Jimenez-Reyes et al. 2017, Nindl et al. 2015).
METHODS: 26 untrained men participated in a progressive strength training period for 13 weeks, including specific training targets; muscle endurance (4 weeks), maximal strength with low volume of muscular power exercises (7 weeks) and power with low volume of maximal strength exercises (2 weeks) training. Subjects were divided into three groups after 4 weeks of training; unsupervised (UnSup), fully supervised (Sup) or fully supervised with optimized training program (Opt). All groups had a similar whole body strength training program with the "GymCoachTM" monitoring device (selector pin) and software in their cellular phones. Only the Opt group's GymCoach software modified their training programs set by set in the gym, when needed. During weeks 4-11, the optimization recalculated one-repetition maximum (1RM) based on the last best set, and during weeks 11-13, it decreased load for the next set, if repetition velocities were reduced. The lab tests included 1RM, peak power with 60% 1RM load, isometric maximal voluntary contraction and rate of force development in leg press devices.
RESULTS: Both supervised groups improved their 1RM more (mean value of 17±10%) compared to the UnSup group ($p<0.05$) during weeks 0-11. However, only the Opt group improved (19±8%, $p<0.001$) their maximal power, but not Sup, compared to the UnSup group during weeks 11-13. The changes in the isometric test results were parallel with dynamic test results, but not statistically significant.
CONCLUSION: Strength training with supervision leads to additional strength gains. Velocity based one variable optimization during weeks 11-13 seemed to be effective for power training. Nevertheless, the present optimized training loads with a progressive training program (weeks 4-11) might be too stressful to maximize improvements in maximal strength. However, whether multivariable optimization algorithms is more effective needs to be investigated.
REFERENCES: Jimenez-Reyes P, Samozino P, Brughelli M, Morin JB. Front Physiol. 7(677):1-13, 2017.
Mazzetti SA, Kraemer WJ, Volek JS, Duncan ND, Ratamess NA, Gomez AL, Newton RU, Häkkinen K, Fleck SJ. Med Sci Sports Exerc. 32(6):1175-1184, 2000.
Nindl BC, Jaffin DP, Dretsch MN, Cheuvront SN, Wesensten NJ, Kent ML, Grunberg NE, Pierce JR, Barry ES, Scott JM, Young AJ, O'Connor FG, Deuster PA. J Strength Cond Res. 29(11S):S221-S245, 2015.

STRENGTH-RELATED ADAPTATIONS TO A STRENGTH TRAINING METHOD CHARACTERIZED BY A BRIEF INTERSET REST INTERVAL AND AN INCREASING NUMBER OF REPETITIONS ACROSS SETS

STRAGIER, S.1,2, BAUDRY, S.2, CARPENTIER, A.1, DUCHATEAU, J.2
UNIVERSITÉ LIBRE DE BRUXELLES

INTRODUCTION: A strength training method (3/7 method) performed with a moderate load (70% of one repetition maximal (1RM)) and consisting in 5 sets of an incremental number of repetitions and a very brief rest interval between sets (≤15 s) was shown to be more effective to increase the maximum strength in bench press exercise than a more classical method (8 sets of 6 repetitions with 150s rest interval between sets; 8x6 method) performed with the same load (Laurent et al., 2016). The combination of moderate-intensity sets with short intervals might provide a superior stimulus for muscle hypertrophy (de Salles et al., 2009). The present study investigated the training-related efficacy of the 3/7 method on strength gains and muscle hypertrophy in the biceps brachii.
METHODS: Twenty-nine young adults were assigned to one of the following methods: 1) 3/7 method repeated two times after 150s of rest (n=15); 2) 8x6 method (n=14). For both groups, the training exercise consisted of lifting and lowering a load (70% of 1RM) with the elbow flexor muscles. All subject trained 2 times per week during 12 weeks. Strength gain was tested during 1RM load. Muscle thickness of the long head of the biceps brachii was measured by ultrasonography and use as an index of muscle hypertrophy.
RESULTS: The 1RM load increased ($p<0.001$) in the two groups (22.2% for 3/7 method; 12.1% for 8x6 method) but the gain was greater ($p<0.001$) for the 3/7 method. A greater increase ($p<0.01$) in muscle thickness was observed for 3/7 method (+9.7%) than 8x6 method (+5.5%) after training. The change in 1RM was positively associated with the increase in muscle thickness only for the 3/7 method ($r^2 = 0.43$; $p<0.01$).
CONCLUSION: The present study indicates that the 3/7 method represents a better stimulus for muscle hypertrophy, likely due to greater metabolic stress and restriction in oxygen supply (Manini et Clark, 2009; Penzer et al., 2016). Such muscular adaptations contribute to a greater strength gain in response to the 3/7 method compared with a more classical method for a similar training intensity and volume.
REFERENCES:
Laurent et al. (2016). Science and Sports. 31 : e115-e121
de Salles et al. (2009). Sports Medicine. 39(9):765-77
Manini et Clark (2009). Exerc Sport Sci Rev. 37(2) :78-85
Penzer et al. (2016). Eur J Appl Physiol. 116(9):1795-806
Contact : Severine.Stragier@ulb.ac.be

EFFECT OF SEATED SHORT-SPRINT TRAINING ON ERGOMETER VS HEAVY STRENGTH TRAINING ON 55-METER SPRINT PERFORMANCE IN WELL-TRAINED CYCLIST

BOVIM, L.P., GUNDERSEN, H., HAFSTAD, A., KRISTOFFERSEN, M.

WESTERN NORWAY UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Short sprint (SS) training on an ergometer and heavy strength training (HS) are widely used methods among elite cyclists. The aim of this study was to investigate the effect of seated SS training on a WattBike ergometer vs HS training on performing a seated and standing 55m sprint on own bike.
METHODS: Twenty well trained cyclists (age: 27 ± 6 yrs, VO2max: 62.1 ± 6.5 ml·kg-1·min-1, body fat: 12.4 ± 5.2%) participated in a 6 week training intervention. Participants were randomized either to perform HS training (n=11) or SS training (n=9). All participants performed familiarization HS training four week before randomization and pre-testing. The HS intervention consisted of half-squats performed in a smith-machine, single leg press, one-legged hip flexion and toe raises twice a week. During the two first weeks, each set consisted of 8 repetition maximum (RM) in one of the weekly training session and of 5 RM in the second training session. In the next 4 weeks, one of the weekly training session consisted of 6 RM and the second of 4 RM. All exercise were performed with maximal effort and with 3 set and with 2 min recovery in-between sets. SS training was performed seated on an air braked bicycle ergometer (WattBike, WattBike Ltd, Nottingham, UK), and consisted of 12 intervals of 4-8 sec with 2 min recovery in-between intervals, and with 5 min active recovery (70% HRmax) after the 4th and 8th interval. HS and SS training was included in addition to usual endurance training. Before and after the intervention participants performed a 55 m sprint in a garage from a stand still start, both in seated and standing position. All participant performed a familiarization session were choice of gear ratio and air pressure in the tires was determined <1 week before testing. Time was measured with timing gates (Musclelab, Ergotest, Norway) at 10m, 20m, 30m and 55m. 1RM squat in smith-machine (TKO, Houston, USA), VO2max (Oxycon Pro, Erich Jaeger GmbH, Hoechberg, Germany), lactate profile (Biosen S-line, EKF diagnostics, Germany) and body composition (Biospace, Tokyo, Japan) was tested on separate day.
RESULTS: The SS-group showed a significant improvement on the 55m sprint test when seated (-.296 sec ±.19, p=.016), but not in standing position (-.073 sec ±.17, p=.266). Further, there was a significant decrease in 1RM squat (-5.0±5 kg, p=.03). No significant change was seen in the HS-group regarding sprint performance, although there was a significant increase in strength (8.7±7.3 kg, p=.003). There is a significant within-group difference in both sitting sprint and strength (p<.001).
CONCLUSION: Our result shows that seated sprint training on an ergometer improves seated sprint performed on bike, which indicates that sprint training on ergometer has a transfer value in well-trained cyclist.

TYRE-PULLING AS CONCURRENT TRAINING

MAMEN, A., FREDRIKSEN, P.M.

KRISTIANIA UNIVERSITY COLLEGE

INTRODUCTION: Concurrent training have gained popularity as a fitness promoting activity. The focus of this study was to investigate the feasibility of Tyre-pulling as a strength and endurance training exercise.
METHODS: Thirty-four volunteered participants accepted to comply with an eight-week training program, and were by drawing lots divided into three groups: Long distance training, high-intensity interval training and control groups. The long-distance group exercised 60 min at 75 to 85% of HRmax three times a week. The high-intensity interval group also exercised three times a week with 10 intervals of 20 s and a rest of 10 s in an all-out intensity. The control group continue their ordinary activities. A test battery measuring arm and leg strength, core strength, and endurance, were taken at the beginning and after eight weeks. Anthropometric measurements and spirometry test were performed likewise.
RESULTS: Maximal oxygen uptake, arm, and leg strength increased in the high-intensity interval group. Systolic blood pressure was reduced. Leg strength and core strength increased in the long-distance group. In addition, systolic blood pressure and resting heart rate were reduced. No significant changes observed in the control group.
CONCLUSION: Tyre- pulling is feasible for training endurance and strength at both low and high-intensity.

THE EFFECTS OF HEAVY STRENGTH TRAINING VERSUS SHORT SPRINT TRAINING ON SPRINT PERFORMANCE, AND 5 MIN ALL OUT CYCLING IN WELL-TRAINED CYCLIST

KRISTOFFERSEN, M.1,2, SANDBAKK, Ø.2, RØNNESTAD, B.R.3, HAFSTAD, A.1, GUNDERSE, H.1

1. WESTERN NORWAY UNIVERSITY OF APPLIED SCIENCES, 2. NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY, 3. INLAND NORWAY UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Road cycling is an endurance sport, but often decided in a final sprint. To improve sprint and cycling performance, many competitive cyclists regularly add heavy strength (HS) and short sprint (SS) training to the endurance training. The aim of the present study was to compare effects of HS and SS training on peak and average power production (PP and AvgP) in 6 sec and 30 sec sprints, and power production during the 5 last minutes of 100 min prolonged cycling.
METHODS: Thirty well-trained cyclist (age: 29±6 year, VO2max: 61.3±5.8 ml/kg/min) performed a battery of physical testes at baseline, after 4 weeks of HS familiarization training (pre-test), and then 6 weeks after either the HS (n=16) or SS (n=14) training interventions (post-test). During the training intervention, participants in the HS group performed a periodized program (10-4 repetitions x 3 sets) including half-squats in a smith-machine, single leg press, one-legged hip flexion and toe raises twice a week.The SS training consisted of 3 series of 4 (4-8 sec) intervals performed seated on an air braked WattBike ergometer. Tests were conducted over two days with a minimum of 48 hours in-between: On day 1, 1RM half-squat in a smith machine, a lactate profile and a VO2max-test was performed. On day 2, a 100 min cycling test on a Lode electromagnetically braked cycle ergometer was performed (5-min cycling at 150 W, 5 min at 175 W, 5 min at the individual's power at 2 mmol/L blood lactate level (calculated from the lactate profile test), 3x6 sec seated sprints, a 30 sec wingate test (WAnT), 60 min cycling at same power as measured at 2 mmol/L blood lactate level, 3 x 6 sec seated sprints, 5 min at 175 W, and finally 5 min-all out cycling).
RESULTS: There were no difference between groups in pre- to post-test changes in VO2max (p=.85) or power production at 4 mmol/L (p=.31). In the 6-sec sprints, the SS group had a 6.4% increase in PP (p<.001) and a 5% increase in AvgP (p=.001). In the WAnT, the SS group had a 6% increase in PP (p<.001), while both groups had a increase in AvgP: 3.6% (p=.001) in the SS group, and 1.1% (p=.045) in the HS group. No difference was found within or between groups in 5-min all-out cycling.

CONCLUSION: Six weeks of seated SS training had a positive effects on peak and average power in 6- and 30-sec seated sprints, while HS training had a positeve effect on AvgP in the 30 sec sprint. However, none of these methods influenced AvgP in 5-min all-out cycling after 95-min cycling.

Mini-Orals

MO-SH02 Motivation , self efficacy and coach behaviours

PERCEIVED COACH EMPOWERING CLIMATE AND BURNOUT: THE MODERATOR ROLE OF ATHLETES AUTONOMOUS MOTIVATION

LOPEZ-WALLE, J.1, TRISTAN, J.1, FLORES, M.2, PÉREZ, M.J.1, ATIENZA, F.3, BALAGUER, I.3

1: UANL , 2: UACJ , 3: UV .

Introduction: Based in Dudas (2013) hierarchical conceptualization of the coach created motivational climate, the purpose of this study was to examine the moderator effect of autonomous motivation on the relationship between perceived empowering climate and athletes burnout.
Methods: University athletes (N = 333, M age = 20.88, SD = 2.14) completed the Mexican versions of the questionnaires assessing their perceptions of coach-created empowering climate (EDMCQ-C, Appleton et al., 2016), autonomous motivation (SMS-II, Pelletier et al., 2013), and burnout (ABQ, Raedeke & Smith, 2009).
Results: Following the recommendations of Hayes (2013) the results obtained using moderated regression analyses showed that autonomous motivation moderated the relationship between the perceived coach empowering climate and athletes burnout ($F = 61.06$, $R2 = .380$, $R2\text{-chng} = .022$, $p < .01$). The relationship between the perceived coach empowering climate and burnout was negative and significant only when the athletes reported medium or high levels of autonomous motivation. Specifically, when the autonomous motivation score was at least 4.21, coach perceived empowering climate and burnout were significantly related. As autonomous motivation increased, the negative relationships between perceived coach empowering climate and burnout became more negative.
Conclusion
Medium-high levels of athletes autonomous motivation contributes to diminish the possibility of athletes burnout. In consequence, it is important that coaches promote empowering climates in order to favor quality of athletes motivation.
References: Appleton, P. R., Ntoumanis, N., Quested, E., Viladrich, C., & Duda, J. L. (2016). Initial validation of the coach-created empowering and disempowering motivational climate questionnaire (EDMCQ-C). Psychology of Sport & Exercise, 22, 53-65. http://dx.doi.org/10.1016/j.psychsport.2015.05.008.
Duda, J. L. (2013). The conceptual and empirical foundations of empowering coaching™: Setting the stage for the PAPA project. International Journal of Sport and Exercise Psychology, 11, 311-318. http://dx.doi.org/10.1080/1612197X.2013.839414.
Hayes, A. F. (2013). Introduction to mediation, moderation, and conditional process analysis. New York: The Guilford Press.
Pelletier, L. G., Rocchi, M. A., Vallerand, R. J., Deci, E. L. y Ryan, R. M. (2013). Validation of the Revised Sport Motivation Scale (SMS-II). Psychology of Sport & Exercise, 14, 329-341. http://dx.doi.org/10.1016/j.psychsport.2012.12.002
Raedeke, T. D., & Smith, A. L. (2009). The athlete burnout questionnaire manual. Morgantown, WV: Fitness Information Technology.

PERCEIVED COACH EMPOWERING CLIMATE AND MOTIVATION IN YOUNG SOCCER PLAYERS: A LONGITUDINAL STUDY

CASTILLO-JIMENEZ, N.1, LOPEZ-WALLE, J.M.1, TRISTAN, J.1, BALAGUER, I.2

1:UANL , 2:UV

Introduction: It has been suggested that a positive and adaptive experience in the sport context is more likely to be evident when children participate in an empowering climate (Duda, 2013). Specifically it has been defended that when coaches create empowering climates, autonomous motivation of young athletes is promoted (Duda, Appleton, Stebbings & Balaguer, 2018).
The aim of the study was to examine the relationship between athletes' perceptions of coach empowering climate at the beginning of the sport season and forms of motivation at the middle of the season in young soccer players.
Methods: In this study participated 385 young soccer players, ranged in age from 12 to 14 years old (Mage= 12.41; SD = .89) who completed the Spanish versions of the questionnaires assessing their perceptions of coach-created empowering climate (EDMCQ-C; Appleton et al., 2016), and three forms of motivation, autonomous motivation (AUT), controlled motivation (CON) and amotivation (AM) (BRSQ-6; Lonsdale et al, 2008). Participants spend three days per week training (SD =1.11) and had played with their current coach an average of two years (SD= 1.37).
Results: Structural Equation Modelling (SEM) indicated that the tested model exhibited very good fit ($\chi2/gl = 2.17$, $RMSEA = .04$). Athletes' perceptions of the empowering climate created by the coach at the beginning of the season, positively predicted autonomous motivation ($\beta = .20$, $p < .01$), and negatively predicted controlled motivation ($\beta = -.68$, $p < .01$) and amotivation ($\beta = -.69$, $p < .01$) at the middle of the season.
Discussion: Our results emphasized that is important to guarantee that the environment created by the coach is empowering from the start of the season to guarantee the quality of the athletes' involvement in sports across the season.
References: Appleton, P., Ntoumanis, N., Quested, E., Viladrich, C., & Duda, J. L. (2016). Initial validation of the coach-created Empowering and Disempowering Motivational Climate Questionnaire (EDMCQ-C). Psychology of Sport and Exercise, 22, 53–65. doi: 10.1016/j.psychsport.2015.05.008.
Duda , J. L. (2013). The conceptual and empirical foundations of Empowering Coaching™: Setting the stage for the PAPA project. International Journal of Sport & Exercise Psychology, 11, 311– 18.
Duda, J. L., Appleton, P. R., Stebbings, J., & Balaguer, I. (2018). Towards more empowering and less disempowering environments in youth sport. In C. J. Knight, C. G. Harwood, & D. Gould (Eds.), Sport psychology for young athletes (pp. 81-93). New York, NY: Routledge.
Lonsdale, C., Hodge, K., & Rose, E. A. (2008). The Behavioral Regulation in Sport Questionnaire (BRSQ): Instrument Development and Initial Validity Evidence. Journal of Sport & Exercise Psychology, 30, 323-355.
Funding
Research funded by the Thematic Network Consejo Nacional de Ciencia y Tecnología (REDDECA), México.

Contact: Nallely Castillo Jimenez [ncj0312@gmail.com]

LIFE ASPIRATIONS AND PASSION IN ARGENTINE ATHLETES FROM YOUTH OLYMPIC GAMES

RAIMUNDI, M.

NATIONAL COUNCIL OF SCIENTIFIC AND TECHNIQUE RESEARCH

LIFE ASPIRATIONS AND PASSION IN ARGENTINE ATHLETES FROM YOUTH OLYMPIC GAMES
Raimundi, M. J.1,2; Iglesias, D.2; García-Arabehety, M.2; Pérez Gaido, M.2; Celsi, I.2; Schmidt, V. 1,2 & Castillo, I. 3 1National Council of Scientific and Technique Research . 2Research Institute, Faculty of Psychology, University of Buenos Aires, Argentina. 3University of Valencia, Spain.
Introduction: Self Determination Theory conceptualizes life aspirations as essential aspects of motivation that influence the quality of experience and well-being. There are two types of aspirations: intrinsic aspirations are related to personal growth, meaningful relationships and community contributions. On the contrary, extrinsic aspirations imply the achievement of rewards and the recognition of others. Another concept addressed from the SDT is passion, defined as a strong inclination over an activity that the person enjoys or loves, in which he invests time and energy and is internalized as part of his own. The Dualistic Model of passion posits that two distinct types of passion develop as a result of the type of internalization process that takes place: harmonious and obsessive. Several studies have indicated that these types of passion are related to important outcomes in relation to the quality of experiences in different activities. From this arises the question about how an adolescent can develop a positive involvement in elite sport. The present study hypothesizes that aspirations could be antecedents for the development of a passion that leads to positive outcomes in sport experiences. The aim of this work was to analyze life aspirations of adolescent elite athletes and their relationship with the passion they have with respect to their sport.
Methods: Participants were 234 Argentine athletes <47.9% male, 52.1% female> aged between 12 and 16 years from National Sport Development Plan selected to train for the next Youth Olympic Games . All adolescents answered a sociodemographic questionnaire, Aspirations Index and Passion Scale.
Results: Results showed that boys had significantly higher scores than girls on wealth and fame aspirations, as well as on obsessive passion, while there were no significant differences depending on the type of sport . For boys, personal growth predicted harmonious passion, while health and community contribution were for girls' harmonious passion. Fame was the only predictor of obsessive passion in the boys group. There were no significant predictors for girls' obsessive passion.
Discussion: These results support previous studies about the role of intrinsic and extrinsic aspirations in enabling of engagement and positive development in adolescent elite sports.
Contact: jraimundi@psi.uba.ar

THE CONCEPTUALIZATION OF EFFECTIVE COMMUNICATION IN SPORTS TEAMS

LEE, C., LIAO, C.

NATIONAL TAIWAN SPORT UNIVERSITY

The conceptualization of effective communication in sports teams
Chi-Chung Lee and Chu-Min Liao
National Taiwan Sport University
Introduction: Communication among teammates is the foundation of successful team functioning. However, in sports, few studies have systematically investigated the effectiveness of communication among teammates. According to social exchange theory, communication is a process in which individuals exchange resources through message transmission. We argued that, for team communication to be effective, team members should be able to send and receive adequate messages in appropriate ways so as to complete the exchanging process of key resources. The purpose of this study was to explore the essence of effective communication in sports teams.
Methods: A qualitative approach was adopted. Eighteen college athletes (9 males, 9 females), aged 20 to 26 (M=21.67, SD=1.85), from 16 Division I varsity teams of 8 different sports were interviewed. The interviews were semi-structured and conducted following an interview guide with questions concerning what was communicated among teammates, how teammates communicate to each other, and how to send and receive messages effectively during team communication. Interview data were analyzed according to the principles of grounded theory, and an investigator-triangulation was used to ensure the trustworthiness of the data.
Results: Data were condensed into 3 higher-order themes representing the three major components of effective communication in sports teams: communication content, communication style, and communication completeness. Communication content comprised five sub-themes (Technique, Strategy, Goal, Emotion, and Responsibility) reflecting the resources pertaining to team functioning exchanged among teammates. Communication style was composed of five sub-themes (Encouraging, Openness, Equality, Empathy, Distinctiveness) illustrating the positive manners in which team members exchange resources. Communication completeness consisted of five sub-themes (Adaptation, Confirmation, Clarity, Attention, Responsiveness) demonstrating team members' ability to send and receive messages effectively.
Discussion: Effective communication is a dynamic process in which team members complete the exchanging procedure of resources pertaining to team functioning in positive ways. Communication content, communication style, and communication completeness are the key elements of effective communication. Communication content stands for resources pertaining to team functioning (the what), communication style represents the positive manners in which team members exchange resources (the how), and communication completeness demonstrates team members' ability to transmit messages effectively (the completion). As communication among teammates plays an important role in team functioning, the relationship between effective communication in sports teams and team functioning is worthy of further investigation.

INVESTIGATING CONFIDENCE AND SELF-EFFICACY RATINGS IN ATHLETIC TRAINING STUDENTS IN JAPAN: A PILOT STUDY

IDE, Y.1, OKAWA, M.2, FURUSHO, A.1, HIRASAKI, K.1

1:KUNSW, 2:TU

Introduction: In Japan, there is 3453 number of certified Japan Sports Association Athletic Trainer (JASA-AT) engaged in competitive sports and health industry with the qualification (as of October 1, 2017). The purpose of this study was to conduct a pilot study investigation of the

relationship between athletic training students' self-confidence and self-efficacy in the junior and the senior students to identify the learning process of undergraduate athletic training students.
Method
Subjects were seventeen students currently enrolled in medical university, which has the JASA-AT accredited program. The Athletic Training Student Confidence Scale (ATSCS) questionnaire consisted of 30 items. Subjects scored each item on a 5-point Likert scale to rate their confidence in completing athletic training program. The General Self-Efficacy Scale (GSES; Sakano&Tohjoh, 1986; Bandura, 1977) consisted of 16 items were rated on a 2-point scale and the total score relating to high self-efficacy was used in the analysis (range: 0-16). Three factors were able to measure in the GSES. All statistical analyses were calculated with a confidence level of $p<.05$.
Result
The GSES score for the senior students were 9.1±3.6 and the junior students were 7.8±2.5. In the junior students, confidence in abilities as an athletic trainer and anxiety about failure had no correlation ($r=-.385$, $p=.272$), however, the senior students had a strong correlation between those ($r=.761$, $p=.047$) ($p=.025$[difference between Jr. and Sr.]).
Discussion: Bandura introduced four major sources of efficacy information (Bandura, 1977). Typically, past accomplishments are most significant source for developing self- efficacy (Nakajima et al, 2013). Therefore, the senior students had higher score, because they were exposed more opportunity to achieve mastery experiences because of program progression that increasing responsibility across semester. The senior students had a strong correlation between confidence in abilities as an athletic trainer and anxiety about failure, whereas, the junior students were not. The junior students had few opportunities because of program progression, therefore, they did not have confidence in abilities as an athletic trainer. On the other hand, in the senior students, it may be suspected that they become prudent in making judgements, that is, they may develop the skill of critical thinking, included prudent in making judgments, and willing to reconsider (APA, 1990). Further studies are needed in order to identify the process of improvement of students' abilities and confidence with longitudinal method. Additionally, it is necessary to develop instruments which are designed to measure the integration of knowledge and skills from athletic training field to compare with students' confidence and self-efficacy.
Contact : yukowh@kyushu-ns.ac.jp

'EVERYTHING CAME OUT ABOUT THE COLLUSION': POWER RELATIONS AFFECTING THE IMPLEMENTATION OF A TALENT DEVELOPMENT SYSTEM

FEDDERSEN, N.B.1, MORRIS, R.1, LITTLEWOOD, M.1, RICHARDSON, D.1

1: LIVERPOOL JOHN MOORES UNIVERSITY

Introduction: Managing interdependencies effectively may be the key to effective changes in elite sports systems. However, a challenge is to ascertain how change strategies are impacted by internal and external power relations . This study aimed to design and implement change strategies in a national talent development system and explore how power relations affected the efficacy of implementation.
Methods: We employed an action research design, conducting participant observations <100 h> and nine focus groups, two with athletes , four with coaches , two with parents of athletes , and one with TD personnel of the national governing body . We analysed the data using grounded theory coding .
Results: We found that the NGB experienced a fragmented sporting community, which they had alienated by imposing a centralised performance programme. This programme forced athletes to break with their club resulting in diminishing belief and trust in the NGB and club coaches actively combating the programme. Culture change was identified as the macro-level change strategy. This strategy was operationalised through three micro-level strategies: <1> establishing a decentralised TD centre strategy <2> selection policies for youth national teams, and <3> national TD camps. Short-term performance goals were viewed as a catalysing factor to positively impact change strategies. External stakeholders tried to undermine the strategies through social dominance and collusion to keep athletes from participating, ultimately to limit performance goals.
Discussion: Our findings shed light on culture as a dynamic process impacted by interdependent power relations . Such relations were influenced by influential members of the NGB and the sporting community employing different active-disruptive behaviours such as ruthlessness and social dominance to combat strategies. Behaviours manipulating athletes to undermine change strategies may be employed because of pressure to reach short-term performance targets. NGBs should give consideration to how they can mitigate active-disruptive behaviours, and how the impact of power relations and short-term goals may limit the efficacy of the implementation of strategies in a TD system.
References:
Corbin, J., & Strauss, A. <2015>. Basics of Qualitative Research - Techniques and Procedures for Developing Grounded Theory <4th ed.>. SAGE Publications Inc.
Cruickshank, A., & Collins, D. <2012>. Journal of Applied Sport Psychology, 24<3>, 338–355.
Gilbourne, D., & Richardson, D. <2005>. Journal of Sports Sciences, 23<6>, 651–658.
Contact: n.b.feddersen@2016.ljmu.ac.uk

THE VALIDATION OF THE CHINESE VERSION OF ACADEMIC AND ATHLETIC IDENTITY SCALE

YANG, C.H.1, YUKHYMENKO-LESCROART, M.A.2, LIAO, C.M.1

1: NTSU , 2: CSUFRESNO

The validation of the Chinese version of Academic and Athletic Identity Scale
Yang, C. H.1,Yukhymenko-Lescroart, M. A.2, Liao, C. M.1
1: NTSU (Toayuan, Taiwan), 2: CSUFresno (California, USA)
Introduction: Student-athletes have to fulfill both the duties of a student and an athlete. However, these two roles usually conflict against each other. Studies have showed that student-athletes spent a significant amount of their time in athletic activities at the expanse of academic and social activities (Ayers, Pazmino-Cevallos, & Dobose, 2012). In sport, the athletic identity is dominant in student-athletes, and other identities have always been ignored, especially academic identity. For the adaptive development of student-athletes, we should pay more attention on their multiple-role identity. Yukhymenko-Lescroart (2014) has developed a reliable and valid instrument, Academic and Athletic Identity Scale (AAIS), to measure the extent to which being academically and athletically engaged is central to one's sense of self. The purpose of this study was to translate AAIS to Chinese and examine its validity.
Methods: Items of AAIS (English language) were translated into Chinese language (traditional font) with a back-translation procedure. 132 collegiate student-athletes (male= 51, female= 81; mean age= 20.33, SD= 3.46) from 20 sports participated in this study, and filled in the

online questionnaire. Some adaptation of the AAIS have been proposed in order to enable its application to Taiwanese people. Exploratory factor analysis (EFA) and item analysis were conducted.
Results: EFA revealed a two-factors solution including athletic identity (6 items; M= 5.27, SD= 0.70) and academic identity (5 items; M= 4.22, SD= 0.93), accounting for 63.48% of total variance. Cronbach's alphas were .86 for both subscales, and the correlation between athletic identity and academic identity was not significant (r= .10, p= .246). The result was in line with the two factors outlined by Yukhymenko-Lescroart (2014).
Conclusion
In general, our data provided preliminary evidence for the factor validity and reliabilty of the Chinese version of Academic and Athletic Identity Scale for student-athletes in Taiwan. In order to examine its psychometric properties, further examination such as confirmatory factor analysis, cross validation, and measurement invariance are warranted.
References: Ayers, K., Pazmino-Cevallos, M., & Dobose, C. (2012). The 20-hour rule: Student-athletes time commitment to athletics and academics. Virginia Journal, 33(1), 22-26.
Yukhymenko-Lescroart, M. A. (2014). Student and athletes? Development of the Academic and Athletic Identity Scale (AAIS). Journal of Sport, Exercise, and Performance Psychology, 3(2), 89-101
Contact: 1030401@ntsu.edu.tw Miss Yang

FACTORS THAT INFLUENCE THE ADHERENCE TO RUGBY PRACTICE IN SPANISH YOUNG RUGBY UNION PLAYERS

MORENTE-ORIA, H.1, ROMANCE, A.R.1, GIL, F.J.1, BENÍTEZ-PORRES, J.1

UNIVERSIDAD DE MALAGA

Introduction: There are many reasons to take up a physical activity or sport. For some authors Rugby Union is considered as a leisure activity for young people (Dong, Zhang, Choe and Pugh, 2013). The aim of this study was to analyse the reasons for young Spanish rugby player to begin practising this sport. we want to know what the real reasons are in order to increase the rugby practice through recruitment campaigns appropriate to these results.
Methods: Data from 225 adolescent's rugby players (Age: 16.9±1.2 years, BMI: 23.6±4.2 kg/m 2) enrolled from 12 teams in the Spanish final championship were used. We used a questionnaire validated for starting motives in Rugby practise (Morente, Zagalaz, Romero y Carrillo, 2010), which is composed by 27 items, based on a previous questionnaires called Participation Motivation Inventory-PMI (Gill, Gross and Huddleton, 1983) and Sport Motivation Scale-SMS (Pelletier et al., 1995). Players completed the questionnaire in the beginning of the final stage under the supervision of the same researches in all cases. A descriptive statistic was conducted to examine the main reasons and associations between categories were analysed by Spearman correlations.
Results: The most valuated motivation to begin Rugby practice was "For fun" (88,9%). The items "Team spirit" (82,2%) and "Contact sport" (68,8%) were also highly valued. The least valued items were "The media" (4%) and "Teachers" (9,3%). A high correlation was obtained between "Parents influence" and "Year of practise" (rho= 0.429, $p < 0.01$); "The media" and "To be famous" (rho = 0.260, $p < 0.01$); and a high negative correlation was obtained between "For fun" and "Friends" (rho = -0.270, $p < 0.01$).
Conclusion
Our results suggest that the most valued REASON to practice rugby was "For fun". These results are similar to those obtained in other studies (Frederick & Schuster-Schmidt, 2003). Although rugby is not a popular sport in Spain, it is interesting to know the more years of practice they have, the more influence "Parents" have in the beginning of the practice of rugby. In the same line, one of the least valued are the "Media" and its high correlation with "To be famous" due to the rugby impact in Spanish society. The negative correlation between "For fun" and "Friends" highlighted players who look for friends in Rugby do not see fun in sports as an important factor.
Contact
hmorente@uma.es

15:00 - 16:00

Mini-Orals

MO-PM03 High intensity training

THE EFFECTIVENESS OF HIGH-INTENSITY INTERVAL TRAINING ON IMPROVING CARDIOMETABOLIC HEALTH AND ENDURANCE CAPACITY IN SCHOOL AGED CHILDREN: A PILOT RANDOMIZED CONTROLLED TRIAL

KETELHUT, S.1, KIRCHER, E.2, KETELHUT, S.R.3, WEHLAN, E.4, KETELHUT, K.5

1MARTIN-LUTHER-UNIVERSITY HALLE-WITTENBERG, 2SRH HOCHSCHULE FÜR GESUNDHEIT GERA, 3CHARITÉ UNIVERSITY MEDICINE BERLIN, 4HUMBOLDT-UNIVERSITY OF BERLIN, 5MSB MEDICAL SCHOOL BERLIN

INTRODUCTION: A growing body of literature confirms the efficacy of high-intensity interval training (HIIT) for improving endurance performance (EP) and eliciting health benefits in adults. Evidence supporting the effectiveness of HIIT in children and adolescents are sparse (William et al., 2017). The present study aimed to evaluate the effects of a school based HIIT intervention on EP, blood pressure (BP) and established markers of arterial compliance in school aged children.
METHODS: 46 students (mean age 10.7 ± 0.7 yr; 44% girls; BMI 19.7 ± 4.6 kg/m2) were randomized into intervention (INT) (N = 22) and control (CON) (N = 24) group. Throughout a 3 month experimental period both INT and CON took part in the regular physical education lessons (PE) 2 times a week. Only the INT received a HIIT during the first 20 minutes of the PE. Apart from an EP-test (6-min run; Bös et al., 2009), peripheral (pBP) and central (cBP) blood pressure, augmentation pressure (AP), total peripheral resistance (TPR) and aortic pulse wave velocity (aPWV) were assessed non-invasively using Mobil-O-Graph (24 PWA monitor, IEM Stolberg, GERMANY).
RESULTS: INT showed a significant improvement in EP (5.58, p= 0.003), systolic pBP (-4.54 mmHg, p= 0.002), systolic cBP (-4.15 mmHg, p= 0.002) AP (-1.13 mmHg, p= 0.028) and aPWV (-0.16 m/sec, p<0.001) respectively. No significant changes were observed in the CON. Significant difference in the mean improvement could be detected for EP (7.73, p= 0.007) systolic pBP (-6.13 mmHg, p= 0.038), systolic cBP (-5.19 mmHg, p= 0.041), TPR (-0.13 s*mmHg/ml, p= 0.023), AP (-2.02 mmHg, p= 0.013) and aPWV (-0.19 m/sec, p= 0.031), favoring INT.

CONCLUSION: The evidence from this study highlights the potential of HIIT for improving EP and hemodynamic measures already in children age 10. The favorable effects of the HIIT may be contributed to a higher exercise intensity eliciting greater sheer stress consequently increasing the release of vasoactive substances. Based on the findings it seems advisable not only to increase regular physical activity in early childhood, but moreover increasing exercise intensity. Apart from the health benefits sporadic high-intensity exercise corresponds to the natural patterns of childrens habitual play which may result in a higher perceived pleasure and compliance.

DYNAMIC CEREBRAL AUTOREGULATION IS NOT IMPAIRED DURING HIGH-INTENSITY INTERVAL EXERCISE

TSUKAMOTO, H.1, HASHIMOTO, T.1, OLESEN, N.D.2, PETERSEN, L.G.2, SØRENSEN, H.2, NIELSEN, H.B.2, SECHER, N.H.2, OGOH, S.3

1 RITSUMEIKAN UNIV. ; 2 UNIV. OF COPENHAGEN ; 3 TOYO UNIV.

INTRODUCTION: To support cerebral energy metabolism and protect brain tissue from the potentially damaging effects of hypo/hyperperfusion, cerebral blood flow is regulated by dynamic cerebral autoregulation (dCA) to adjust for changes in mean arterial pressure (MAP) [1]. Acute high-intensity continuous exercise (HICE) causes diminished brain cognitive function [2], even though exercise training with high-intensity promotes and maintains cardiovascular health more than exercise at moderate-intensity [3]. In addition, HICE impairs dCA [4], indicating that HICE training may increase the risk of cerebral vascular disease. On the other hand, high-intensity interval exercise (HIIE) enhances brain cognitive function [5] and is beneficial for patients with cardiovascular disease [6]. However, the impact of HIIE on dCA remains unknown. The purpose of the present study was to investigate the changes in dCA during HIIE using transfer function analysis (TFA) gain and phase shift between oscillations in MAP and middle cerebral artery blood flow velocity (MCA V).
METHODS: Nine healthy male subjects (24.2 ± 2.8 yr.) performed the HIIE protocols, which was preceded by a warm-up at 50-60% maximal workload (Wmax) for 5 min and included four 4 min bouts of exercise at 80-90% Wmax interspaced by four 3 min bouts at 50-60% Wmax for a total of 28 min. Transcranial Doppler determined mean MCA V, and blood pressure was measured by a brachial artery catheter.
RESULTS: HIIE increased MAP from 91.6 ± 8.7 to 114.2 ± 7.6 mmHg ($P < 0.01$) but the exercise-induced increase in MAP was gradually decreased during HIIE. In contrast, MCA V was maintained during HIIE. A TFA indicated that the phase in the low-frequency (LF; 0.07 to 0.20 Hz) range was temporarily increased during HIIE compared to rest from 32.1 ± 10.9 to 56.1 ± 15.5° ($P < 0.05$) while gain in the LF range was unchanged during HIIE.
CONCLUSION: These results indicate that the HIIE does not impair dCA. We propose that, unlike HICE [4], HIIE may be beneficial for improving brain-related health [5] without an increasing risk of cerebrovascular event. Thus, HIIE may be useful as an exercise prescription in rehabilitation programs within the clinical population.
REFERENCES:
[1] Ogoh, S and Ainslie, PN. (2009) J Appl Physiol. 107(5), 1370-80.
[2] Kamijo, K. et al. (2004) Eur J Appl Physiol. 92(3), 305-11.
[3] Schjerve, IE. et al. (2008) Clin Sci. 115(9), 283-93.
[4] Ogoh, S. et al. (2005) Am J Physiol Heart Circ Physiol. 288(3), 1461-7.
[5] Tsukamoto, H. et al. (2016) Physiol Behav. 155, 224-30.
[6] Rognmo, Ø. et al. (2012) Circulation. 126(12), 1436-40.
CONTACT:
Tsukamoto, H. [h-tsuka@fc.ritsumei.ac.jp]

HIGH INTENSITY INTERVAL TRAINING IN SWIMMING – EFFECTS OF DIFFERENT INTENSITIES

ALMEIDA, T.1,2, PESSOA-FILHO, D.2, SIMIONATO, A.2, ESPADA, M.1,3, REIS, J.1,4, ALVES, F.1

1: CIPER, BIOLAD – FACULTY OF HUMAN KINETICS, UNIVERSITY OF LISBON, 2: UNESP, LABOREH, RIO CLARO, BRAZIL, 3: SCHOOL OF EDUCATION – POLYTECHNIC INSTITUTE OF SETÚBAL, 4: UNIVERSIDADE EUROPEIA, LISBON

INTRODUCTION: The interval training has been proposed as an effective way to improve aerobic performance. However, in swimming, the studies are scarce and focus in different distances with the same intensity (Bentley, 2005). The aim of this study is to compare the oxygen uptake response (VO2) during different high intensity interval training sets in swimming.
METHODS: Fourteen well trained swimmers, 7 female and 7 male, (age 16.4±1.8yr; mass 68.3±10.6kg; height 1.73±0.1m) completed a discontinuous incremental test for the assessment of second ventilatory threshold (VT2), maximal oxygen uptake (VO2peak) and maximal aerobic velocity (MAV). In 4 different days and in randomized order, swimmers performed 4 broken 400m intermittent swimming tests (IT): (a) 3 sets of 8x50m (IT50) at 100%, 105% and 110% of MAV with 15s rest, and (b) 4x100m (IT100) at 100% of MAV, with 15s rest. For each IT session, mean (ITMVO2peak) and maximal oxygen uptake (ITVO2peak) and time spent above VT2 were recorded. All tests were conducted using a breath-by-breath apparatus (K4b2, Cosmed, Italy) connected to a swimming snorkel (AquaTrainer, Cosmed, Italy) for pulmonary gas sampling and an underwater visual pacer for velocity control (PACER 2 SWIM, KulzerTEC, Portugal).
RESULTS: ITMVO2peak and ITVO2peak in the IT50 at 100%, 105% and 110%-MAV were higher as the intensity increases, (42.94±4.65/45.83±4.62 vs 46.19±5.37/49.07±5.14 vs 49.69±5.34/52.92±5.21 ml/kg/min, respectively). Time spent above VT2 showed the same profile (34.8±43.4 vs 113.1±68.9 vs 199±68.5 s for 100%, 105% and 110%-MAV, respectively). At the IT100, the ITMVO2peak (47.34±4.65 ml/kg/min) and time above VT2 (144±68.8s) were different from the IT50 at 100%-MAV but not from IT50 at 105% and 110%-MAV. VO2peak from the incremental test (52.07±4.5 ml/kg/min) was significantly different from IT50VO2peak at 100%-MAV and 105%-MAV, but not from 110%-MAV or IT100VO2peak (49.07±4.79 ml/kg/min). MAV (1.24±0.09 m.s) was correlated with the time spent above VT2 ($r = 0.60$, $p<0.05$), mean and ITVO2peak ($r=0.56$, $p<0.05$ and $r = 0.62$, $p<0.05$, respectively) at the 110%-MAV IT50's test.
CONCLUSION: The results suggested that higher velocities than 100%-MAV are better to keep oxidative rate at maximal level (5 to 10% higher) and improve tolerance (~20 to 46%) to exercise in severe domain (ie, above VT2), whilst training with short distances bouts (50-m). These results are in line with Millet et al (2003) for running at 100 and 105% of MAV. In IT50 sessions higher MAVs seem to be related with better performance at the highest intensity (110%-MAV), the only test where VO2peak was achieved. Seeking for training schedule effectiveness to improve endurance and aerobic power, the results recommend IT50 test at least at 105%-MAV, which attained oxidative rates similar to IT100 at 100%-MAV.
Millet, G., Libicz, S., Borrani, F., Fattori, P. (2003). Eur J Appl Physiol, 90, 50-57.
Bentley, DJ., Roels, B., Hellard, P., Fauquet, C., Libicz, S., Millet, GP. (2005). J Sci Med Sport 8(4):392-402.

INFLUENCE OF PIO2 ON THE SKELETAL MUSCLE EXPRESSION OF MYOKINES DURING INTENSE EXERCISE REVEALED BY POST-EXERCISE OCCLUSION OF CIRCULATION IN HUMANS

PÉREZ-LÓPEZ, A.1, MARTIN-RINCON, M.2, PEREZ-SUAREZ, I.2, SANTANA, A.2, MORALES-ALAMO, D.2, DORADO-GARCIA, C.2, CALBET, J.A.L.2

1: UNIVERSITY OF ALCALÁ ; 2: IUIBS & UNIVERSITY OF LAS PALMAS DE GRAN CANARIA

INTRODUCTION: Myokines have a pivotal role in the metabolic adaptation to exercise. Interleukin (IL)-6, IL-15 and its alpha receptor (IL-15Rα), and fibroblast growth factor 21 (FGF21) promote fat oxidation, glucose uptake and oxidation, and glycogen synthesis in several tissues. Nevertheless, little is known regarding the mechanisms that trigger their synthesis by the skeletal muscle. In vitro and in vivo studies have shown that oxygen restriction elicits the expression of some myokines in a process mediated by AMPK. Thus, the aim of the study was to determine whether human skeletal muscle IL-6, IL-15, IL-15Rα and FGF21 are influenced by PIO2 in response to exercise.
METHODS: In separate days, eleven volunteers performed an incremental exercise (IE) to exhaustion in normoxia (PIO2=143mmHg) and hypoxia (PIO2=75mmHg). At exhaustion, the circulation of one leg was instantaneously occluded during 60s (Hokanson, 300mmHg). Muscle biopsies from vastus lateralis were obtained before (PRE) and after the 10th s from the occluded leg (POST), and simultaneously at the 60th s from the occluded (OC1M) and non-occluded leg (nOC1M). AMPK, IL-6, IL-15, IL-15Rα and FGF21 protein expressions were analyzed by Western Blot.
RESULTS: Muscle lactate, phosphocreatine (PCr) and ATP did not change between conditions. Muscle lactate increased at OC1M (25%; P<0.05) and PCr was reduced by a 94 and 48% at OC1M and nOC1M (P<0.005). pThr172/AMPK and pSer485-491/AMPK total ratios were increased in both conditions (time effect, P<0.001), while AMPK phosphorylation rate was elevated at OC1M compared to nOC1M (5.2 vs 2.5-fold; P=0.032). During the IE in hypoxia, IL-15Rα expression was upregulated (ANOVA interaction P=0.017), with a significant effect at POST and OC1M (1.3 & 1.5-fold; P<0.005), while FGF21 was also elevated at POST and OC1M (2.1 & 2.7-fold; time effect, P=0.008). IL-15Rα and FGF21 were not increased in skeletal muscle of the non-occluded leg at 1 min post-exercise. IL-6 and IL-15 protein expressions were not significantly altered.
CONCLUSION: Intense exercise increases the AMP/ATP ratio, which stimulates AMPK phosphorylation and activation. Post-exercise ischemia causes oxygen deficiency when the metabolism is still active as shown by a 22% increase in lactate accumulation. This further stimulates AMPK phosphorylation at pThr172 and may increase ROS production. In this study, skeletal muscle IL-15Rα and FGF21 expressions are facilitated by a reduced PIO2 during IE to exhaustion, coinciding with an increased AMPK phosphorylation. Therefore, a substantial energy deficit combined with hypoxia trigger the expression of IL-15Rα and FGF21, but not that of IL-6 and IL-15 in human skeletal muscle. The lack of IL-15Rα and FGF21 upregulation in the non-occluded leg may be due to the release into the circulation or to a fast turnover of both myokines during the first minute after exercise.
Grants: DEP2015-71171-R and CCG2015/BIO-069

HIGH-INTENSITY INTERVAL TRAINING IMPROVES CARDIORESPIRATORY FITNESS MORE WHEN HYPOXIC STRESS BEING MAINTAINED IN SEDENTARY YOUNG WOMEN

KONG, Z.1, LEI, L.1, LEI O.K.1, SHI, Q.2, NIE, J.2

1. UNIVERSITY OF MACAU, 2.MACAO POLYTECHNIC INSTITUTE

INTRODUCTION: Our previous study shows that short term high-intensity interval training (HIT) under normobaric hypoxia simulated at 2500 m has an additive effect on the improvement of cardiorespiratory fitness in overweight young women. The purpose of this study was to investigate whether further improvement can be observed in aerobic and aerobic capacity as well as blood lipids if hypoxic stress were maintained throughout the HIT intervention period.
METHODS: A single-blind randomized controlled experimental design was applied. 42 sedentary young women (age: 22 ± 2 years, BMI: 23 ± 3 kg·m-2) completed the HIT under normoxia (NORM, n = 14, FIO2: 0.21), or normobaric hypoxia simulated a stable altitude of 2500 m (HYPS, n = 14, FIO2: 0.15) or a graded altitude of 2500-3400 m (HYPG, n = 14, FIO2: 0.15-0.14) for 4 weeks. HIIT was composed of 80 repetitions of 6 s maximal cycling effort interspersed with 9-s recovery per day, for 3 days per week. Cardiorespiratory fitness (peak oxygen uptake (V?O2peak), anaerobic capacity with two Wingate-based test and serum lipid profile (triglycerides, total cholesterol, high-density lipoprotein cholesterol, and low-density lipoprotein cholesterol) were assessed with 4 to 5 days at pre- and post-intervention. Habitual physical activity and diary behavior were maintained during the intervention period.
RESULTS: With similar daily energy intake and physical activity, four weeks HIT resulted in significantly improvements in V?O2peak [NORM: 0.7 ± 2.7 ml·kg-1·min-1 (+3.4%), HYPS: 2.6 ± 2.8 ml·kg-1·min-1 (+10.2%), HYPS: 3.8 ± 2.8 ml·kg1·min-1 (+15.1%)]. Compared to NORM, the increments of V?O2peak in HYP (HYPS: $p > 0.05$, $d = 0.63$, HYPG: $p < 0.05$, $d = 1.02$) were greater. Moreover, no group effect was found in anaerobic capacity despite significant improvements in peak power, average power, relative average power and power decline rate ($p < 0.01$). There were no significantly changes on the serum variables after the intervention.
CONCLUSION: 4-week of HIT improved cardiorespiratory fitness and anaerobic capacity in sedentary young females. Furthermore, it seems that the additive effect of the HIT under normobaric hypoxia is more effective when hypoxic stress can be maintained.

HIGH-INTENSITY INTERVAL TRAINING (HIIT) ON THE CYCLE ERGOMETER INDUCES PERIPHERAL AND CENTRAL IMPROVEMENTS IN HEALTHY YOUNG FEMALES

MARTERER, N.

UNIVERSITY OF INNSBRUCK

INTRODUCTION: High intensity interval training (HIIT) is widely used to improve endurance performance. It has been shown that HIIT increases total hemoglobin mass that contributes to the increase in maximal oxygen uptake (VO2max) of the trained muscles (Weston, 2014 & Gibala, 2015). However it remains unclear if untrained muscles can profit from the unspecific central adaptations. Therefore the purpose of this study was to examine if a HIIT of the lower extremities result in an improved VO2max and power output of the upper extremities.
METHODS: 11 healthy female participants (24,5 ± 3,3 years, VO2max 39,6 ± 4,8 ml/min/kg) underwent a 6 week HIIT program of the lower extremities on a cycle ergometer (3 days/ week for the first 3 weeks and 4 days/ week for the last 3 weeks). Training sessions consisted of a warm-up period of 5 minutes followed by a 4 times 4-minute high intensity (85-95% of maximal heart rate) and 3-minutes rest (65-75% of maximal heart rate) interval training protocol. Before and after the training period a maximal cycle ergometry (start at 30 W, increase 30W every 3min) and a maximal crank handle ergometry (start at 20W, increase 15W every 3min) with continuous gas analy-

sis were conducted. All values are given as the mean and standard deviation. T-test for paired samples was used to test differences between pre and post training. Relationships between variables were examined with Pearson`s product moment correlations. The level of significance was set at p<.05.
RESULTS: Significant increases in VO2max on the cycle ergometer (39.6 ± 4.8 to 43.4 ± 5.7 ml/min/kg) as well as on the crank handle ergometer (25.8 ± 3.6 to 27.5 ± 4.4 ml/min/kg) from pre- to post-test were measured. The maximum heart rate decreased significantly for the crank handle exercise (179 ± 12 to 169 ±15 bpm). The maximum lactate level increased significantly for the cycle exercise (9.0 ± 1.7 to 10.2 ± 1.3 mmol/L). Peak power output on the cycle ergometer increased significantly (186 ± 42 to 201 ± 41 W), whereas it remained unchanged during crank handle ergometry (66 ± 12 to 68 ± 15 W). Increase of VO2max on the cycle ergometer correlated positively with participants` performance on the cycle ergometer (r=.747, p=.008).
CONCLUSION: Not only leg-VO2max (10%), but also the arm-VO2max (6,9%) increased significantly after 6 weeks of HIIT training of the lower extremities in healthy young females. It can be assumed that improved O2 delivery is responsible for an increased VO2max of the upper extremities but did not result in a higher peak power output of this muscle group. Further studies should focus on potential mechanisms of these effects.

INTRAMUSCULAR INJECTION OF HYPERTONIC SALINE DURING LOW INTENSITY EXERCISE CREATES EXERCISE-INDUCED PAIN SIMILAR TO THAT DURING HIGH INTENSITY EXERCISE

MAUGER, A.R.1, SMITH, S.A.1, MICKLEWRIGHT, D.P.2

1. UNIVERSITY OF KENT; 2. UNIVERSITY OF ESSEX

INTRODUCTION: Intense exercise creates a metabolic environment in the muscle that elicits exercise-induced pain (EIP). The magnitude of this response is dependent on both the intensity and the duration of the exercise, and has been suggested to limit exercise performance. However, exploring this relationship is challenging because of the need to use an experimental pain model that can be induced independently of exercise and that replicates the sensation of EIP. The intramuscular injection of hypertonic saline solution has been suggested to closely replicate EIP, but to date the sensation of this pain has not been combined with low intensity exercise and qualitatively and quantitatively compared to 'normal' EIP.
METHODS: Fifteen participants performed an isometric time to exhaustion test with the right knee extensors (20% maximal voluntary contraction; MVC) to record the associated perception of EIP. Following this on separate visits, a 1 mL bolus of 5.85% hypertonic saline was injected into participants' right vastus lateralis in both a resting condition and during a low intensity (10% MVC) isometric contraction of the right knee extensors. During all experimental conditions, participants recorded their pain intensity every 5 s using an electronic visual analogue scale, and completed a McGill Pain Questionnaire (MPQ) once pain perception returned to baseline levels.
RESULTS: The 20%MVC task elicited a quality of EIP that was predominantly described in a sensory classification as throbbing, cramping and aching, which was similar to both the rest with hypertonic saline condition and the low intensity exercise with hypertonic saline condition. The affective and evaluative classifications for 20%MVC were mainly described as exhausting and tiring (affective), and intense (evaluative) which was not replicated in the rest with hypertonic saline condition, but was in the hypertonic saline with low intensity exercise condition. The mean total pain score in the 20%MVC condition was 28, which was similar to both the rest with hypertonic saline condition (20) and the hypertonic saline with low intensity exercise condition (23).
CONCLUSION: The findings of this study suggest that the intramuscular injection of hypertonic saline in resting conditions produces a similar sensory dimension of pain to EIP, but not affective and evaluative dimensions. However, when the intramuscular injection is combined with low intensity exercise, the sensory, affective and evaluative dimensions of pain are similar to EIP. As such, this experimental pain model could be used to accurately replicate EIP, and with the level of EIP moderated independently of the intensity of the exercise performed.

HIGH INTENSITY INTERVAL TRAINING, BUT NOT ENDURANCE TRAINING, IN TYPE 2 DIABETIC PATIENTS LOWERS SUB-SARCOLEMMAL LIPID DROPLET VOLUMETRIC CONTENT BY REDUCING DROPLET SIZE IN TYPE 2 MUSCLE FIBRES

KOH, H.C., NIELSEN, J., WINDING, K.M., ØRTENBLAD, N., MORTENSEN, S.P.

UNIVERSITY OF SOUTHERN DENMARK

INTRODUCTION: Elevated levels of lipid droplets (LDs) beneath the sarcolemma have been associated with lower insulin sensitivity in obese or type 2 diabetic individuals. Moreover, endurance training has been reported to decrease the volumetric content of those LDs. Therefore, our aim was to investigate the effects of moderate intensity endurance training (END) and high intensity interval training (HIIT) on the subcellular distribution and size of LDs in skeletal muscles of type 2 diabetic patients.
METHODS: Sixteen (9 males, 7 females) sedentary overweight type 2 diabetic patients (57±7 years old) were randomised to complete 11 weeks of either 40 min cycling at 50% peak workload (END) or 10 1-min cycling intervals at 95% peak workload separated by 1 min of recovery (HIIT), 3 times per week. Assessments for aerobic fitness, body composition, glycaemic control (OGTT and continuous glucose monitoring), and muscle biopsies were performed prior and after the intervention. Quantitative electron microscopy based on stereological principles was used to estimate the volume fractions and diameters of LDs beneath the sarcolemma (subsarcolemmal) and between the myofibrils (intermyofibrillar) of biopsied leg muscles. Number of LDs was derived from volumetric estimates and diameters. Electron micrographs were taken at x6000 magnification. Muscle fibres were categorised as type 1 or type 2 fibres based on volume fractions of intermyofibrillar mitochondria and width of Z-lines.
RESULTS: Aerobic fitness, body composition and non-fasting glycaemic parameters were improved following both END and HIIT (P<0.05). In the subsarcolemmal region, there was a tendency (P=0.1) for a 3-way interaction (training group x fibre type x time) with the volume fraction of LDs lowered by ~57% in type 2 fibres following HIIT (P=0.009), but not END, and no change in type 1 fibres following both training modalities. A main time effect was shown by a ~36% volumetric reduction following training (P=0.003). A 3-way interaction between training group, fibre type and time was observed in the size of LDs represented by individual LD diameters (P=0.03). This was explained by a ~31% reduction in LD diameters in type 2 fibres, following HIIT (P<0.001) but not END, with no change in type 1 fibres following both training modalities. The number of LDs was unchanged following training in both groups. In the intermyofibrillar region, all measures of LDs remained unchanged following training in both groups.
CONCLUSION: We demonstrate that, along with improvement in glycaemic control, HIIT was able to lower subsarcolemmal LD volumetric content via a reduction in size of LDs in type 2 fibres of type 2 diabetic patients. This highlights the relevance of HIIT as an alternative time efficient training modality that could influence the links between fibre type- and subcellular localisation-dependent LD distribution and insulin sensitivity in diabetes.

THE MEASUREMENT OF WHOLE BODY GROSS EFFICIENCY WITHIN HIGH INTENSITY CYCLING EXERCISE

EBREO, R., HOPKER, J., PASSFIELD, L.

UNIVERSITY OF KENT

INTRODUCTION: Gross Efficiency (GE) in cycling is a key determinant of endurance performance; reflecting the coupling of energy expenditure to power and propulsion. Conventionally, GE is measured during submaximal exercise at intensities below the lactate threshold. However, it is unclear whether GE during high-intensity exercise (HIE) with a significant anaerobic contribution, is reflected by measurements of GE performed during submaximal exercise. Using a back extrapolation (BE) model (De Koning et al. 2013), the aim of this study was to determine if GE is affected by HIE.
METHODS: 15 trained cyclists completed a maximal incremental exercise test to determine Maximal Aerobic Power (MAP). On 3 subsequent visits participants cycled for 4 min at either 80% (T1) or 100%MAP (T2) in a randomised order with 30 min recovery between each. Each HIE bout was preceded by 6 min at 50%MAP and 2 min at 25W, followed by 1 min at 25W and 10 min at 50%MAP. GE was calculated in the last 3 min of the 50%MAP pre- and post-HIE. Using linear regression, GE values during the 50%MAP after HIE were back extrapolated to the end of the high-intensity interval to estimate GE.
RESULTS: A greater reduction in GE is seen following HIE at 100% vs 80% MAP (-3% vs 0.43%, respectively) using the BE method. BE resulted in a significantly lower GE in both T1 (20.5 1.7%) and T2 (18.2 +/-1.1%) compared to T1 and T2 Post 50%MAP (20.8 +/-1.68% P = 0.04 and 20.0 +/-1.7% P= <0.05 respectively) as well as T2 Pre50%MAP (21.2 +/-1.9% P =<0.05). There was no significant difference between T1 Pre50%MAP (20.93 +/-2.31%) and T1 BE (P =0.27). T1 Pre and Post GE were not significantly different (P = 0.51), but T2 Post GE was significantly lower than T2 Pre GE (P = 0.018). GE back extrapolated from the end of HIE was significantly correlated with Post50%MMP in T1 (r= 0.98; P = <0.05), and in T2 (r = 0.80; P = 0.001). Calculated anaerobic contribution at the end of the 4min HIE bout in both T1 and T2 was higher when using the BE method compared to assuming a constant GE from the Pre 50%MMP bout (T1 = 8.16 kj vs 6.48 kj, P = <0.05) ; T2 = 21.12 kj vs 9.36 kj, P = <0.05).
CONCLUSION: HIE acutely reduced GE during cycling. A greater anaerobic contribution to exercise at 100% MAP may contribute to this decline in efficiency and account for the lower correlation between BE GE values and those measured during Post 50%MAP. However, a greater post HIE oxygen deficit at 100%MAP compared to 80%MAP may account for the greater fall in the calculated BE values. The BE method may be a useful tool in both estimating GE during HIE and calculating aerobic and anaerobic contributions.
Reference:
De Koning J, Noordhof D, Uitslag T, et al. (2013). Int J Sports Physiol Perform, 8, 682-684

BOUT DURATION IN HIGH-INTENSITY INTERVAL EXERCISE AFFECTS CARDIORESPIRATORY AND METABOLIC RESPONSES, PERCEIVED EXERTION AND AFFECTIVE VALENCE

BOGDANIS, G.C.1, TSIRIGKAKIS, S.2, MOUGIOS, V.3, MASTORAKOS, G.4, VELIGEKAS, P.1

1,4NATIONAL & KAPODISTRIAN UNIVERSITY OF ATHENS, GREECE; 2UNIVERSITY OF THESSALY, GREECE, 3ARISTOTLE UNIVERSITY OF THESSALONIKI, GREECE.

INTRODUCTION: Although the physiological and metabolic responses to high-intensity interval exercise (HIIE) have been largely explored over the past decade, there is relatively little information regarding the perceptual and psychological responses that may influence exercise participation and adherence (Stork et al., 2017). This study compared cardiorespiratory and metabolic responses, perceived exertion and affective valence during isoenergetic continuous and HIIE exercise with bout duration ranging from very short (10 s) to moderate (60 s).
METHODS: Eleven healthy males (age, 28 ± 6 y, mean ± SD throughout) performed four trials one week apart, in random and counterbalanced order. Each trial consisted of 20 min of cycling with equal mean power output, performed either continuously (CON) or intermittently with 10 s (HIIE10), 30 s (HIIE30), or 60 s (HIIE60) bouts, at an intensity corresponding to 100% of VO2max. The exercise-to-interval ratio for the HIIE trials was 1:1.5; thus, recovery intervals were 15, 45 and 90 s of cycling at an intensity corresponding to 15% of VO2max, respectively. Oxygen uptake (VO2), pulmonary ventilation (VE), blood lactate concentration (BL), heart rate (HR), rating of perceived exertion (RPE) and affective valence (11-point feeling scale) were measured every 5 min during exercise. Results were analyzed using one-way (mean values of trials) or 2-way ANOVA (trial x time) with repeated measures and Tukey's post-hoc test.
RESULTS: Mean VO2 was lower in CON (2.02 ± 0.38 L/min, $p < 0.001$) compared with the HIIE trials, during which VO2 was similar (approx. 67% of VO2max; 2.29 ± 0.42, 2.20 ± 0.43, 2.12 ± 0.45 L/min, for HIIE15, HIIE30 and HIIE60, respectively). HR was similar in CON, HIIE10 and HIIE30, but higher in HIIE60 (peak: 167 ± 15 beats/min, $p < 0.01$). BL at the end of exercise and mean VE were lower in CON and increasingly higher in HIIE10, HIIE30 and HIIE60 (BL, from 4.9 ± 1.6 mmol/L in CON to 12.5 ± 3.5, mmol/L in HIIE60, $p<0.001$; and VE, from 54.7 ± 11.0 L/min in CON to 74.7 ± 18.7 L/min in HIIE60, $p<0.001$). The increase in RPE during exercise was similar in CON, HIIE10 and HIIE30, reaching 13, i.e., "somewhat hard". However, RPE in HIIT60 was higher from the 10th min onwards compared with all other trials ($p < 0.01$), reaching 17 ± 3, i.e., "very hard". Affect declined during all HIIT trials ($p < 0.01$) but not during the CON trial. However, there were no significant differences among trials at the same time points.
CONCLUSION: Despite similar external power output and VO2 in trials, HR, BL, VE and RPE were higher in HIIE60. Although the decrease in affect was similar, the greater metabolic stress, cardiorespiratory stress and RPE in HIIE60 may influence exercise participation and adherence (Kilpatrick et al., 2015).
REFERENCES:
Kilpatrick MW, Martinez N, Little JP, Jung ME, Jones AM, Price NW, Lende DH (2015). Med Sci Sports Exerc, 47(5):1038-1045.
Stork MJ, Banfield LE, Gibala MJ, Martin Ginis KA. (2017). Health Psychol Rev, 11(4): 324-344.

IMPACT OF HIGH INTENSITY INTERVAL TRAINING FREQUENCY ON FUTURE PHYSICAL ACTIVITY PARTICIPATION

STAVRINOU, P.S.1, BOGDANIS, G.C.2, TERZIS, G.2, GIANNAKI, C.1, HADJICHARALAMBOUS, M.1

1 UNIVERSITY OF NICOSIA, NICOSIA, CYPRUS; 2 NATIONAL & KAPODISTRIAN UNIVERSITY OF ATHENS, ATHENS, GREECE

INTRODUCTION: The potential effect of high intensity interval training (HIIT) interventions on future participation in HIIT or other forms of physical activity (PA) has rarely been investigated (Jung et al., 2015). The present study examined the impact of HIIT frequency on future PA participation in inactive adults.
METHODS: Thirty five healthy inactive adults were randomly assigned to a control (CON) and to two training groups which performed HIIT (10 x 60s cycling, ~83% Wpeak), two (HIIT-2) or three times per week (HIIT-3) for eight weeks. Following the HIIT intervention, the intention to implement HIIT in the future was evaluated. Eight weeks after cessation of training, follow-up evaluation of HIIT completion was per-

formed, using a questionnaire. PA was also estimated at baseline and at follow up using the International Physical Activity Questionnaire (IPAQ) (Hagstromer et al., 2006).
RESULTS: Following the intervention, HIIT-2 and HIIT-3 participants reported similarly higher intention to implement HIIT in the future compared to CON participants (CON: 1.1±1.9, HIIT-2: 2.6±1.1, HIIT-3: 3.3±0.8 sessions/week, p<0.05). At follow-up, HIIT-3 participants reported higher completion of HIIT compared to HIIT-2 and CON (CON: 0±0, HIIT-2: 0.9±1.3, HIIT-3: 2.2±1.4 sessions/week, p<0.05). Both training groups increased vigorous PA (HIIT-2: from 0±0 to 371±559 MET-min/wk; p<0.05 and HIIT-3: from 0±0 to 862±709 MET-min/wk; p<0.05) and total PA levels (HIIT-2: from 349±165 to 1012±505 MET-min/wk; p<0.05 and from 348±219 to 1307±871 MET-min/wk; p<0.05) at follow up compared with baseline. Furthermore, 64% and 77% of participants of HIIT-2 and HIIT-3 respectively, were classified in the moderate or high PA category, compared with being inactive at baseline.
CONCLUSION: The present study showed that performing HIIT either two or three times per week may induce high intention to implement HIIT in the future. However, the higher training frequency resulted in greater HIIT completion eight weeks following the cessation of training intervention; although both training frequencies resulted in increased PA. These results demonstrate a modification of the habitual PA patterns, of the previously inactive participants, following the HIIT program, highlighting the positive influence of HIIT in promoting sustainable PA participation.
References: Jung ME, Bourne JE, Beauchamp MR, Robinson E, Little JP. (2015). J Diabetes Res. doi:10.1155/2015/191595.
Hagstromer M, Oja P, Sjostrom M. (2006). Public Health Nutr, 9, 755-762.

Mini-Orals

MO-PM04 Ageing

EFFECT OF AEROBIC TRAINING-INDUCED ACCELERATION OF ADIPONECTIN SECRETION FROM LOCAL FAT CELLS ON ARTERIAL STIFFNESS IN ELDERLY

HASEGAWA, N.1,2, FUJIE, S.1,2, HORII, N.1, UCHIDA, M.1, SANADA, K.1, HAMAOKA, T.3, IEMITSU, M.1
1> RITSUMEIKAN UNIVERSITY. 2> JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE. 3> TOKYO MEDICAL UNIVERSITY.

INTRODUCTION: Recent studies have showed that ectopic fat accumulation rather than whole-body fat content may be important for predicting cardiovascular disease (Lim S et al, 2014). Aerobic training (AT) elevates serum level of adiponectin, an adipokine secreted from adipocytes, concomitant with a decrease in fat accumulation. Adiponectin regulates endothelial nitric oxide synthase in endothelial cells, promoting production of nitric oxide, a vasodilator. Although adiponectin mRNA expression levels differ various local adipose tissues (Padilla J et al, 2014), it is unclear whether AT-induced acceleration of adiponectin secretion from local fat cells is involved in the reduction of arterial stiffness. This study aimed to clarify whether AT-induced changes in adiponectin production in local fat cells is associated with reduction in arterial stiffness in older adults and senescence mice.
METHODS: Human study; 42 older subjects were randomly divided into AT and control (CON) groups. Subjects in the AT group completed 8-week of aerobic training (60–70% peak oxygen uptake for 45 min, 3 days/week). Before and after the intervention, we measured carotid-femoral pulse wave velocity (cfPWV) as an indicator of arterial stiffness, and serum adiponectin concentrations using enzyme-linked immunosorbent assay method. Animal study; seventeen 38-week-old SAMP1 mice were divided into CON and AT (voluntary wheel running for 12-weeks) groups. Expression of adiponectin mRNA in epididymal, subcutaneous, perivascular and subscapular brown fat was measured by using real-time RT-PCR.
RESULTS: In the human study, AT intervention significantly decreased cfPWV and elevated plasma nitrite/nitrate (NOx) and serum adiponectin levels (each P<0.05). Furthermore, the training-induced change in plasma NOx level was negatively correlated with training-induced change in cfPWV (r=-0.40, P<0.05) and was positively correlated with the training-induced change in serum adiponectin level (r=0.41, P<0.05). By contrast, none of these parameters changed significantly in the CON group. In animal study, adiponectin mRNA expression levels of different adipose tissues were examined to identify localization of fats involved in an increase in serum adiponectin levels by AT. Adiponectin mRNA expression in epididymal and subscapular brown fats significantly elevated in AT group as compared to CON group (P<0.05), whereas no significant differences in subcutaneous and perivascular fat depots between AT and CON groups were seen.
CONCLUSION: These results suggest that AT-induced increase in the production of adiponectin from local fat cells may be associated with a reduction in arterial stiffness via elevation of nitric oxide production.
Reference
Lim S, Meigs JB. Arterioscler Thromb Vasc Biol 2014; 34: 1820–1826.
Padilla J et al, Physiol Rep 2014; 2: e00225.
Contact: gr0168ri@ed.ritsumei.ac.jp

THE EFFECT OF ACUTE ORAL PHOSPHATIDIC ACID INGESTION ON MYOFIBRILLAR PROTEIN SYNTHESIS AND INTRACELLULAR SIGNALING IN OLDER MALES

SMEUNINX, B.1, NISHIMURA, Y.1, MCKENDRY, J.1, LIMB, M.2, SMITH, K.2, ATHERTON, P.J.2, BREEN, L.1
1 UNIVERSITY OF BIRMINGHAM, 2 UNIVERSITY OF NOTTINGHAM

INTRODUCTION: Age-related muscle wasting (sarcopenia) impairs physical function and increases the risk of frailty and mortality. Impaired mTORC1-mediated signaling and myofibrillar protein synthesis (MyoPS) rates are thought to be the primary mechanisms driving the progression towards sarcopenia. The purported nutraceutical phosphatidic acid (PA) has been reported to stimulate mTORC1-mediated signaling increasing muscle protein synthesis in rodents, and enhance resistance training-induced muscle remodelling in young humans. Therefore, the present study examined the effects of acute oral PA ingestion on resting and exercise induced MyoPS rates and intracellular signaling in older individuals.
METHODS: Sixteen healthy older males were randomly allocated to either consume 1.5g of PA (PA; n=8; 68.4 ± 1.8 yrs) or a rice-flour placebo (PL; n=8; 69.4 ± 3.5 yrs) over 60 min after a bout of unilateral leg resistance exercise (RE). A primed-continuous infusion of L-[ring-13C6]-phenylalanine was combined with serial muscle biopsy sampling to determine intramuscular anabolic signaling and MyoPS at rest and between 0-150 and 150-300 min post-RE.

RESULTS: Acute PA ingestion increased plasma [PA] above basal values over 180-300 min post-exercise (P = 0.02). Exercise increased MyoPS rates by 40% above basal values (0.029 ± 0.002%h-1) over 150-300 min post-exercise in PL (0.050 ± 0.006 %h-1, P = 0.001), but not PA (0.033 ± 0.004%h-1 to 0.034 ± 0.005%h-1, P = 0.83). In addition, there was a trend for a reduction in resting MyoPS rates between 150-300 min in PA (0.023 ± 0.002%h-1, P = 0.053) compared with PL (0.035 ± 0.008%h-1). Phosphorylation of p70S6K, rpS6, 4EBP1 and Akt was elevated above basal levels in the exercised leg at 150 and 300 min post-RE in PL (P < 0.05). In contrast, only p70SK phosphorylation was elevated above basal values at 150 min post-RE in PA (P = 0.047). Phosphorylation of Akt at 150 min (P < 0.001), and phosphorylation of 4EBP1, p70S6K and rpS6 at 300 min (P < 0.01) was higher in the PL exercised leg compared with corresponding PA values. Total ubiquitin conjugates in PL rest were elevated from basal values and corresponding PA values at 150 (P < 0.01) and 300 min (P < 0.01). Ubiquitin conjugates at 30kDa and LC3II protein content were elevated compared with basal values in PL exercise at 150 min. LC3II protein content was higher in PL exercise compared with corresponding PA values at 150 (P < 0.01) and 300 min (P = 0.015).
CONCLUSION: Acute oral PA ingestion significantly increased plasma concentrations in the late study phase, and coincided with a blunted MyoPS and intramuscular anabolic signaling response upon RE. Therefore, based on our acute findings, there is no clear mechanism of action to support the idea that oral PA possesses muscle anabolic properties that might effectively counteract sarcopenia.

PRESERVED SKELETAL MUSCLE MASS AND FUNCTION IN CHRONICALLY TRAINED MASTER ATHLETES COMPARED WITH AGE-MATCHED UNTRAINED OLDER INDIVIDUALS.

MCKENDRY, J., BAIG, S., LIU, B., GREIG, C., BREEN, L.

SCHOOL OF SPORT, EXERCISE & REHABILITATION SCIENCES, UNIVERSITY OF BIRMINGHAM. QUEEN ELIZABETH HOSPITAL, BIRMINGHAM. MRC- ARTHRITIS RESEARCH UK CENTRE FOR MUSCULOSKELETAL AGEING RESEARCH.

INTRODUCTION: The progressive loss of skeletal muscle mass and function with advancing age, sarcopenia, presents a significant challenge to individuals and healthcare provision. However, the relative contribution of inherent ageing and secondary, environmental influences to sarcopenia are yet to be elucidated. It is well established exercise training elicits a multitude of benefits in young and older individuals. Master athletes are a unique, older, population who maintain high physical function while remaining relatively free of age-associated comorbidities. Therefore master athletes are an ideal model in which to study ageing. Previously, studies on master athletes had not included such a comprehensive array of measures to fully characterise these exceptional individuals, and had typically been carried out in individuals below the age of 60 years.
METHODS: The aim of this study was to determine whether chronic exercise training is protective in its effects against the deleterious process of ageing. In a cross-sectional investigation of 15 young (20 ± 2.7 y, 78.9 ±13.3 kg), 12 older (69.8 ± 4.1 y, 77.5 ± 14.2 kg) and 14 master endurance athletes (67.1 ± 4.1 y, 68.7 ± 6.5 kg) we compared body composition, skeletal muscle function and morphology.
RESULTS: The older healthy controls had a significantly lower VO2max (36.7 6.5 vs. 49.3 3.6 ml.kg-1.min-1, P<0.01) and skeletal muscle index (69.8 ± 5.1 vs. 77.0 ± 4.0, P<0.05) and greater body fat percentage (26.8 5.4 vs. 19.2 4.1 %, P<0.01) than master endurance athletes. Young controls were stronger than both old controls and master endurance athletes, with a similar VO2max and a tendency to lower body fat (22.0 ± 5.5 vs. 26.8 ±5.4, P=0.58), compared with master endurance athletes. Muscle thickness was significantly greater for young controls compared with older non-exercising controls (Vastus Lateralis (Vl): 25.7 ± 3.6 vs. 17.8 ± 4.7 mm, P<0.01, Vastus Intermedius (VI): 18.6 ± 3.5 vs 13.5 ± 3.1 mm, P<0.01, Rectus Femoris (RF): 26.3 ± 3.5 vs 17.5 ± 5.0 mm, P<0.001). Master endurance athletes offset the decline in VL and VI, but not RF, muscle thickness. Type I fibre area was significantly greater for master endurance athletes compared with old controls (5179 ± 1137 vs. 3838 ± 1008 µm2, P<0.05). Type II fibre area was significantly greater for young controls compared with old controls (5509 ± 1964 vs. 3584 ± 951 µm2, P<0.01).
CONCLUSION: In summary, older, non-exercising men exhibited impairments in almost every outcome compared with young healthy individuals. In many cases chronic exercise was able to rescue this decline, demonstrating that chronic exercise training is a beneficial strategy for off-setting age-related decrements in physical function, body composition and muscle morphology.

POTENTIAL FUNCTIONAL BENEFITS OF A COMPREHENSIVE EVALUATION OF PHYSICAL ACTIVITIES FOR MIDDLE AGED AND OLDER ADULTS

MAYO, A., SENECHAL, M., BOUCHARD, D.R.

UNIVERSITY OF NEW BRUNSWICK

INTRODUCTION: Most adults do not meet the most common recommendations of 150 minutes of moderate to vigorous physical activity (PA) plus two days of resistance training (RT) a week. This recommendation excludes possible influences of other types of activities and intensities to maintain or increase physical capacities that are highly associated with independent living. The objective of this study is to explore potential functional benefits of a comprehensive evaluation of all activities completed over 24 hours for seven days.
METHODS: Data collected was from the National Health and Nutrition Examination Survey of adults 45-85 years of age. PA intensities was obtained via accelerometer, but self-reported for sleep and RT. The three PA indexes were: 1) Total Activities in a day (Total Index), 2) Resistance Training/Aerobic Training (RT/AE Index), 3) Activity Time/Sedentary Time (Activity/SED Index). The physical capacity was derived from a factor analysis using 11 questions related to activities of daily living (e.g., walking a quarter of a mile) which were answered as: no difficulty, some difficulty, much difficulty, and unable to do. Logistic regression analyses were used to test the hypothesis that the computed indexes would be significantly associated with physical capacity even when adjusting for body mass index, age, sex, ethnicity, income, education and the average of self-reported chronic conditions and then further for meeting the current PA recommendation.
RESULTS: 932 people (67.0 ± 9.6 years; 45% women) were analyzed. All indexes were included in the regression model even when adjusted for CPAG (Total Index - Beta: 1.15, CI (1.02-1.17), RT Index- Beta: 1.22, CI= (1.04-1.43), SED index- Beta: 0.58, CI= (0.47-0.71) in the full adjusted models.
CONCLUSION: This study suggests that moderate to vigorous intensity PA are not the only movements important for increasing physical capacity of older adults.

ASSOCIATION OF DIETARY PATTERNS AND PHYSICAL ACTIVITY ON CENTRAL OBESITY IN MIDDLE-AGED AND ELDERLY JAPANESE ADULTS: THE WASEDAS HEALTH STUDY

ITO, T.1, KAWAKAMI, R.1, TANISAWA, K.2,3, MIYAWAKI, R.1,4, ISHII, K.1, TORII, S.1,3, SUZUKI, K.1,3, SAKAMOTO, S.1,3, MURAOKA, I.1,3, OKA, K.1,3, HIGUCHI, H.1,3

1 WASEDA UNIVERSITY, 2 NATIONAL INSTITUTE OF HEALTH AND NUTRITION, NIBIOHN, 3 INSTITUTE OF ADVANCED ACTIVE AGING RESEARCH, WASEDA UNIVERSITY, 4 MEIJI UNIVERSITY

INTRODUCTION: Although healthy dietary patterns and physical activity are independently known to be associated with central obesity, data on the combined association of dietary patterns and physical activity on central obesity is limited. Therefore, the aim of this study was to investigate the independent and combined associations of dietary patterns and moderate-to-vigorous physical activity (MVPA) on waist circumference (WC) in middle-aged and elderly Japanese people.
METHODS: A cross-sectional study was conducted in 829 adults (534 men and 295 women), aged 40–79 years, who participated in the Waseda Alumni's Sports, Exercise, Daily Activity, Sedentariness, and Health Study (WASEDAS Health Study). Dietary patterns were derived using principal component analysis of the consumption of 52 food and beverage items, which were assessed by a validated Brief-type self-administered Diet History Questionnaire. MVPA was assessed using the Global Physical Activity Questionnaire. The dietary pattern scores and MVPA were categorized into tertiles based on sex and age (40–49 years, 50–59 years, and 60 years or older). To examine the association of each dietary pattern and MVPA on the WC, we performed multiple linear regression analysis. To examine the combined association of each dietary pattern and MVPA on the WC, we added interaction terms of dietary patterns and MVPA in the regression models.
RESULTS: Two major dietary patterns were identified: "healthy Japanese" and "seafood and alcohol". After adjustment for covariates, the healthy Japanese dietary pattern score was inversely associated with WC in men (P for trend = 0.029), but not in women (P for trend = 0.571). The seafood and alcohol dietary pattern score was not significantly associated with WC in both men and women. MVPA was inversely associated with WC in men (P for trend < 0.001), but not in women (P for trend = 0.104). There was no interaction between the healthy Japanese dietary pattern score and MVPA (P for interaction= 0.208 and 0.883 for men and women, respectively). As compared with the lowest healthy Japanese dietary group with the lowest MVPA group, the highest healthy Japanese dietary group with the highest MVPA group had significantly low WC in men (P < 0.035).
CONCLUSION: The healthy Japanese dietary pattern and MVPA were independently inversely associated with WC in middle-aged and elderly Japanese men but not in women. The healthy dietary pattern and higher MVPA together are associated with a lower WC in men.

INTERNAL LOADS, BUT NOT EXTERNAL LOADS AND FATIGUE RESPONSES, ARE SIMILAR IN YOUNG AND MIDDLE-AGED RESISTANCE TRAINED MALES DURING HIGH VOLUME SQUATTING EXERCISE

FERNANDES, J.F.T., LAMB, K., TWIST, C.

UNIVERSITY CENTRE HARTPURY

INTRODUCTION: This study compared the internal and external loads during high volume squatting exercise and the fatigue-related responses in young (n = 9; age 22.3 ± 1.7 years) and middle-aged (n = 9; age 39.9 ± 6.2 years) resistance-trained males. A secondary purpose was to determine the relationship between internal and external load variables with post-exercise impairments in muscle function
METHODS: Measures of heart rate (HR), OMNI ratings of perceived exertion (OMNI-RPE), and session RPE (internal load) and repetition peak velocity and power and volume load (external load) were recorded during 10 x 10 sets of squats performed at 60% one-repetition maximum (1RM). Markers of muscular fatigue (maximal voluntary contraction (MVC), voluntary activation (VA) and resting twitch torque of the knee extensor, peak power at 20 and 80% 1RM, and capillary blood lactate concentration) were recorded before and immediately after exercise.
RESULTS: All differences internal load variables and peak velocity between groups during exercise were unclear. Peak power and volume load were likely moderately higher (ES -0.71, CI -1.53 to 0.10) in the young compared to the middle-aged group. The unclear differences in MVC, VA and blood lactate between groups after exercise were accompanied by very likely greater decrements in resting twitch torque (ES -1.53, CI -2.34 to -0.71) and peak power at 20 (ES -1.21, CI -2.03 to -0.39) and 80% (ES -0.94, CI -1.76 to -0.12) 1RM in the middle-aged group compared to the young group. Mean HR during exercise was likely and very likely correlated with decrements in MVC (r = .45, CI .06 to .72) and 80% 1RM peak power (r = .50, CI .13 to .75), respectively, whilst OMNI-RPE was likely correlated to impairments in 20 (r = .36, CI -.05 to .66) and 80% 1RM peak power (r = .32, CI -.09 to .64, respectively). Mean peak power and volume-load were likely and very likely correlated with reductions in MVC (r = .38, CI -.03 to .68 and r = .59, CI .24 to .80, respectively) and peak power at 20 (r = .43, CI -.03 to .71 and r = .55, CI .19 to .78, respectively) and 80% 1RM (r = .35, CI -.06 to .66 and r = .50, CI .13 to .75, respectively), but peak velocity during exercise were not.
CONCLUSION: The subsequent fatigue response, for which middle-aged males can expect greater decrements in peak power, appears to be related to a higher HR, OMNI-RPE, peak power and volume-load during exercise. Practically, these findings suggest that internal, but not external, load can be monitored in a like manner between these age groups.

LOWER BODY FORCE PRODUCTION PROPERTIES AND DYNAMIC BALANCE CONTROL IN MIDDLE AGED MEN AND WOMEN

GLAD, A., HAKKARAINEN, A., LINNAMO, V., RUOTSALAINEN, K., HEIKKINEN, T., PIIRAINEN, J.M.

FACULTY OF SPORTS AND HEALTH SCIENCES, UNIVERSITY OF JYVÄSKYLÄ, FINLAND

INTRODUCTION: Balance deficiencies are significant factors in falling accidents and hospitalization in the working age population (Valonen et al. 2016). In 2013, 54% of individuals seriously injured were men and 46% were women. Of these incidents, 69% were related to poor daily functional capacity (Valonen et al. 2016). At present, standard procedures for physical performance testing for occupational health are lacking. The aim of the present study was to assess if a novel dynamic balance perturbation device would be an appropriate tool to measure daily functional capacity and if gender differences in balance control would be observed.
METHODS: 72 participants, WOMEN (n=34, 52 ± 5.5 years) and MEN (n=37, 49 ± 6.5 years), completed the study. Dynamic balance was measured with 5 sets of 16 anteroposterior perturbations each with 30 cm amplitude (SLOW: v=10 cm/s, MIDSLOW: v=13 cm/s, MID: v=16 cm/s, MIDFAST: v=19 cm/s, FAST: v=21 cm/s,) using a special perturbation device modified from Piirainen et al. (2013). Maximal centre of

pressure peak displacement (PeakD) from 8 anterior and posterior perturbations were analyzed. In addition, isometric knee extension and plantar flexion force production (maximum force, rate of force development, max RFD) were measured.
RESULTS: In posterior perturbations, MEN had lower PeakD during the MIDFAST (6.8%, p<0.01) and FAST (8.6%, p<0.01) situation than WOMEN, while in anterior perturbations MEN had lower PeakD during all five velocities from SLOW to FAST (10.8±%, p<0.01, 11.0%, p<0.01, 8.9%, p<0.01, 9.5%, p<0.01, 10.7%, p<0.01), respectively. Even though similar differences were observed in isometric knee extension (21.1%, p<0.001) and plantar flexion (23.3%, p<0.001) RFD, no significant correlations were found between PeakD and force parameters in either group.
CONCLUSION: WOMEN showed consistently weaker dynamic balance in comparison to MEN, but the differences in RFD alone do not adequately explain the differences in balance capabilities. Previously it has been shown in men that RFD correlated with dynamic balance control in elderly but not in young (Piirainen et al. 2010). It is possible that the lower RFD observed within middle-aged women compared to men is related to an increased risk of falling accidents and injuries later in life. Even though the potential of the system to measure functional capacity was observed, further investigations are needed.
REFERENCES:
Piirainen JM, Linnamo V, Cronin NJ, Avela J. 2013. J Neurophysiol. 110(11):2557-62.
Piirainen JM, Avela J, Sippola N, Linnamo V. 2010. Eur J Sports Sci. 10(1):69-79.
Valonen K, Aho P, Hallikainen J, Hatakka M, Virtanen A,Ylönen K 2016. OTKES, ISBN: 978-951-936-477-4.

CARDIORESPIRATORY RESPONSE TO A 12-WEEK EXERCISE PROGRAM COMBINING HIIT AND POWER TRAINING AND 1-YEAR FOLLOW-UP IN ELDERLY PATIENTS WITH COPD

RODRIGUEZ-LOPEZ, C.1, LOSA-REYNA, J.2,3, ALCAZAR, J.1, BALTASAR-FERNANDEZ, I.1, NAVARRO-CRUZ, R.1, GARCÍA-GARCÍA, F.J., ESPINOSA, M.J.3, ALFARO-ACHA, A.2,3, ALEGRE, L.M., ARA, I., GUADALUPE-GRAU, A.

1: GENUD-UCLM . 2. CIBERFES 3: CHT . 4. UPM .

INTRODUCTION: Moderate resistance and continuous endurance combined training are considered one of the main parts of pulmonary rehabilitation (1). HIIT and power training separately have showed good results in elderly populations with cardiopulmonary diseases (2, 3). For these reasons, we aimed to investigate cardiorespiratory response to a 12-week exercise program combining HIIT and power training in elderly patients with COPD.
METHODS: Twenty-six elderly subjects (77±7 years, 5 women) with mild COPD severity (FEV1=53±17% pred.) were randomly distributed in an exercise training group (ET; 24 sessions combining HIIT on a cycle ergometer and power training on a leg press apparatus) or a control group (CON; usual care) during 12 weeks. Pulmonary function and cardiorespiratory response were evaluated pre and post training by spirometry (FEV1, FVC, and FVC/FEV1), the six minute walk test (6MWT) and a maximal incremental exercise test on a cycle-ergometer with breath-by-breath analysis (Oxycon pro, Germany) Furthermore, oxygen uptake kinetics was assessed during warm-up of maximal incremental test (VO2Tau, constant for mono-exponential model). Magnitude based inferences analysis was performed for pre and post training comparisons. A 1-year follow-up was included in the analysis.
RESULTS: VO2peak and peak power of the incremental test (Wpeak) were improved with a moderate effect in ET [% change; ES±90%CL] (+17%; 0.6±0.5 and + 50%; 0.7±0.4 respectively) while CON showed no changes (VO2peak= +0.4%; 0.0±0.1 and Wpeak= +7.4; 0.0±0.2). 6MWT was increased in ET (3.3%; 0.2±0.2) compared with a decrease in CON (-4.7%; 0.1±0.2). Oxygen uptake kinetics was accelerated in ET whereas CON was slowed (VO2Tau= -8.9%; 0.5±0.6 vs. +4.5%; 0.10±0.60 respectively). These changes were not accompanied by any improvement in pulmonary function. After 1-year follow-up, this intervention only promoted a positive difference between groups in Wpeak and 6MWT with respect to pre-training values (ES±90%CL=1.0±0.8 and 0.8±0.8 respectively).
CONCLUSION: Twelve weeks of HIIT and power combined training could be a proper strategy to improve cardiorespiratory response on elderly patients with COPD. However, it is still not clear whether this improvement could be triggered by enhanced peripheral dysfunction, central factors or both. After 1-year follow up, ET presented residual benefits of exercise compared to usual care programs. This would support the frequently prescription of pulmonary rehabilitation programs for better COPD management.
References: 1. Iepsen et al. Chron Respir Dis.2015;12(2):132-45.
2. Weston et al. Br J Sports Med. 2014;48(16):1227-34.
3. Byrne et al. Sports Med. 2016;46(9):1311-32.
Contact: Carlos Rodriguez Lopez (carlos.rlopez@uclm.es)

THE EVALUATION OF PHYSICAL FITNESS PARAMETERS OF OLDER ADULTS WHO PARTICIPATED EXERCISES IN FIELD-BASED PHYSICAL ACTIVITY

SUNA, N., ODABAS, I., BULGAN, C., ERALP, F.

HALIC UNIVERSITY

INTRODUCTION: Physical fitness is a set of attributes that people have or achieve. Being physically fit has been defined as the ability to carry out daily tasks with vigor and alertness, without under fatigue and with sample energy to enjoy leisure-time pursuits and to meet unforeseen emergencies. In recent years, the increase of exercise awareness and the possibility of doing sports activities in public parks have reduced the physical inactivity levels of individuals. Controlled and deliberate exercises will prevent any injuries and health problems, especially in elderly adults. For this reason, it is important to provide follow-ups by measuring and evaluating some pyhsical parameters of these population. The purpose of this study was to investigation of the demographic characteristics, physical fitness and self-care parameters of women over 50 years of age who participated some exercise activities such as walking, running and using some fitness equipment in public park areas in Kadikoy, Istanbul.
METHODS: Thirthy-eight women (mean age 62.37±7.81years; mean height 159.38±5.47cm; mean mass 67.81±12.03kg) were participated to this study as voluntarily. They were participated to the moderate exercises three days a week. Some anthropometric parameters such as waist and hip circumference and BMI were calculated for all participants. Additionally, right and left hand grip strength were measured using a hand dynamometer; also 30sec. chair stand for lower body strength; arm curl for upper body strength; back stratch for upper body flexibility; chair sit and reach for lower body flexibility; 6min walking for aerobic endurance were assessed as physical fitness parameters. Par-Q test and self-care evaluations were also done. Descriptive statistics (mean±SD) formulated for the variables age, height, body mass and other data were analysed by using SPSS version 24 for windows (SPSS, Chicago, IL). Bivariate Correlation (Pearson r) were also used for determination of the relations between some parameters.

RESULTS: As a result of the study participants BMI values were found as 26.72±4.70kg/m2; waist to hip ratio were calculated .84±11.69cm and .103.03±8.52cm, respectively. Hand grip strength for both hand were found as 22.19±6,08kg for right hand and 20.97±6,80kg for left hand. Also, 30sec chair stand test were 25.49±9.26times; 30sec arm curl test were 24.68±9.54times; back stratch test were 4,79±6,87cm; chair sit and reach test were 14,80±11,38cm and 6min walking test were 413,42±75,86m. Meanwhile there were some relationship between BMI and waist-hip circumferences and body mass (r=,699 and r=,909); and no any relationship between physical fitness parameters and others (p>0.05).
CONCLUSION: In conclusion, participants were in moderate level of physical fitness assessments. However their body fat amount were found in risk level. Its necessary that a more systemic exercise model should be applied to decrease the amount of fatness and it should be directed to the sports activity through exercise leaders.

Mini-Orals

MO-PM06 Injuries

ASYMMETRY OF QUADRATUS FEMORIS AND PIRIFORMIS MUSCLES IN ADOLESCENT TENNIS PLAYERS WITH FEMOROACETABULAR IMPINGEMENT: A VOLUMETRIC MRI STUDY

KUX, J.1, BALIUS, R.2, ALOMAR, X.3, RUIZ-COTORRO, A.4, CALBET, J.A.L.1, SANCHIS-MOYSI, J.1
1 IUIBS ; 2 CONSELL CATALÀ DE LESPORT, 3 CLÍNICA CREU BLANCA, 4 MAPFRE CENTRE FOR TENNIS MEDICINE

INTRODUCTION: Femoroacetabular impingement (FAI) is an important problem which prevalence is increasing in young athletes participating in sports with great unilateral loads, i.e. tennis, soccer, hockey (1). Although the physiopathological mechanisms leading to FAI remain unknown, it has been hypothesized that imbalances in the muscles stabilizing the pelvis may play a role (2). The main aim was to determine if playing tennis during adolescence elicit bilateral asymmetries in quadratus femoris (QF) and piriformis (PI) muscles, and if this asymmetry is greater in tennis players (TP) with FAI.
METHODS: Thirty male TP participated in the study (15.4±2.2 years, playing frequency 5-6 days/week, at least 2 years), 15 had FAI (6 unilateral dominant leg, 6 unilateral non-dominant leg, 2 bilateral) and 15 were healthy, asymptomatic TP (CG). All TP used the two-handed backhand stroke. The volume of QL and PI was determined by MRI in the dominant (arm holding the racket) and non-dominant side. Slice thickness was 2 mm without inter-slice interval. MRI images were manually segmented. Side-to-side differences were assessed using Student's paired t-tests and differences between groups using ANCOVA with Bonferroni-Holm post hoc test. Statistical significance was set at P<0.05.
RESULTS: The FAI group had spent more time playing tennis than controls during the previous two years (218.0±62.6 vs. 174.0±48.4 min/day, respectively, P<0.05), although weekly training frequency was similar in both groups (5.1.0±1.6 vs. 5.2±0.6 days/week, respectively, P=0.9). In the FAI group, the volume of QF and PI was 9.5±16.3 and 5.7±8.8% (mean±SD) greater in the non-dominant than in the dominant side (27.9±14.9 vs 25.6±14.2 cm3 and 36.1±14.3 vs 33.7±11.9 cm3, for QF and PI, respectively, both P<0.05). In the CG, QF and PI had similar volumes in the non-dominant and dominant sides (26.4±13.4 vs. 25.6±14.5 cm3, P=0.37 and 33.7±13.0 vs 33.4±12.1 cm3, for QF and PI, respectively, P=0.79).
CONCLUSION: This study shows, for the first time, that FAI is associated with asymmetries in the hip muscles in young tennis players, likely caused by an excessive training volume and/or technical aspects of the training causing asymmetric loadings. However, the side with greater QF and PI volume did not always coincide with the hip with FAI.
REFERENCES: Keogh M.J, Batt M.E. (2008). Sports Med, 38(10):863-878.
Amaro et al. (2007). Int J Sports Med, 28(12):1035-1039.

KNEE VALGUS ANGLES DURING THE STANCE PHASE OF RUNNING: A LATE SWING PHASE PROBLEM?

LIU, J., TENG, H.L., POWERS, C.M.
UNIVERSITY OF SOUTHERN CALIFORNIA

INTRODUCTION: Excessive knee valgus during running has been shown to contribute to knee pain in runners [1]. In addition, female runners tend to exhibit greater amounts of knee valgus compared to their male counterparts [2-5]. While most studies have focused on stance phase kinematics, studies also have reported that females display greater knee valgus at initial contact than males [2,4]. The purpose of the current study was to determine whether late swing phase knee valgus is associated with stance phase knee valgus.
METHODS: 15 female and 10 male healthy recreational runners participated <26.7±6.4 years old>. All were heel strikers. Subjects were instructed to run at a controlled speed of 3.4 m/s along a 14-m runway using their own running shoes. Knee joint kinematics throughout the swing and stance phases of running were collected using an 11-camera motion capture system at a sampling rate of 250 Hz. Average frontal plane knee angles during the late swing phase and the peak frontal plan angles during the stance phase were calculated. Pearson correlation was used to determine the association between late swing and stance phase knee valgus. Independent sample t-tests were used to compare sex differences in knee valgus angles during these two phases. Statistical analyses were performed using SPSS , with significance level alpha=0.05.
RESULTS: Average knee valgus angles during late swing were positively associated with peak valgus angles during stance . On average, females exhibited greater average late swing knee valgus angles than males <1.19±1.75° vs -1.20±1.39°, p=0.002>. Females also exhibited greater peak stance knee valgus angles than males <2.59±1.66° vs 0.59±1.16°, p=0.003>.
CONCLUSION: Our results indicate that knee valgus during the stance phase of running is influenced in part by swing phase kinematics. Future studies should consider potential causes of abnormal knee valgus during late swing to better understand mechanisms of excessive knee valgus during the stance phase of running.
REFERENCES:
1. Powers, C.M., The influence of altered lower-extremity kinematics on patellofemoral joint dysfunction: a theoretical perspective. Journal of Orthopaedic and Sports Physical Therapy, 2003. 33<11>: p. 639-46.
2. Willson, J.D., et al., Male and female gluteal muscle activity and lower extremity kinematics during running. Clinical Biomechanics , 2012. 27<10>: p. 1052-7.
3. Ferber, R.,I. McClay Davis, andD.S. Williams Iii, Gender differences in lower extremity mechanics during running. Clinical Biomechanics, 2003. 18<4>: p. 350-357.

4. Gehring, D., et al., Knee and hip joint biomechanics are gender-specific in runners with high running mileage. International Journal of Sports Medicine, 2014. 35<2>: p. 153-8.
5. Malinzak, R.A., et al., A comparison of knee joint motion patterns between men and women in selected athletic tasks. Clinical Biomechanics , 2001. 16<5>: p. 438-45.

ACADEMIC OUTCOMES IN MANITOBA STUDENTS WITH SPORT-RELATED CONCUSSION OR FRACTURE INJURY

SELCI, E., RUSSELL, K., BLACK, B., COCHRANE, K., ELLIS, M.

UNIVERSITY OF MANITOBA

Background: Concussion symptoms include physical, cognitive, behavioral, and emotional deficits. A notable proportion of youth develop Persistent Post-Concussion Syndrome, which may result in difficulties in school activities and negatively impact health-related quality of life. The 2017 Concussion in Sport Group consensus statement describes a four-step Return to Learn program for students to return to school in a timely and safe manner. The objectives of this study were to compare the effects of adolescent sport-related concussion and sport-related extremity fracture on 1> academic outcomes including change in school grades and school attendance and 2> determine which specific academic accommodations were most helpful during recovery from these injuries.
Methods: A prospective cohort study was conducted to compare report-card grades, attendance, and school accommodations among students with a sport-related concussion or sport-related fracture. Students were included if they were diagnosed with an isolated sport-related concussion or fracture and presented within seven days of the injury to the Pan Am Clinic in Winnipeg, Manitoba. Grades data were extracted from students' immediate pre-injury report card and their report card after they recovered. Students completed a school attendance log book. Upon recovery, students completed an exit interview to determine how helpful they perceived their school accommodations to be during their recovery.
Results: Of 231 recruited students, 124 submitted pre- and post-injury report cards, 203 returned school attendance log books, and 190 completed the exit interview. Concussion and fracture students experienced a similar decrease in grades post-injury . Concussion students missed significantly more days of school: median of 4 versus 1 for fracture students . In total, 53.1% concussion students versus 40.3% fracture students found their school be very accommodating .
Conclusions: Students who sustain a sport-related concussion miss significantly more days of school but demonstrate similar changes in school grades post-injury compared to those with a sport-related fracture injury. Future studies are needed to identify the pre- and post-injury factors associated with poor academic functioning following concussion and identify measures that can be taken to help optimize academic outcomes in these patients.

DO FRENCH AND CHINESE REGULAR BADMINTON PLAYERS EXPERIENCE THE SAME INJURIES?

HERBAUT, A., DELANNOY, J., FOISSAC, M.

DECATHLON

INTRODUCTION: Badminton is a popular racket sport practiced worldwide by more than 200 millions of players. The injury incidence in elite and recreational players during training and competition is around 2.3–3.2 injuries/1000 badminton hours (Fahlström & Söderman, 2007). Epidemiological studies examined injuries in European and Asian badminton players but no study directly compared these 2 populations (Krøner et al., 1990; Høy et al., 1994). Therefore, the objective of this study was to examine whether differences existed between French and Chinese regular badminton players injuries distribution.
METHODS: An online questionnaire was completed by 113 French and 117 Chinese RBP. The two populations were matched for distribution of genders, ages, skill levels and badminton exposure. Chi-square tests ($\chi 2$) were conducted to determine differences in injuries distribution between the two populations.
RESULTS: A higher percentage of French players reported to have experienced at least one injury over the 5 past years compared with Chinese players (66% vs. 45%, respectively, χ^2= 10.3, p=0.001). For the upper limb, French players experienced more shoulder/arm injuries (59% vs. 32%, respectively, p<0.001) whereas Chinese players reported more wrist/hand injuries (44% vs. 12%, respectively, p=0.049). The vast majority of injuries were localized to the lower extremity both for French and Chinese (69% and 56%, respectively), with a higher prevalence for the ankle (33% and 49%, respectively), then the knee (19% and 27%, respectively).
CONCLUSION: The most common injury reported was the ankle sprain, which generally occurred during a jump landing upon backward and lateral movements (60%) or during forward lunge (26%). As more than half of the ankle sprains were moderate or severe, a particular attention should be paid to the effects of footwear and court surface characteristics on the biomechanics of badminton players.
Furthermore, the differences observed between French and Chinese RBP in terms of injuries distribution suggest differences in the employed playing techniques to perform the variety of badminton strokes. Thus, a biomechanical investigation aiming to compare French and Chinese strokes performance and movements may be of interest.
REFERENCES:
Fahlström M & Söderman K, (2007) Scand. J. Med. Sci. Sports, 17, 246–51.
Høy K, Lindblad BE, Terkelsen CJ, Helleland HE, Terkelsen CJ, (1994) Br J Sports Med, 28, 276–279.
Krøner K, Schmidt SA, Nielsen AB, Yde J, Jakobsen BW, Møller-Madsen B, Jensen J, (1990) Br J Sports Med, 24, 169–172.

INJURY EPIDEMIOLOGY IN U13 FOOTBALL PLAYERS FROM AN ELITE ACADEMY AND A NON-ELITE CLUB: A ONE-SEASON PROSPECTIVE COMPARISON

LARRUSKAIN, J.1,2, TRASVIÑA, U.2, LEKUE, J.A.1,2, BIDAURRAZAGA-LETONA, I.2, GIL, S.M.2

1: ATHLETIC CLUB, 2: UNIVERSITY OF THE BASQUE COUNTRY

INTRODUCTION: Elite young players recruited by professional football clubs into their academies are presumably under more physical and psychosocial stress compared to their non-elite counterparts, which might predispose them to a higher injury risk and negatively impact their development and chances of becoming professional players. The aim of the study was to compare the epidemiology of injuries in young players from a professional academy and a non-elite club over one season.
METHODS: Injuries, exposure time and anthropometric data were prospectively recorded in U13 players from a professional academy (Athletic Club, n=20) and a non-elite club (Zalla Union Club, n=17) over the 2015-2016 season following the FIFA consensus. Maturity offset was calculated as Chronological age – Predicted age at peak height velocity (APHV).[1] Ratios were compared using z-tests, and the rest of variables using Mann-Whitney's U-test.

RESULTS: There were no statistically significant differences between teams in age (mean±SD, Elite vs. Non-elite: 12.4±0.4 vs. 12.4±0.3 years, p=0.78), body mass (42.8±5.8 vs. 43.3±7.8 kg, p=0.80) and height (155.8±5.2 vs. 150.6±8.4 cm, p=0.06), but the sum of 6 skinfolds was lower in elite players (48.5±15.8 vs. 68.5±19.5 mm, p<0.01). Elite players were also closer to APHV (-1.6±0.4 vs. -2.3±0.6 years, p<0.01). Both teams had a similar amount of match time (21±9 vs. 25±4 h, p=0.07), but the elite team trained considerably more (172±35 vs. 133±7 h, p<0.01). There were a total of 23 injuries in the elite team and 12 in the non-elite team. Match injury incidence was 5 times higher in elite players (26.0 vs 5.2/1000 h, p=0.04), but training (3.5 vs. 4.4/1000 h, p=0.60) and total (5.9 vs. 4.5/1000 h, p=0.43) incidence were similar between teams. Non-elite players suffered one injury of moderate severity (8-28 days), and the rest were minimal and mild (<8 days). Conversely, the elite team suffered 8 moderate and 10 severe (>28 days) injuries. There were 11 growth injuries (6 were severe) in elite players compared to only 1 in non-elite players, with an 8 times higher incidence in the elite team (p=0.05). All of this resulted in a 12 times higher injury burden in elite players (199 vs. 16 days lost/1000 h, p<0.01).
CONCLUSION: The high burden of injuries in elite U13 players, in particular growth injuries, might be due to an "early professionalization" in the elite academy with higher playing intensities, training load and psychosocial demands. However, these preliminary findings should be replicated in larger cohorts. Considering the negative impact that injuries have in player development and health, tailored preventive strategies are needed to promote safe football participation in young players.
References:
1. Mirwald RL, Baxter-Jones AD, Bailey DA, Beunen GP (2002). Med Sci Sports Exerc, 34, 689-94.
Acknowledgements: University of the Basque Country (UPV/EHU) (PPG17/34), Basque Government (IT922-16).
Contact: jlarruskain@hotmail.com

INJURY PROFILE OF NON-CONTACT INJURIES IN U.S. MENS RUGBY-7S

MA, R., LOPEZ JR, V., WEINSTEIN, M., HUME, P., VICTORIA, C., HALEEM, S., METTRY, M., ALLEN, A.
UNIVERSITY OF MISSOURI, RUGBY RESEARCH & INJURY PREVENTION GROUP, AND HOSPITAL FOR SPECIAL SURGERY

INTRODUCTION: Rugby-7s is an Olympic global collision sport played with a high incidence of injury. There is limited injury data on Rugby-7s, including injury mechanisms in Rugby-7s. The study aims were to report men's injury incidence and nature of non-contact risk factors in U.S. Rugby-7s.
METHODS: Match injury incidence (per 1000 player-hour (ph)) and non-contact factors were catalogued using the Rugby Injury Survey & Evaluation (RISE) report methodology (Lopez et al., 2012). 26,334 U19 to elite U.S. men players (age: 10-54 years) on 2,174 teams involving 4,716 matches in 80 USA Rugby sanctioned tournaments (2010-2015) were evaluated. Medical attention (no absence from play), time-loss (players were unable to return to play the same day) injuries, and injury severity (days absent before return to training/competition) were determined. Incidence of non-contact injuries, defined as no contact with an opposing player or collision-type mechanism, were determined. Non-contact injuries were further subdivided into classic-non-contact while in play (i.e. cutting, changing direction, sprinting); or other non-contact causes influenced by another factor (i.e. slipping or trip) (Marshall, 2010). Significance was set a P<0.05.
RESULTS: Non-contact injuries occurred frequently (31%; n=446) over the study period (classic-non-contact=98%, n=403; other=2%, n=8; P<0.001). Non-contact injuries (time-loss 25%; medical attention 75%) were found at higher rates among backs (62%; 28.4/1000ph, CI:24.9-32.1) than forwards (38%; 23.2/1000ph, CI:19.7-27.2; RR:1.22, p=0.050). Non-contact injuries resulted in 48.7 mean days absence (classic-non-contact 48.1 days; other 77.0 days). Injuries overall were acute (85%) and occurred most commonly during avoiding/attempting tackling (31%) and running/open play (48% overall; from 35% in 2010, 41% in 2011, 52% in 2012, 43% in 2013, 46% in 2014, 70% in 2015). Most non-contact injuries (44%) occurred during the first two matches of the tournaments. Recurrent injuries were 33% of all injuries (9.5/1000ph, CI:8.0-11.2). Most common time-loss injuries were ankle sprains and posterior thigh muscular injuries, equivalently at 15%, 1.0/1000ph. Ankles were most commonly injured (17%, 4.9/1000ph), followed by knees (14%, 4.0/1000ph). Similar injury rates were observed among playing surfaces (grass 28.9/1000 ph; artificial 28.7/1000 ph; p<0.973
CONCLUSION: Elite Rugby-7s players may cover a total of 1,400–2,000 meters at a mean intensity of 96–120 meters·minute–1 (Higham et al., 2012). Nearly one half of the non-contact injuries in our series occurred during open running. Injury preventive measures among developing populations such as the U.S. must include conditioning for these intense running demands of Rugby-7s, which should include incorporating repeated bouts of high-intensity running with appropriate work:rest ratios (Portillo et al., 2014) and proper warm up routines. This may minimize the match thigh, knee, and ankle non-contact injuries seen in the U.S. men Rugby-7s.

BIOMECHANICAL DIFFERENCES OF CUTTING MOVEMENTS BETWEEN FOOTBALL AND AMERICAN FOOTBALL PLAYERS INTERPRETED IN RELATION TO INJURY PREVENTION

KURZ, G.1, AST, B.2, STRUTZENBERGER, G.2, STEIN, T.1, SCHWAMEDER, H.2
1 KARLSRUHE INSTITUTE OF TECHNOLOGY , GERMANY; 2 UNIVERSITY OF SALZBURG, AUSTRIA

INTRODUCTION: Tears of the anterior cruciate ligament (ACL) is one of the most critical injuries in team-sports as football (FB) and American football (AF). Cutting movements are associated with noncontact ACL-injuries. Therefore, a comprehensive understanding of the relations between cutting performance and joint biomechanics is crucial (Joseph et al., 2013; Havens et al., 2015). Especially since cuts are an essential part of training in AF (Brock et al., 2014). Less is known about the mechanics in cutting movements and how a different execution in sports may affect the knee joint loads. The aim of this study was to investigate whether knee kinetics differ between AF and FB cuts.
METHODS: Twenty-four male athletes (12 AF, 12 FB) performed three cutting movements with different cutting angles (45°, 90°, 135°, 180°) to the dominant and non-dominant foot at maximum speed. The kinematics were recorded with Vicon cameras (250 Hz) and the dynamics were measured with two AMTI force plates (1000 Hz). Knee flexion moment (FM), valgus moment (VM) and rotation moment (RM) were calculated using an inverse-dynamic model (Dynamicus 9, Härtel & Hermsdorf, 2006) and analyzed at initial contact (IC) and the maxima over the entire period of the footrest. Univariate ANOVAs with post hoc tests (Tukey HSD) were performed to compare AF and FB groups.
RESULTS: The non-dominant leg showed no differences in knee kinetics between the groups. No differences were also found in FM across all cutting conditions. RMmax values were lower in FB compared to AF (p = 0.022). At 90° and 135° FB showed lower RM at IC compared to AF (p = 0.002). In addition, FB showed lower VM at IC compared to AF (p = 0.009) and a lower VMmax than AF (p = 0.034).
CONCLUSION: Overall, AF produced higher internal rotational moments and had to accept the higher internal rotational loads in the cutting movements than FB. High rotational loads are linked with higher knee loads, which consequently, are associated with increased risks of injury. A potential explanation of the higher moments in AF might be the subject-specific movement execution, especially the direction of the Plant-step, which is in line with the deceleration direction. Further evaluations are required to get a better understanding

of the mechanics in cutting movements to develop training programs that aimed at improving performance and reducing the risk of ACL injury.
Brock E, Zhang S, Milner C, Liu X, Brosnan JT, Sorochan J (2014). Sports Biomech, 13 (4), 362-379.
Joseph AM, Collins CL, Henke NM, Yard EE, Fields SK, Comstock RD (2013). JAT, 48 (6), 810-817.
Haertel T, Hermsdorf H (2006). J Biomech, 39, 549.
Havens KL, Sigward SM (2014). Med. Sci. Sports Exerc., Vol 47 (4), 818-824.

INJURY EPIDEMIOLOGY IN AUSTRALIAN PROFESSIONAL SOCCER: SEASON 2012/13- 2016/17

LU, D.1,2, JONES, M.2, KOVALCHIK, S.3, STEINWEG, J.2, GELIS, L.2, DUFFIELD, R.1,2

1: UTS , 2: FFA , 3: TA .

INTRODUCTION: The negative consequences of injuries on player health and performance in football are well reported [1]. The first step in injury prevention is exploration and understanding of the extent of injuries within a cohort [2]. Presently only one study has reported injury epidemiology in Australian professional soccer [3]. However, such findings are outdated and may not reflect the current epidemiological profile of injuries in the A-League. Therefore, this study investigated the current injury epidemiology trends in the Australian A-League by reporting injury incidence and describing the frequency of injury type, region, mechanism and number of missed matches in all clubs over the last 5 seasons (seasons 2012/13 – 2016/17).
METHODS: During regular A-League competition rounds (n=27/season) over 5 seasons, 10 physiotherapists were contractually obligated to report injury data from their respective A-League teams. Injury data was reported on a weekly basis to the national governing body for collation and statistical analysis. Injury diagnosis was overseen by the Club physiotherapist who determined if the event met the definition of "any physical complaint requiring medical attention that results in an A-League match missed". Individual injury cases were aggregated to league-based injury and missed matches count per season. Injuries were further categorized by type, region and mechanism suggested in the consensus statement on football injury definition and data collection procedures [4]. Data is presented as a rate per season and 95% confidence interval (CI).
RESULTS: Over the 5 seasons 775 injuries were reported at 154.6 (144.1-165.9) per season. Poisson regression showed injury count linearly decreased over the reported period, though a spike was observed in 2014/15 ($p<0.01$). Hamstrings (25.1(21.1-29.9)), knee (24.6(20.6-29.3)) and ankle (19.7(16.2-24)) are the most common regions of injury. Additionally, injuries were most commonly Muscle/Tendon (86.2(78.4-94.7)) and Joint/Ligament (45.8(40.2-52.1). Missed matches increased significantly in 2013/14 and 2015/16 seasons compared to 2012/13 season ($p<0.05$ and $p<0.001$, respectively).
CONCLUSION: Comparable to European football data, lower-body injuries remain critical to player health and safety. Injury incidence continues to decrease in the A-League; however, the number of missed matches due to injury has increased. Consequently, assessing the severity of injuries may be a more meaningful outcome than just the injury incidence.
REFERENCE:
1. McCall, A., et al. (2014) BJSM 48:1352-1357.
2. van Mechelen, W., et al. (1992) Sports Medicine 14(2):82-99.
3. Gouttebarge, V., et al. (2016) AsJSM 7(1):e31385.
4. Fuller, CW, et al. (2006) BJSM 49(3):193-201.
CONTACT: Donna.lu@ffa.com.au

SEASONAL VARIATIONS OF HEAD INJURIES IN PROFESSIONAL MALE FOOTBALL (SOCCER) – AN 11 SEASON ANALYSIS AFTER A RULE CHANGE IN 2006.

BEAUDOUIN, F.1, AUS DER FÜNTEN, K.1, TRÖß, T.1, REINSBERGER, C.2, MEYER, T.1

1 SAARLAND UNIVERSITY, 2 UNIVERSITY OF PADERBORN

INTRODUCTION: Only limited information is available on the seasonal variation of head injury rates over multiple seasons in professional male football. This study aimed to investigate the seasonal variations of head injuries and their injury mechanisms in German professional football (soccer) since a rule change in 2006 (punishing direct and deliberate elbow to head contacts).
METHODS: Based on continuously recorded data from the German football magazine 'kicker Sportmagazin®' and further media-based sources, a database of head injuries in the 1st German 'Bundesliga' was generated comprising 11 consecutive seasons (2006/07-2016/17). Injury incidence rates (IR) and 95% confidence intervals (95% CI) were calculated. Injury mechanisms were analysed from video recordings. Time trends were analysed via linear regression (Ekstrand et al. 2013; Hägglund et al. 2016).
RESULTS: 238 match head injuries occurred (IR 1.77/1000 match hours, 95% CI 1.56 to 2.01). There were no significant seasonal changes, expressed as annual average year-on-year change, in IRs over the 11-year period for total head injuries ($p=0.693$), facial/head fractures ($p=0.455$), facial/head lacerations and abrasions ($p=0.162$), and head contusions ($p=0.106$). The annual average year-on-year increase for concussion was 6.4% ($R^2=0.623$, $b=0.064$, 95% CI 0.026 to 0.101, $p=0.004$). Five predominant head injury mechanisms (incl. elbow-head blows) were identified. There were no seasonal changes in head injury mechanisms over the study period.
CONCLUSION: Total match head injuries, most of the subtypes and their injury mechanisms remained stable with no seasonal variation over 11 consecutive seasons of the German 'Bundesliga' since the rule change in 2006. However, the subcategory concussion increased slightly year-on-year over the seasons which may either be a result of increasing match dynamics or raised awareness among team physicians. Ongoing head injury surveillance remains essential. Furthermore, preventative strategies are required to decrease head injuries in professional football.
Ekstrand J, Hägglund M, Kristenson K et al. Br J Sports Med 2013; 47(12): 732-737.
Hägglund M, Walden M, Ekstrand J. Br J Sports Med 2016; 50(12): 751-758.

ASSESSMENT OF RECENT INJURY STATUS AND FUNCTIONAL MOVEMENT SCREENING IN YOUNG FOOTBALL PLAYERS

TARNÓCZY, Z.1, BALOGH, L.2, SZENTES-SZENDREY, A.3, PUCSOK, J.M.2

1) UNDERGROUND TRAINING CENTER, NYÍREGYHÁZA, HUNGARY (2) UNIVERSITY OF DEBRECEN, INSTITUTE OF SPORT SCIENCES, DEBRECEN, HUNGARY (3) NYÍREGYHÁZI SPARTACUS, JÓZSEF BOZSIK FOOTBALL ACADEMY, NYÍREGYHÁZA

INTRODUCTION: The Functional Movement Screening (FMS) is a widely used assessment system to evaluate current and prior injury and training status. FMS scores enable sport professionals to discover individual movement patterns through identifing possible unbalances

in certain movements executed in both sides. Fundamental core stability, mobility and strength characteristics may be identified, thus corrected with sport-specific functional movement programme (Perry, 2017).
Implementing efficient movement strategies, such core training programmes may significantly reduce the risk of injuries (Chorba et al. 2010). Use of FMS scores may improve the quality of the training programme, age, history of injuries, training status may influence the evaluation of data. (Butler, 2011).

METHODS: Youth and junior football players were volunteered to take part in our examination. A total of 45 subjects participated in our study, their age varied from 16 to 19. Three age groups: U16, U17 and U19 members of József Bozsik Football Academy were represented in our research. We were specifically interested on key areas of injuries typical to football players. We used a special questionnaire, which was developed earlier by our research team (Pucsok et al. 2014). We implemented a five to one scoring system to identify the status of injuries from healthy (5) to surgical procedure was made (1). Finally, a complete FMS testing was performed, involving all participants.
RESULTS: Beside evaluating the total FMS scores of the participants, we choosed to specifically stress on further five test batteries out of seven. We hypothesized, that in this particular population, those five test batteries provide a more accurate estimate of the injury status, thus motor performance. We were trying to establish any significant relationship between total and selected FMS scores, and the status of more recent (within two years) injuries.
In this given population, we have not found significant relationship between total FMS scores and overall scores (5 to 1) of injury status. When we were examined selected FMS scores, we were able to identify some kind of trend, although the strength of the relationship was weak, except between the scores of deep squat (DS) and injury status of the left hamstring muscle, where we found moderate negativ correlation (r=-0.54).
CONCLUSION: Because of common human error during the test procedure, individual bias may distract the evaluation of FMS scores in some extent. After reviewing the related literature, we concluded, that FMS testing combined with other traditional motor skill tests (standing long jump etc.), and pneumatic training devices (such as Keiser) may provide a better estimate for functional performance. It is critical, to identify common injury patterns in the selected sport. Ball sports such as football, basketball and volleyball are both overwhelmingly asymmetrical in nature, with a dominant-side involved in a movement (kick, throw or a serve), so similar injuries may occur.

Mini-Orals

MO-PM12 Nutrition

CARBOHYDRATE MOUTH RINSE FAILS TO IMPROVE VO2MAX TEST OUTCOMES

PIRES, F.O.1, BRIETZKE, C.1, PINHEIRO, F.A.1, FRANCO-ALVARENGA, P.E.1, DE MATTOS, E.C.T.2, VERAS, K.3, RODACKI, A.L.F.2, UGRINOWITSCH, C.1

1UNIVERSITY OF SÃO PAULO, 2FEDERAL UNIVERSITY OF PARANÁ, 3UNIVERSITY OF MOGI DAS CRUZES

INTRODUCTION: The carbohydrate (CHO) mouth rinse has been accepted as an ergogenic aid to improve endurance performance in different exercise modes. The likely mechanism underpinning the CHO mouth rinse effects on endurance performance is a greater reward system-cerebral activation that attenuates neuromuscular fatigue, thus ameliorating muscle activation (Jeffers et al., 2016). To the best of our knowledge, no study has been designed yet, to verify the CHO mouth rinse effects on VO2MAX test outcomes. Therefore, the present study aimed to verify this proposal.
METHODS: Nine recreational, experienced cyclists (36.9 ± 6.4 yr, VO2MAX of 54.3 ± 9.3 ml/kg/min, WPEAK of 333.4 ± 28.6 W) performed a VO2MAX test either after a CHO or a placebo (PLA) mouth rinse. The VO2MAX test consisted of a warm-up of 5 min self-paced exercise followed by 1 min controlled-paced exercise (100 W and 70-80 rpm). Thereafter, the intensity was successively increased (25W/min) until exhaustion. In a double-blinded, randomized order, participants rinsed their mouth for 10 s with CHO or PLA (spiting it out, thereafter) during the controlled-pace warm-up. Cardiopulmonary responses were assessed throughout the VO2MAX while ratings of perceived exertion (RPE) were obtained every stage.
RESULTS: Time-to-exhaustion (p=0.24), WPEAK (p=0.45) and VO2MAX (p=0.60) were comparable between CHO and PLA conditions. There was a moment main effect on ventilatory threshold (VT) expressed as %VO2MAX (p<0.001, ES=extremely large) and %WPEAK (p<0.001, ES=extremely large), so that VT1 intensity was lower than VT2. However, neither manipulation main effect nor moment by manipulation interaction was observed The RPE increased similarly throughout the VO2MAX test in both CHO and PLA mouth rinse conditions (p=0.56, ES=moderate).
CONCLUSION: In contrast to previous results reported in different exercise models, neither CHO mouth rinse improved performance in VO2MAX test as espressed as time-to-exhaustion and WPEAK, nor CHO mouth rinse improved outcomes such as VO2MAX, VT1 and VT2. In addition, RPE increase was comparable between CHO and PLA. It has been previously proposed that the effect of CHO mouth rinse on exercise performance is centrally-regulated, thereby suggesting that CHO mouth rinse improves central drive and reduce central fatigue. However, a body of literature has argued that VO2MAX test performance is peripherally-regulated, thus highlighting that CHO mouth rinse effect on performance is likely exercise model-dependent, possible with neglected effect on peripheral-regulated (Jacobs et al., 2018) exercises performance such as a VO2MAX test.
References: Jeffers R. Shave R. Ross E. Stevenson EJ. Goodal S. (2016). Appl Physiol Nutr Metab. 40(6):557-64.
Jacobs RA, Rasmussen P, Siebenmann C, Díaz V, Gassmann M, Pesta D, Gnaiger E, Nordsborg NB, Robach P, Lundby C. (2011). J Appl Physiol. 111(5):1422-30

THE EFFECTS OF GOATS MILK, COWS MILK AND AN ENERGY-MATCHED CARBOHYDRATE DRINK ON RECOVERY FROM REPEATED SPRINTING AND JUMPING IN TEAM SPORT ATHLETES

CURRISTIN, M., FITZPATRICK, P., RANKIN, P.

INSTITUTE OF TECHNOLOGY CARLOW

INTRODUCTION: Effective recovery following intense exercise is integral for any athlete to ensure subsequent performance is not comprised. The aim of this investigation was to determine the effects of cows milk and goats milk on recovery from a sprinting and jumping protocol.

METHODS: Twenty-four team sport athletes participated in an independent group investigation. Participants were randomly but equally assigned to a goats milk group (GOAT), a cows milk group (COW) or an energy-matched carbohydrate group (CHO), with 750ml of the allocated fluid consumed following a sprinting and jumping protocol. Assessment of muscle function (peak torque (PkTq), 5, 10, 20m sprint, countermovement jump (CMJ) and soreness and tiredness (visual analogue scale (VAS)), took place pre- and 24h, 48h, and 72h post-exercise.
RESULTS: Compared to CHO, GOAT had a beneficial effect on CMJ B-24h (2 v -8%; likely, small) and B-48h (-1 v -6%; possible, trivial) and COW had a beneficial effect B-24h (-4 v -8%; possible, trivial). Comparisons of GOAT and COW showed a benefit for GOAT at B-24h (2 v -4%; possible, small) but other comparisons were trivial. Comparisons of GOAT and COW to CHO for peak torque revealed trivial or unclear outcomes, though a benefit for GOAT v CHO was seen at B-48h for peak torque (180○/s) extension (-3 v -11%; possible, small) and a positive effect for peak torque (60○/s) extension B-48h (-8 v -13%; possible, trivial) and B-72h (-5 v -9%; possible, trivial). GOAT compared to CHO had a harmful effect B-24h on 5m (0 v 1%; possible trivial), 10m (-1 v 0.3%, possible, trivial), and 20m (-2 v -1%; possible, trivial) sprint time performance. Unclear and trivial effects were found for B-48h and B-72h for all sprints. In comparison to CHO, a benefit for COW was found for 5m B-24h (1 v 1%; possible, trivial), B-48h (2 v 0.4%; possible, small) and B-72h (1 v 0.4%; possible, small). Similarly, for 10m B-24h (1 v 0.4%; possible, trivial) and B-48h (1 v -0.4%; possible, trivial). Likewise, for 20m B-24h (3.5 v 0.9%; likely, small). Comparisons of GOAT to COW on sprint time performance for 5m, 10m and 20m were unclear, however there was a benefit for COW from B-48h (-2 v 4%; likely, small). GOAT v CHO had a positive effect on soreness B-24h, B-72h (possible, trivial) and B-48h (possible, small). COW v CHO had a positive effect (possible, small) on soreness B-48h and B-72h (possible, trivial). GOAT v COW had a positive effect on soreness B-24h and B-72h (possible, trivial). Comparisons of GOAT and COW to CHO for tiredness revealed a positive effect B-24h, B-72h (possible, trivial) and B-48h (likely, small). GOAT v COW showed a positive effect for GOAT B-24h and B-72 (possible, trivial).
CONCLUSION: Consumption of 750ml of goats milk and cows milk minimised losses for some muscle function variables and limited increases in muscle soreness and tiredness. Thus both are potential valuable recovery interventions for team sport athletes, though additional investigation is necessary to further elucidate responses.

EFFECT OF A PROGRESSIVE RESISTANCE TRAINING PROGRAM AND WHEY PROTEIN INTAKE ON QUALITY OF LIFE IN HUMAN IMMUNODEFICIENCY VIRUS INFECTED INDIVIDUAL RECEIVING ANTIRETROVIRAL THERAPY.

SOOKAN, T., ORMSBEE, M.J., ANTONIO, J., MAGULA, N.P., MOTALA, A.A., LALOO, U.G., MCKUNE, A.J.
UNIVERSITY OF KWAZULU NATAL

INTRODUCTION: Advances in HIV treatment in the last three decades has resulted in improved health, prolonged life and substantially reduced the risk of HIV transmission. This impact broadens to all facets of life, influencing quality of life (QOL). Progressive resistance training (PRT) combined with effective supplementation can increase muscle mass and improve physical performance in persons with HIV infection and may enhance outcomes in these patients as well as improve QOL.
METHODS: Forty HIV infected participants (40.8 ±7.7 yrs, 70.8 ±16 kgs, BMI 30.9 ±7.2 kg.m2) receiving ART (≥18 months) were randomly assigned to either a whey protein/resistance training (RT) group (n=18), placebo/PRT group (n=14) or control group (n=8). Participants received either 20g whey or placebo (maltodextrin) pre and immediately post each RT workout. Whole body RT was performed 2/week for 12 weeks. To assess QOL the WHOQOL-HIV BREF 31 was used which has six domains: Physical (1), Psychological (2), Level of Independence (3), Social Relations (4), Environment (5), and Spiritual (6). The questionnaire was completed at baseline and then at 12 weeks. The mean score of questions within each domain was used to calculate the domain score. Statistical analysis consisted of a two-way ANOVA and Sidak's multiple comparison post hoc testing. Alpha was set at $P \leq 0.05$.
RESULTS: The Physical Domain showed a significant time effect (TE) (P=0.02) with the placebo group increasing from baseline (17.69a.u.) to post (19.15a.u) (Mean difference -1.5a.u., 95% CI -2.9 to -0.05a.u.). There were no significant changes in the supplement group. The Social Relationships Domain exhibited a significant TE (P=0.02) with the placebo group increasing significantly from 14.23a.u. to 16.54a.u post (Mean difference -2.3a.u., 95% CI -3.9 to -0.7a.u.). Environment Domain showed a significant TE (P=0.002) with both placebo (15.65a.u. to 16.46a.u.; mean difference -0.8a.u., 95% CI -1.5 to -0.09a.u.) and supplement groups (14.35a.u. to 15.03a.u.; mean difference -0.7a.u., 95% CI -1.3 to -0.04a.u.) demonstrating significant increases from baseline after 12 weeks of training. The Spiritual Domain indicated significant TE (P=0.05) with the placebo group increasing from baseline (16.38a.u.) to post (17.92a.u) (Mean difference -1.5a.u., 95% CI -2.8 to -0.3a.u.). There were no significant changes in the supplement group. There were no changes in the Psychological or Level of Independence Domains for the placebo and supplement groups. There were no significant changes in the control group for any of the six domains.
CONCLUSION: Several components of QOL improved in ART treated HIV infected individuals that participated in the PRT program. Changes were predominately shown in the placebo group (Domains 1, 4, 5, 6). This can be attributed to positive social and environmental effects of exercise programmes. Exercise training is an inexpensive and efficacious strategy for improving QOL in this population with can impact other facets of their lives.

EFFECTS OF RESISTANCE EXERCISE TRAINING AND FERMENTED SOYBEANS CONSUMPTION ON GLUCOSE TOLERANCE AND MYOKINES EXPRESSION IN HIGH-FAT DIET-INDUCED OBESE MIDDLE-AGED RATS

KIM, K., AHN, N., LEE, G.
KEIMYUNG UNIVERSITY

INTRODUCTION: Soybean is widely used as an ingredient in various Korean fermented products such as Cheong-guk-jang , Doenjang , and Gochujang . Among them, fermented soybeans such as Cheonggukjang are produced by fermenting with Bacillus subtilis in a relatively short period of time during which various enzymes, microorganisms, and bioactive compounds that are not found in unfermented soybeans are produced . This study aims to help increase the living qualities of seniors who suffer from sarcopenic obesity and low immune function as a result by providing solutions from identifying the effects of 12 weeks of resistance exercise and fermented soybean consumption for obese middle-aged Wistar rats.
METHODS: Male Wistar rats aged 50 weeks were fed a high fat diet for 8 weeks to induce obesity, followed by ladder climbing exercise and soybeans treatment for 12 weeks. Subjects were randomly divided into four experimental groups: control , soybeans group , resistance exercise , and soybeans plus resistance exercise . Proteins for CON and RE group were the standard casein proteins and those for SO and SR groups were substituted with fermented soybean proteins which were consumed in the form of pallets. The exercising groups underwent high-intensity intermittent training using a ladder-climbing and weight exercise 3 days/week for a total of 12 weeks.

RESULTS: In oral glucose tolerance test, glycemic responses of SO group and SR group, a group which received both the consumption of fermented soybeans and resistance exercise training, showed significantly higher improvements compared to those of the control group and resistance exercise group . There was no difference in the amount of plantaris muscle found among groups but the myokines expression related to immune senescence was significantly low for the SO group . However, no significant differences in IL-15 which is a preventative factor for immune senescence were found among the groups.
CONCLUSION: Han et al. <2017> has reported that soy leaf extracts are effective in reducing cytokines related to inducing inflammation. Mercer et al. <2017> has reported that soy protein isolates have inhibitory effects on high-fat diet-induced hepatoma proliferation in mice during which IL-6 and TNF-α expressions related to inducing inflammation are reduced. These results lead to the idea that consumption of fermented soybeans during obesity and senescence process can help improve glucose tolerance, and prevent inflammation and increase the immune function.
References: Han J-M et al. Int J Mol Sci 2017, 18, 373.
Lee YB et al. Journal of Nutrition, 2004, 134<7>, 1827-31.
Mercer KE et al. Exp Biol Med 2017, 242, 635–644.
Contact to e-mail : kjk744@kmu.ac.kr

HYPERTONIC, ISOTONIC, HYPOTONIC SPORTS DRINKS AND NON-CARBOHYDRATE WATER EFFECTS ON PLASMA VOLUME DECLINE DURING CONTINUOUS EXERCISE: A META-ANALYSIS

ROWLANDS, D.

MASSEY UNIVERSITY

INTRODUCTION: Reduced blood and plasma volume coupled to exercise-induced dehydration is associated with higher cardiovascular strain and impaired performance. There is considerable interest, therefore, in sports drinks that best increase plasma volume, which is the arguably the best marker of relative hydration status and physiological end-point functional change during exercise. Osmosis and solvent drag properties support hypotonic carbohydrate-electrolyte solutions as most likely to be absorbed fastest across the gut wall vs more-concentrated drinks. Faster absorption should increase relative plasma volume; the published literature, however, is inconclusive. Therefore, the purpose of this research was to meta-analyse available datasets on the effects of ingested hypertonic (>300 mOsmol·kg-1), isotonic (275–300 mOsmol·kg-1), hypotonic (<275 mOsmol·kg-1) drinks containing carbohydrate and electrolyte ([Na+] <50 mmol·L-1), and non-carbohydrate and mineral containing flavored waters and water (<90 mOsmol·kg-1) on the delta % change in plasma volume (dPV) during continuous exercise.
METHODS: A systematic literature search to 31 Jan 2018 included studies that measured dPV during continuous exercise in healthy adults in response to continually ingesting the specified drinks. The search produced 21 studies and 59 single drink treatment type contrasts, with 199 measures of dPV over 0-180 min. A random effects mixed model (SAS 9.4) with repeated-measures of time binned into <35 min, 35-60 min, and 60-180 min provided estimates of drink effects. Fixed effects were Treatment*TimeBin and continuous predictor covariates drink ingestion rate, heat index, and metabolic rate. The random effects were intercept (between-study SD, heterogeneity), within-study contrast unique identifier, Treatment*TimeBin, and the subject term StudyID. The method of setting the residual variance to unity was used to apply the weighting. Weight was 1/SE derived from the reported SD with missing values imputed using a meta-regression weighted by 2DF.
RESULTS: Weighted mean (SD) dPV were hypertonic -8.6% (2.7), isotonic -7.6% (2.1), hypotonic -6.3% (2.6), water -7.4% (2.2). Estimates (95%CI) were (higher=more effective hydration) hypertonic-isotonic -0.0% (-1.4, 1.4), hypotonic-isotonic 1.7% (0.6, 2.8), water-isotonic 1.0% (-0.2, 2.2), hypotonic-hypertonic 1.7% (0.5, 2.9), hypertonic-water -1.0% (-2.2, 0.1), hypotonic-water 0.7% (-0.2, 1.6). The smallest standardised change score (0.2SD) vs isotonic was 0.6 making the hypotonic-isotonic and hypotonic-hypertonic contrasts very likely substantial, and the hypotonic-water increase possible. Adjusting for metabolic rate accentuated outcomes (e.g. hypotonic-isotonic 2.9%, 1.4, 4.3; hypotonic-water 1.0%, 0.1, 1.9), but ingestion rate and heat index had no impact.
CONCLUSION: Hypotonic carbohydrate-electrolyte drinks ingested continually during exercise provide very likely benefits to hydration vs hypertonic and isotonic, with benefits also possible relative to non-carbohydrate waters.

ENERGY EXPENDITURE DURING PALEOLITHIC-LIKE MOVEMENT PATTERNS – A PILOT STUDY

MARKS, N.

FACULTY OF SPORT SCIENCE, RUHR-UNIVERSITÄT BOCHUM

INTRODUCTION: Mimicking a paleolithic lifestyle including a paleo diet, plentiful sleep, and exercising in nature is associated with health-improving effects for overweight and diabetic people with a high cardiovascular risk [1]. It is estimated that the physical activity of ancestral humans accounted for about 1000 kcal/d and that caloric intake was typically about 3000 kcal/d [2]. Aim of the study was to analyse energy expenditure (EE) of paleolithic-like movement patterns during a 9-days hiking trip imitating a paleolithic-like lifestyle.
METHODS: 11 healthy sport students (age: 21.7 ± 2.2 y, VO2max: 49.2 ± 8.9 ml/min/kg, BMI: 23.9 ± 2.4 kg/m²) underwent a 9-day hiking trip mimicking a paleolithic-like lifestyle in the rural area of the Carpathians (d1-d9). The diet composition consisted of food high in fat and protein and low in carbohydrates with an energy intake of approximately 1700 kcal/d. Three typical activities were analysed: gathering (GA, n=7), fishing (FI, n=2) and hunting (HU, n=2). Portable spirometry with breath-by-breath technology was used to determine maximum oxygen uptake during activities (VO2peak) and EE. Furthermore, heart rate (HR) was measured continuously. Data are presented descriptively as non-parametric values (median and range).
RESULTS: Average EE during GA, FI, and HU was 362 (244-446), 194 (140-248), and 472 (451-494) kcal/h, respectively, equivalent to approximately 4.7, 2.6, and 6.0 MET. VO2peak was 36.4 (21.5-48.0), 25.1 (20.1-30.0), and 40.9 (40.3-41.5) ml/min/kg for GA, FI, and HU, respectively. Mean HR during GA, FI, and HU was 107 (55-169), 80 (60-110), and 116 (85-171) bpm, respectively.
CONCLUSION: The three analysed activities induced an energy expenditure similar to low and moderate sporting activities. With respect to the assumed energy expenditure of ancestral humans [2] about 3 hrs of gathering, 5 hrs of fishing, or 2 hrs of hunting would sum up to the estimated energy expenditure of about 1000 kcal/d. Assuming the daily needs for these activities during stone age energy expenditure of ancestral humans might have been much higher than 1000 kcal/d. The WHO recommends a target of a physical activity level (PAL) of 1.75 (490 kcal/d more than resting PAL of 1.4) to prevent obesity and reduce cardiovascular risk in sedentary populations [1]. Concerning these recommendations on physical activities for health, they are much lower than what our ancestors consumed daily.
REFERENCES:
[1] Frassetto et al. (2009). Eur J Clin Nutr, 63, 947-55.
[2] Saris et al. (2003). Int. assoc. for study of obesity, 4, 101-114.

Mini-Orals

MO-BN01 Motor Learning and Control

REPRODUCIBILITY OF FMRI MOTOR CORTEX ACTIVATION DURING HANDGRIP CONTRACTIONS

ANDRUSHKO, J.W., GOULD, L.A., RENSHAW, D.W., BOROWSKY, B., FARTHING, J.P.

UNIVERSITY OF SASKATCHEWAN

INTRODUCTION: Current methods of functional MRI analysis can be subjective beyond the statistical threshold for comparing multiple voxels when generating activation maps. Therefore, the utility of fMRI to measure robust changes in brain activation over time would benefit from a systematic approach. This study investigated the reproducibility of repeated fMRI scans involving execution of a motor task.
METHODS: Eight healthy participants (5 male; 29±7yrs; 1.72±0.07m; 79.9±16.6kg) attended two fMRI sessions at least two days apart to perform an isometric handgrip task. Three maximal voluntary contractions (MVC) were acquired first, followed by three separate scans involving handgrip contractions at three sub-maximal intensities (25, 50, & 75% MVC) in random order. Functional imaging scans were block paradigms including five blocks of 20 volumes each; with five volumes for stabilization (105 volumes total). Each block was 10 volumes of task and 10 volumes of rest. Task blocks included five handgrip contractions alternated with equal rest, and rest blocks involved no movement. Coefficient of variation (CV%) values were calculated for data acquired on each occasion for handgrip MVC force, sub-maximal target forces, corresponding voxel number and intensity values for activation in motor cortex. Between session handgrip MVC (CV=8.4%) and sub-maximal handgrip intensities (CV: 25% MVC=6.4-8.3%; 50% MVC=8.4-11.6%; 75% MVC=7.5-9.7%) were reproducible across the five blocks on repeat occasions. Two threshold methods were used to compute brain activation in motor cortex. First, a fixed threshold method (FIXED) was used with a threshold set to r=0.65. Second, a novel relative threshold method (RELATIVE) was used to normalize within session brain activation prior to comparison. The RELATIVE method determined a window of activation using the highest threshold value before brain activation disappeared and the lowest threshold value for which the map was first 'clean' (i.e. no false activation as determined by the researcher). Based on this, the 50% value between these two thresholds was used to compute the maps. Therefore, a different threshold was used for each participant, occasion, and condition.
RESULTS: For the number of voxels, the RELATIVE threshold method resulted in similar or much better reproducibility across conditions; 25% (CV: RELATIVE=14.6%; FIXED=14.3%), 50% (CV: RELATIVE=11.5%; FIXED=25.3%), and 75% (CV: RELATIVE=13.6%; FIXED=29.4%). For signal intensity, reproducibility was excellent for both methods across conditions; 25% (CV: RELATIVE=3.0%; FIXED=1.3%), 50% (CV: RELATIVE=7.0%; FIXED=2.7%), and 75% (CV: RELATIVE=3.8%; FIXED=2.2%).
CONCLUSION: The novel relative method for determining threshold for activation maps improved motor cortex voxel count reproducibility during handgrip contractions. These data are useful for determining effect size and sample size estimates for intervention studies involving repeat measures of fMRI brain activation for hand motor tasks.

PHYSICAL ACTIVITY, ACTUAL AND PERCEIVED MOTOR COMPETENCE IN 6-9 YEAR-OLD CHILDREN: A WINDOW OF OPPORTUNITY?

VENETSANOU, F., AFTHENTOPOULOU, A.

NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

Introduction: Motor competence (MC) and perceived motor competence (PMC) are thought as key-correlates of lifelong physical activity (PA). This study aimed at investigating the association among PA, MC, and PMC in children aged 6-9 years. Moreover, potential gender differences were explored.
Methods: Participants were 143 children (Mage=7.6 years, SD=0.9; 67 boys). Their PA was recorded by Omron HJ-720IT pedometers for seven days; MC was assessed with the Bruininks-Oseretsky Test of Motor Proficiency-Short Form (BOT-SF; Bruininks & Bruininks, 2005) and PMC with the Pictorial Scale of Perceived Movement Skill Competence for Young Children-Greek version (PMSC-GR; Venetsanou et al., 2018).
Results: According to the ANCOVAs (age as a covariate) that were applied, there were no differences between boys' and girls' MC and PMC ($p > .05$). Both were motor competent and held positive MC perceptions. Nevertheless, pedometer data revealed that gender was associated with PA ($F=29.94$, $p < .001$, $\eta 2=.20$), with boys being more active (13365+3514 steps/day) than girls (10106+1872 steps/day). Moreover, girls' PA was significantly lower ($t=2.665$, $p=.010$) than the recommended levels for their age and gender (Tudor-Locke et al., 2011). Finally, according to the correlation analyses, there was not a significant association among PA, MC and PMC either in boys or girls ($p > .05$).
Discussion: It seems that, between 6 and 9 years, the relation among PA, MC, and PMC has not been formed yet. Since this relation is thought to strengthen as children get older (Stodden et al., 2008), this age appears to be "a window of opportunity" for enhancing MC and maintaining positive PMC to achieve lifetime PA participation. Moreover, further research for other PA correlates may provide valuable evidence if children's (and especially girls') PA is to be enhanced.
References: Bruininks, R., & Bruininks, B. (2005). Bruininks-Oseretsky Test of Motor Proficiency (2nd ed.). Minneapolis, MN: NCS Pearson.
Stodden, D. F., Goodway, J. D., Langendorfer, S. J., Roberton, M. A, Rudisill, M. E., Garcia, C., & Garcia, L. E. (2008). A developmental perspective on the role of motor skill competence in physical activity: An emergent relationship. Quest, 60, 290-306.
Tudor-Locke, C., Craig, C. L., Bassett, D. R., Beets, M. W., Belton, S., Cardon, G., ... & Raustorp, A. (2011). How many steps are enough? For children and adolescents. International Journal of Behavioral Nutrition and Physical Activity, 8, 78.
Venetsanou F., Kossyva, I., Valentini, N. C., Afthentopoulou A., & Barnett, L. (2018). Validity and reliability of the Pictorial Scale of Perceived Movement Skill Competence for young Greek children. Journal of Motor Learning and Development, 1-22.

DEVELOPMENT OF MOVEMENT CONTROL IN VARIOUS PATTERNS OF HOPPING IN PRESCHOOL CHILDREN

SASAKI, R., ISHIZAWA, J.

KEIO UNIVERSITY

INTRODUCTION: Early childhood is an important period for the development of fundamental movement skills, and the various locomotive movements, such as hopping, galloping, and skipping, increase with age. Hopping is a rhythmically cyclic movement requiring signifi-

cant muscle strength, multi-limb coordination, and dynamic balance in order to be performed proficiently. In this study, we clarified the developmental characteristics of motor coordination, focusing on adaptation to the restricted patterns of hopping in preschool children.
METHODS: Participants were typically developing children, 94 boys and girls aged 4-6 years. They were asked to pursue the following 4 tasks: 1. one-foot hopping, 2. alternating hopping in every three hops, 3. both feet hopping (jumping), 4. hopping with a pattern sequence with either one or two feet. In each task, they hopped forward according to the frames indicated on the floor. We filmed all their movements and analyzed the footage. We then evaluated observations of children's movements using certain criteria. We focused on the temporal and spatial control and bilateral coordination during these tasks. Mastery of the movement tasks were compared among older and younger children.
RESULTS: In task 1, about 30% older children and less than 10% younger children completed the task. In task 2, few children completed the movement sequence. In task 3, the rate of accomplishing the task was higher than the other one-foot hopping tasks in both age groups. In task 4, approximately 30% boys and 50% girls accomplished the task. However, younger children had some difficulties, and paused and faltered while executing the sequence.
CONCLUSION: Overall, the rate of accomplishing each task was higher in older than younger children. Furthermore, older girls showed more advanced performances in all tasks. The preschool years are important for learning and acquiring good hopping techniques (Gallahue et al., 2012). An adequate hopping pattern was shown at around 5 years of age, with girls showing this pattern several months earlier than boys (Seefeldt and Haubenstricker, 1982). In this study, those tasks required continuous adaptation to balance and bilateral coordination. It is considered to be difficult for younger children to execute hopping with non-dominant foot, and control rhythmic alternation of bilateral extremities.
REFERENCES:
Gallahue DL, et al., (2012), Understanding Motor Development, 222-248, McGRAW-HILL, New York.
Seefeldt V., and Haubenstricker J., (1982), The development of movement control and co-ordination, 309-318, John Wiley & Sons, New York.
CONTACT:
sasaki@z6.keio.jp

APPROACHING PERFORMANCE CONTROL IN GYMNASTICS: ARE WELL-ESTABLISHED HANDSTAND COACHING CONCEPTS SUFFICIENT FOR MOTOR SKILL ACQUISITION?

ROHLEDER, J.

GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: According to the upright stance, successful postural control in human handstand performances can be modelled as a single segment inverted pendulum which is mainly controlled by wrist flexor torques. However, despite the dominant contributions of wrist torques, common handstand coaching concepts primarily focus on developing the aligned fixed body configuration. Therefore, this study challenged the effects of a sole postural training on the maintenance vs. the execution quality in handstands in competitive young gymnasts.
METHODS: Twenty-two participants (13 females, aged: 8.54 ± 1.56 years; 9 males, aged: 8.67 ± 0.87 years) were randomly assigned into two counterbalanced groups, GPT (guided postural training) and CON (control, no training intervention), each n = 11. Within one week, GPT received four standardised training sessions (T1, T2, T3 and T4) including augmented feedback and instructions addressing a straight body posture. Prior to T1 (pre-test), after T2 (mid-test) and after T4 (post-test), all participants (GPT and CON) were asked to perform five handstands focussing on a long balancing time. Standardized video recordings captured the balancing time and postural execution during the handstands that were subsequently assessed by four international-level gymnastic judges.
RESULTS: ANOVA results revealed no changes in balance time in GPT ($p > .05$), whereas divergent changes for postural execution were observed for the groups ($p < .05$) in favour of GPT. ANCOVA results showed that the impact of GPT increased with age, leading to postural changes at the expense of decreased balance abilities. Positive correlations between balance time and postural execution were revealed at all three times of measurement (pre, mid, post; each $p = .01$).
CONCLUSION: The present findings raise doubts about the benefits of sole postural training on enhanced handstand balancing abilities. Considering the importance of wrist contributions for maintaining the handstand, we attribute these findings to the continuative hypothesis that explicit information regarding the forearm work is of utterly importance for accelerated handstand acquisition processes. Furthermore, decreased balance times that were observed in older gymnasts were accompanied by short-term enhanced postural performances. Enhanced cognitive capacities compared to less-experienced gymnasts may facilitate the implementation of additional declarative knowledge, but may also impair already automated motor processes in terms of balance control. This would explain facilitated joint angle adjustments at the expense of unknown and, thus, disrupted equilibrium in handstand performances. With respect to the mutually dependences of balance and postural alignment in handstands, further motor behavioural research is needed approaching wrist-related advice in handstand acquisition.

EFFECT OF VISUAL TRAINING IN TENNIS PERFORMANCE. A RANDOMIZED CONTROLLED TRIAL

GATTI, C., LA TORRE, A., BONATO, M.

UNIVERSITÀ DEGLI STUDI DI MILANO

INTRODUCTION: Tennis is a direct opposition sport in which the result of the game is directly influenced by the interaction with the opponent. Therefore, the athlete has to respond to the different playing situations analysing in a short period of time direction, speed and rotation of the ball. "Visual training" is a training method that helps to receive and process different information optimizing the subsequent performance with extreme precision and dexterity. Therefore, the aim of the present study was to investigate how this training method could affect visual and tennis performance in junior tennis players.
METHODS: This was a randomized controlled trial in which 18 junior tennis players were recruited and randomized to either en experimental group (EG; n=10; age 15±3 years; body mass 52±11 kg; height 1.67±0.1m) that performed 30 min visual training after the warm-up or a control group (CG; age 15±3.1; body mass 53.5±12kg; height 1.7±0.1) that was involved in a standard training. Players were tested before and after 12weeks of training (3 session/week) with Motor Brain application (iOS 7.1 version, University of Udine) for off court reaction time measurement, QLIPPTM sensor for backhand, forehand and serve sweet spot and speed, and Kinovea software (Version 0.8.15, France) to evaluate the time course between split steep and shoulder rotation. Results are given as mean ± standard deviation (SD). T0 and T12 intervention intra- and intergroup differences between EG and CG were checked using two-way analysis of variants with Tukey post-hoc test.

RESULTS: No significant differences regarding off court reaction time during the two signals and four signals reaction time measured with Motor Brain application were noted. Regarding specific tennis performance improvement over baseline were noted for the time course speed between split steep and shoulder rotation for forehand (0.84±0.07 vs 0.57±0.11 sec, p=0.0008), backhand (1.02±0.12 vs 0.66±0.12 sec, p=0.001), and return of serve (0.96±0.13 vs 0.72±0.08 sec, p=0.0007). In addition an improvement over baseline values for second serve speed was noted (59.6±34.9 vs 122.6±32.8 km/h, p=0.0008). Differences were noted in post-intervention for the time course speed between split steep and shoulder rotation for forehand (0.57±0.11 vs 0.90±0.15 sec, p=0.0001), backhand (0.66±0.12 vs 0.95±0.17 sec, p=0.012), return of serve (0.72±0.08 vs 1.08±0.11 sec, p<0.0001) and second serve speed (122.6±32.8 vs 84.7±24.1 km/h, p=0.043).
CONCLUSION: Visual training improved specific tennis performance in junior tennis players. Incorporating this type of training into the workout routines may optimize precision and dexterity of tennis performance.

INFLUENCE OF AN INCREASED NUMBER OF PHYSICAL EDUCATION LESSONS ON MOTOR ABILITY AND SELF-ESTEEM

REIF, A., TSCHAN, H., WEIß, O.

UNIVERSITY OF VIENNA

Physical activity and sports can be seen as a promotor for physical and mental development and plays a significant role in shaping the personality (1). As a result, lack of physical activity especially in prepubertal age and adolescence has negative influences on their physical, mental and social well-being. Less than a fifth of Austrian students (17,4%) fulfils the physical activity recommendations (2) which amount at least 60 minutes of physical activity in moderate intensity daily (3). Previous studies demonstrated a significant relation between physical education lessons and the development of motor ability as well as self-esteem (4). Thus, the Austrian government supports the inception of an increased number of physical education (PE) lessons in schools with the intention to reach children and adolescences in all social classes and lead them to a more active and healthy lifestyle. Therefore, the aim of this study is to assess the effect of two additional PE lessons weekly on children's motor-skills and their self-esteem.
141 pupils aged 12-14 years volunteered to participate in this study. The sample comprised an observation group (n=57) with five weekly PE lessons and a control group (n=84) with three weekly PE lessons during an observation period of 1.5 years. During this period pupils were tested every 6 months. The data collection tools used were a test module for motor skills (Deutscher Motorik-Test 6-18), a tool measuring self-esteem (ALS-Test), and a questionnaire on the movement behavior outside school. A two-way analysis of variance (ANOVA) was used to detect significant differences between time and groups. An alpha-level of $P < 0.05$ was considered to be statistically significant. Preliminary results suggest a strong trend of improved motor ability in the observation group, especially in endurance (i.e. 6 min run). Furthermore, results of the questionnaire suggest that self-esteem is higher in the observation group compared to the control group. The principal findings of the study were that pupils having more than the usual hours PE tend to score higher in the Deutsche Motorik-Test and have a stronger self-esteem. These results suggest that more hours of PE have positive effects on motor skills as well as self-esteem.
contact: astrid.reif@univie.ac.at
1. Weiss, Voglsinger & Stuppacher (2016)
2. Ramelow, Teutsch, Hofmann & Felder-Puig (2015)
3. WHO (2010)
4. Ericsson & Karlsson (2011)

DIFFERENTIAL EFFECTS OF COMBINED MOVEMENT AND STORYTELLING INTERVENTION ON MOTOR SKILLS IN SOUTH ASIAN AND WHITE CHILDREN AGED 5 -6 YEARS LIVING IN THE UK.

EYRE, E.L.J.1, DUNCAN, M.J.1, LOWTON-SMITH, S.1, HODSON, D.2, DOBELL, A.1

1: COVENTRY UNIVERSITY , 2: LEEDS TRINITY

Introduction: Early motor skill development has an important role in promoting physical activity (PA) during childhood, and across the lifespan. There is some evidence to suggest that both motor skill performance (Eyre et al., 2017) and physical activity levels are lower in children from Indian, Pakistani and Bangladeshi backgrounds (South Asian) compared to White (Eyre et al., 2013). Combined movement and storytelling interventions has shown improvements in children's motor skills compared to motor skill intervention alone (Duncan et al., 2017). However, whether children across ethnic groups benefit the same from these interventions has not been studied. This study examined the effect of a combined movement and storytelling intervention for 12 weeks on motor skills in children from South Asian backgrounds compared to White peers matched for deprivation.
Methods: Following ethics approval and parental informed consent, 46 children (27 White, 19 South Asian, 14 boys; 32 girls aged 5-6 years) from 2 schools, participated in quasi-randomised study. Schools were matched by deprivation, and children underwent a 12 week combined movement and storytelling intervention. Pre and post, 4 motor skills: run, jump, throw, and catch were assessed the Test of Gross Motor Development-2. The scores for all the skills were then summed to create a total motor competence score (0-30). Weight status was assessed using BMI.
Results: Results from a 2 (pre vs post) X 2 (group) way repeated measures ANCOVA revealed a significant time X ethnic group interaction for motor competence ($P = .013$). No interaction between time and gender, nor main effects were found. Both ethnic groups motor competence improved as a result of the intervention from baseline (White $\Delta = 4$, South Asian $\Delta = 9$). At baseline, White children had a significantly higher total motor competence score compared to South Asian children (18 ± 5 vs 15 ± 4, $P = .014$), however following the intervention there was no significant difference between these ethnic groups ($P= 0.137$, White 22 ± 5 vs South Asian 24 ± 4).
Discussion: The results of this exploratory study suggest that a) Motor competence may be developmentally delayed in South Asian children compared to deprivation matched white peers and; b) A combined movement and storytelling intervention results in beneficial changes to motor competence as well as narrowing the motor competence gap between South Asian and white children's ethnic groups.
References: Duncan, MJ. (2017). European Physical Education Review, 1-15.
Eyre, ELJ. et al (2017). Perceptual and Motor Skills, 4(11).
Eyre, ELJ. et al (2013). Diabetic Medicine, 30 (8), 939-945.
Contact: emma.eyre@coventry.ac.uk

RELATIONSHIP AMONG BIOLOGICAL MATURATION, ANTHROPOMETRY AND MOTOR ABILITY IN YOUTH ELITE SOCCER PLAYERS

ITOH, R., HIROSE, N.

WASEDA UNIVERSITY

INTRODUCTION: In youth soccer players, the differences in biological maturation affect anthropometrical and physiological development. Conversely, in a young setting, coaches evaluate a player's performance by their motor ability, e.g., speed and power. Thus, studies have reported that early-matured players, unlike late-matured players with lower motor ability (i.e., jump power), may be regarded as elite players within the same age group. Therefore, to evaluate a player's future performance, coaches should identify the motor ability influenced by the difference in players' biological maturity. Hence, we aimed to investigate the cross-sectional relationship among skeletal age (TW3), anthropometric, and motor abilities in youth elite soccer players.
METHODS: We enrolled 38 youth male soccer players (12.2±0.6 y) belonging to the J League academy club. Height, weight, body fat percentage, foot size, circumference girth (thigh/calf), and flexibility were measured. Measurements related to the 10m/50m sprint, 10m×5 shuttle run, crank test, 5-step bounding, Yo-Yo IR2, and cooper run were conducted. Further, individual radius-ulna-short bone score, evaluated using the left hand X-ray, was converted into the skeletal age (SA) using a TW3 conversion table. The participants were divided into Late, Average, and Early maturation groups as per the following criteria: SA-CA<−1 year, SA-CA=±1 year, and SA-CA>+1 year, respectively. The difference in parameters among the groups was analyzed using ANOVA and Turkey's post hoc test. Statistical significance was set at $P<0.05$.
RESULTS: The Early group participants were taller and their foot size and circumference were bigger than those of the Average group (163.8 ± 5.1 vs.151.8 ± 8.2 cm, $p<0.001$; 26.0 ± 0.9 vs. 24.8 ± 1.4 cm, $p=0.046$; 33.6 ± 1.9 vs. 31.5 ± 2.0 cm, $p=0.010$; respectively). Further, all the anthropometric parameters of the Late group (144.5 ± 5.5 cm, $p=0.028$; 23.6 ± 1.4 cm, $p=0.047$; 29.8 ± 1.4 cm, $p=0.041$; respectively) were lower than those of the Average group. Conversely, the Early group was significantly faster in the 10m (2.01 ± 0.08 vs.2.11 ± 0.05 sec, $p=0.011$) and 50m sprints (7.65 ± 0.33 vs.8.16 ± 0.30 sec, $p=0.016$) and scored higher in the 5-step bounding (10.03 ± 0.63 vs.9.13 ± 0.43 m, $p=0.006$) than the Late group; there was no difference among the groups regarding other parameters.
CONCLUSION: These results indicate that the difference in biological maturity influences the anthropometrical and physiological development, particularly muscular power. Therefore, coaches should consider maturation levels while evaluating muscular power. Conversely, endurance (Yo-Yo IR2 and cooper run) and agility (10m×5 shuttle run and crank test) were not significantly different among the three groups, implying that endurance and agility are independent of biological maturation. They may depend on other factors such as technique, coordination, and cardiopulmonary function rather than muscle power. This research may help to achieve a fair evaluation of players.

EFFECTS OF THE 12-WEEK CLIMBING-SPECIFIC HOME-BASED EXERCISE PROGRAM "HEIMSPORT" ON MOTOR FUNCTION AND LIFESTYLE IN PERSONS WITH MULTIPLE SCLEROSIS

GRAF, A., SPITZENPFEIL, P., KERN, C.

TECHNICAL UNIVERSITY OF MUNICH

INTRODUCTION: While positive effects of physical activity to limit the progression of multiple sclerosis are well-known, people with multiple sclerosis (PwMS) still tend to be less physically active than their healthy counterparts. Home-based exercise programs represent a major opportunity to encourage physical activity among PwMS. Several studies exist which include endurance and strength exercises, but no home-based exercise program for a single specific sport has been researched so far. The aim of this study was to evaluate the feasibility and effectiveness of such a home-based exercise program with a focus on climbing ("heiMSport").
METHODS: The study includes 31 PwMS (mean age 52 ± 7 years), all members in the therapeutic climbing group "MS on the Rocks". Once a week participants are enrolled to take part in therapeutic climbing lessons. The intervention group (n = 14) is encouraged to practice the home-based exercise program additional to therapeutic climbing twice a week, while the control group (n = 17) only took part in the climbing sessions. Data for motor functions (leg strength: Isomed 2000; walking speed: T25FW), physical activity (Baecke), self-efficacy (SWE), fatigue (WEIMuS) and quality of life (HAQUAMS) are collected in pre-post design after three month. Also the feasibility and effectiveness of program were explored (ZUF-8).
RESULTS: All participants were totally satisfied (100 %) with the structure of the program and the comprehensibility of the exercises. 79 % could integrate the home-based exercise program easily in their daily life. A high acceptance rate was achieved and the dropout of 8.8 % was very small. Significant improvements were seen in leg strength (p-value 0.00, ES 0.99), walking speed (p-value 0.03, ES0.64) and in self-efficacy (p-value 0.05, ES0.60). QoL, fatigue and physical activity did not change significantly.
CONCLUSION: The newly developed program heiMSport combines a regular sports activity with a home-based exercise program. The minor dropout in comparison to former studies and the high satisfaction and acceptance demonstrated the good feasibility of this program. Significant effects on motor functions and psychosocial parameters were shown. A high acceptance was achieved and the connection to their individual sports and to the therapeutic climbing group "MS on the Rocks" may be decisive. Furthermore the positive effects of individual physical activity for people with multiple sclerosis were again proved. A combined regular sports with a home-based exercise program seems to represent a more successful program to increase physical activity sustainably.

Mini-Orals

MO-PM13 Athlete phenotype

BONE MINERAL DENSITY AND ASSOCIATED GENETIC VARIANTS IN HIGH-LEVEL CAUCASIAN MARATHON RUNNERS

HERBERT, A.J.1, WILLIAMS, A.G.1, LOCKEY, S.J.1, ERSKINE, R.M.2, SALE, C.3, HENNIS, P.J.3, ANTROBUS, M.R.1, BRAZIER, J.1, HEFFERNAN, S.M.4, DAY, S.H.1, STEBBINGS, G.K.1

1:MANCHESTER METROPOLITAN UNIVERSITY , 2:LIVERPOOL JOHN MOORES UNIVERSITY , 3:NOTTINGHAM TRENT UNIVERSITY , 4: UNIVERSITY COLLEGE DUBLIN,

INTRODUCTION: Endurance runners (except those who may have low energy availability) tend to have higher total and/or loading site-specific bone mineral density (BMD) in comparison with non-athletes, most likely due to the larger volume of exercise completed. A large

genetic component also contributes to BMD, although little is known about which specific genes are involved, whether particular genotypes are sensitive to mechanical loading and the impact of such an interaction on BMD. This study investigated if high-level endurance runners possess enhanced BMD associated with an "advantageous" genetic predisposition, via a potential gene-physical activity interaction.
METHODS: Age- and weight-adjusted total BMD (TBMD) and leg BMD (LBMD) measured via Dual-energy X-ray absorptiometry of 67 high-level Caucasian marathon runners (males < 2 h 45 min, n = 37; females < 3 15 min, n = 30) was compared with 40 male and 26 female non-athletes. LRP5 rs3736228, TNFRSF11B rs4355801, VDR rs2228570, WNT16 rs3801387 and AXIN1 rs9921222 variants were then investigated singularly, and collectively, as a total genotype score (TGS) via multivariate analysis of variance in a subgroup of this cohort (male runners n = 19, controls n = 26; female runners n = 17, controls n = 14).
RESULTS: Male runners had higher TBMD (1.34 vs 1.28 g/cm2; P=0.02) and LBMD (1.53 vs 1.42 g/cm2; P=<0.01) than non-athletes. Female runners had higher LBMD than non-athletes (1.30 vs 1.22 g/cm2; P=0.02) but not TBMD (1.23 vs 1.18 g/cm2; P=0.22). An interaction (P=0.047) was observed between VDR rs2228570 genotype and group regarding LBMD in males: ff genotype runners had 0.02 g/cm2 higher LBMD than FF or Ff runners, but the FF genotype had the highest LBMD (1.45 g/cm2) amongst non-athletes. LBMD was also 0.12 g/cm2 higher in ff runners compared to ff non-athletes, whereas FF and Ff runners had 0.09 g/cm2 higher LBMD compared to their genotype-matched controls. No other interactions or variants, individually or collectively as part of a TGS, were associated with BMD (P≥0.11).
CONCLUSION: High-level female runners possess higher LBMD but not TBMD in comparison with non-athletes whereas male runners possess both higher TBMD and LBMD than non-athletes. Consistent with prior literature, we observed higher BMD in VDR rs2228570 FF genotype in non-athletes, which may be due to increased biological activity associated with the F variant. However, our preliminary data suggest that the ff genotype may be associated with enhanced LBMD in male runners via a gene-environment interaction.

INVESTIGATION OF POWER ABILITIES IN PROFESSIONAL FUTSAL PLAYERS

BERDNIKOVA, A., ZAKHAROVA, A., TARBEEVA, N.

URAL FEDERAL UNIVERSITY

Introduction: The specificity of the competitive activity in futsal involves high-intensity/high-speed and power intermittent work with variable rest intervals between player changes during the game and requires a high level of the players power capabilities. The insufficient number of research data in the field of the power abilities assessment of elite and sub-elite athletes in futsal determined the relevance of the study. Therefore, the aim was twofold – to assess the power and to test a repeated triple Wingate test in the power performance of top level futsal players.
Methods: The professional futsal club players (n=10, age 27,0±4,8 years, height 181,4 ± 7,4 cm, weight 78,8±8,4 kg, VO2max 51,6±6,6 ml/kg/min) underwent repeated (triple) Wingate test with 3 minutes rest interval between sets. Peak power (PP), average power, the time of peak power reaching (TPP) and the fatigue index in each set were under consideration.
Results: A high level of power preparedness (PP 11,74 ±0,8 W·kg-1) was determined in the tested group of athletes. The PP higher than 12 W·kg-1 was revealed in 50% of the players. 40% of futsal players showed a rapid achievement of PP (earlier than the 5th second).
Peak power was the highest in the second set in 60% of the players whereas the best values of TPP were showed in the second Wingate test by 40% of the tested athletes.
In 50% of athletes there was a gradual increase of the fatigue index during the repeated Wingate test while stable value of the fatigue index (within the 5% range) was fixed in 30% of the players that provides a high level of power endurance.
On average, the decrease in peak power and average power in the best and last approach of the Wingate test was 10.82 ± 6.55% and 14.27 ± 6.16%, respectively.
Conclusion
The achievement of the highest values of PP and average power can have place not only in the first attempt but also in the second set of the repeated Wingate test.
The assessment of power and power dynamics in three sets of Wingate test reveals a range of possible variations in the athletes' results and helps the coach to identify players' capabilities of repeatedly withstanding high intensity during attacks and counterattacks, which is extremely important for competitive activity in futsal.

BODY MASS CHANGES OF LOCAL AND INTERNATIONAL ELITE MARATHON RUNNERS IN THE TROPICS

TAN, X.R.1,2, LOW, C.C.2, LEE, J.K.W.2,3

1: NUS GRADUATE SCHOOL FOR INTEGRATIVE SCIENCES AND ENGINEERING, 2: NATIONAL UNIVERSITY OF SINGAPORE, 3: DSO NATIONAL LABORATORIES, SINGAPORE

INTRODUCTION: Prolonged exercise under a hot and humid environment leads to rapid body fluid loss due to profuse sweating. This is especially important to marathon races conducted in the tropics where the rate of sweat loss will be the fastest. The amount of dehydration accrued in elite marathon runners has yet to be directly measured in the real-world setting. Hence, we recorded the body mass changes in local runners and international elite runners after a marathon organized in a tropical country (Standard Chartered Singapore Marathon; SCSM).
METHODS: A total of 32 runners' body mass data was collected in SCSM 2017. Immediately before and after the marathon, the participants weighed themselves in their race attire. Body mass was measured to the nearest 0.01kg with an electronic balance scale (Mettler-Toledo GmBH, Giessen, Germany) placed on a flat surface. To account for the sweat retained in the clothing after the run, a set of running attire was soaked in water and weighed. The measured mass was subtracted from the post-run body mass. Any water intake by the runners after the end of marathon was estimated as accurate as possible and was included in the calculation for body mass changes. The ambient temperature and humidity were measured by a heat stress monitor before and after the marathon.
RESULTS: Valid race and body mass data was obtained from 20 runners - eight local runners (Singaporeans; SG) and 12 international elite runners (11 Kenyans and 1 Kazakhstan; INT). The runners were mixed gender (SG: 3 males, 5 females, INT: 6 males, 6 females) and their age ranged from 24 - 41 yrs old. Mean dry bulb temperature and humidity were 27.9°C and 78%. Median race timings for all runners was 160.7 mins. INT runners performed better than SG runners (155.9 mins vs 197.8 mins). Mean body mass loss and % mass loss for all runners were 2.6 kg and 4.8%. The mean body mass loss and % mass loss in SG runners were lower than the INT runners (2.0 kg vs 2.9 kg; 3.8% vs 5.5%).
CONCLUSION: While it is uncertain if the INT runners could have performed better if they opted for a more aggressive hydration plan, our data nonetheless showed that elite INT runners opted to hydrate less during a self-paced marathon as compared to SG runners.

THE INTERACTIVE EFFECTS OF SITUATIONAL VARIABLES ON TEAM PERFORMANCE IN NBA

SHAOLIANG, Z.

POLYTECHNIC UNIVERSITY OF MADRID

INTRODUCTION: Existing performance analysis has identified the effects of situational variables on sports performance at a behavioural level. However, the examination of situational variables in isolation would provide limited insight into the complex nature of team sports performance (O'Donoghue, 2009). Therefore, the aim of this study was to consider the potential interactive effects of situational variables when assessing team's performance.
METHODS: Archival data were obtained from NBA website during the 2015–2016 regular season. A total of 699 games that ended with final score differences equal to or less than 10 points were selected. The team quality was decided by final team ranking in the NBA league. Magnitude-based inferences were applied to identify differences between winning and losing teams under situational efficiency (Hopkins et al., 2009).
RESULTS: When weaker teams played against weaker teams, winning team secured more defensive rebounds (EShome=-0.62; ESaway=-0.85) and made more points inside the paint area (EShome =-0.29; ESaway=-0.32) than losing team for home and away games, respectively. When stronger teams played against weaker teams, winning teams secured more defensive rebounds (EShome =-1.07; ESaway=-0.85) and scored more points from the middle-range area (EShome =-0.73; ESaway=-0.43) than losing team for home and away games, respectively. When stronger teams played against stronger teams, winning teams secured more defensive rebounds (EShome=-0.49; ESaway=-0.69) and made more free-throws (EShome=-0.62; ESaway=-0.26) than losing team for home and away games, respectively.
CONCLUSION: The current study identified difference in team's performance between winning and losing teams under different situational variables at the NBA league. These findings were in line with (Gomez et al., 2008) demonstrating that 'defensive rebounds' were a key performance indicator to winning basketball games. In addition, our study indicated that stronger teams tend to shoot in the middle-range area or made more free-throws when playing against weaker or stronger teams, while weaker teams tend to make more points in the paint area when playing against weaker teams. It is possibly suggested that team's performance is affected by the quality of the opposition (Sampaio et al., 2010).
References: Gomez, M. A., et al. (2008). Game-related statistics that discriminated winning and losing teams from the Spanish mens professional basketball teams. Collegium Antropologicum, 32(2), 451-456.
Hopkins, W. G., et al. (2009). Progressive statistics for studies in sports medicine and exercise science. Med Sci Sports Exerc, 41(1), 3-13. doi:10.1249/MSS.0b013e31818cb278
O'Donoghue, P. (2009). Interacting performances theory. International Journal of Performance Analysis in Sport, 9(1), 26-46.
Sampaio, J., et al. (2010). Effects of starting score-line, game location, and quality of opposition in basketball quarter score. European Journal of Sport Science, 10(6), 391-396. doi:10.1080/17461391003699104

THE EFFECTS OF DIFFERENT UNSTABLE CORE MUSCLE TRAINING METHODS ON THE TRUNK STABILITY IN FEMALE BASKETBALL PLAYERS

LIANG, I.J., LIN, L.L., HUANG, C.C., LI, G.J.

GRADUATE INSTITUTE OF PHYSICAL EDUCATION, HEALTH & LEISURE STUDIES, NATIONAL CHENG KUNG UNIVERSITY, TAINAN, TAIWAN

INTRODUCTION: Basketball is a high speed, intense, physical game that demands exceeding strength, power, speed, balance, coordination, and dribble control. Trunk position is not only related to the performance of the physical fitness but also important for the balance and stability of the whole body (Shinkle et al., 2014). The TRX® Suspension Training has been shown to be an effective device for eliciting an increased core muscle endurance and core muscle activation. Besides, Swiss ball core muscle training can improve the core muscle strength and the neuromuscular recruitment. To our knowledge, only few studies have discussed the effects of different unstable core muscle training methods on the trunk muscle abilities. Therefore, the purpose of this study was to investigate the effects of the two training methods on the trunk stability in female basketball players.
METHODS: 34 healthy elite female basketball players (age: 14.76± 1.84yrs, BMI: 21.41± 1.96 kg/m2) were assigned to either TRX training group (n=17) or Swiss ball training group (n=17). All participants performed a progressive program consisting of 3*8 sessions twice-a-week unstable core muscle training for 8 weeks under supervision.The main outcome measures were "core muscle strength and stability test" and the performance of modified double leg lowing task (MDLL) for trunk stability. These parameters were evaluated before and after the 8-week core muscle training. Independent Sample t test was used to determine the differences of baseline data. Two way ("group" x "time") analysis of variance (ANOVA) with repeated measures on "time" was used for analyzing the effects of core muscle training on variables of trunk muscle abilities. Scheffés post-hoc comparison was used to determine the differences between groups.
RESULTS: A significant group x time interactions were found for MDLL task in TRX group (p=.021). In MDLL task, TRX group (8.6%,) increased significantly more than Swiss ball group (2.9%)(p<.05). The score of core muscle strength and stability test increased in both TRX (182%) and Swiss ball groups (168%) (p=.001), but no significant difference was observed between the two groups.
CONCLUSION: A previous study indicated that the score of MDLL task could represent the ability of maintaining the spine in neutral position (Butcher et al., 2007). The main result of this study shows that the trunk stability (score of MDLL task) in TRX was significantly higher after the 8-week training. TRX core muscle training may have a greater effect on the trunk control ability and muscle activation than Swiss ball core muscle training (Mok et al., 2015). In addition, this study also found that both TRX and Swiss ball training could increase core muscle strength and stability. In conclusion, both unstable core muscle training methods could enhance trunk control ability. Consequently, considering the goal was to improve the trunk muscle abilities, TRX training was the more preferable choice especially for the control ability.

MOVEMENT COMPETENCY IN JUNIOR ATHLETES: PILOTING AN ATHLETE PATHWAY ASSESSMENT TOOL

ROGERS, S.A.1,2, HASSMÉN, P.1, ALCOCK, A.1,2, ROBERTS, A.H.1, WARMENHOVEN, J.1, GILLEARD, W.2, WEISSENSTEINER, J.R.1

1: AUSTRALIAN INSTITUTE OF SPORT , 2: SOUTHERN CROSS UNIVERSITY

INTRODUCTION: Movement competencies form the foundations for the development and training of young aspiring athletes. Yet formal assessment of such capabilities can be overlooked within early athlete programs, arising from the wide range of assessments varying in length, difficulty, and reliability in the current literature. The aim of this study was to assess the reliability of a simple assessment tool of

four key movement patterns and subsequently evaluate its effectiveness and application to younger athletes, first entering a formal sporting system.
METHODS: Eleven junior athletes (7 male, 4 female; 15.0±1.4 years) were assessed in four movement tasks using a selection of criteria from previous reliable batteries in adolescent (Lubans et al. 2014) and adult (McKeown et al. 2014) populations. Each athlete performed two sets of four repetitions of an overhead squat, lunge, push up, and a straight-arm prone brace with alternating hand touches to the opposite shoulder. Movements were scored retrospectively via video against four criteria per movement, on a 1-3 scale. For intra-rater reliability, the same movements were scored on two occasions, three weeks apart. Athletes were reassessed under identical conditions, seven days apart, for between-day reliability. Reliability was deemed acceptable if mean difference (Mdiff) was <5%; typical error (coefficient of variation; CV) was <10% and intra-class correlation coefficient (ICC) was >0.7.
RESULTS: The composite movement scores from a possible total of 48 points, ranged from 24 to 47 points in this cohort. Assessing the same videos twice, scores were (mean±SD) 39.2±5.1 and 39.4±5.9 points. Day one and day seven performances were 38.8±5.5 and 39.2±5.1 points respectively. Both the intra-rater (Mdiff=1.0%; CV=4.7%; ICC=0.94) and between-day (Mdiff=1.0%; CV=6.4%; ICC=0.86) reliability fell within acceptable limits.
CONCLUSION: In junior athletes, this assessment appears promising in constructing a practically worthwhile measurement tool that can be integrated into a pathway program. Pilot results give a reference for the minimal detectable change in a reassessment of these movements by the same assessor. In addition, between-day reliability revealed a limited learning effect. It is useful for practitioners to screen emerging athlete's movement competency, especially prior to increases in training and competition loads, which accompany pathway transitions. Evaluating movement proficiency when athletes first enter formal development pathways, can allow informed and targeted movement training approaches, required to reduce athlete injury risk and improve holistic development outcomes.
References:
1. Lubans D, Smith J, Harries S, Barnett L, & Faigenbaum A. (2014). J Strength Cond Res, 28(5), 1373-1380
2. McKeown I, Taylor-McKeown K, Woods C, & Ball N. (2014). Int J Sports Phys Ther, 9(7), 862-873.

Mini-Orals

MO-BN05 Orthopedic issues in sport

DOES THE DEGENERATED NUCLEUS PULPOSUS OF LUMBAR INTERVERTEBRAL DISC INFLUENCE IN A GAIT PATTERN?

TAKEMURA, M.
ICHIHASHI ORTHOPEDICS CLINIC

INTRODUCTION: The degenerated nucleus pulposus (NP) of lumbar intervertebral disc (LID) is often observed to adolescent athletes with non-specific Low Back Pain (LBP). This degenerated NP is characterized by the shortness of the NP longitudinal axis and its anterior position on the LID longitudinal axis that was measured by magnetic resonance images (MRI) of spine and sacrum in sagittal plane in T2 weighted sequence (we called it the " bullet type ", see chart). The hypofunction of the LID by this degenerated NP causes the hypertonic of the back muscle and others, for example the lumbar multifidus muscle (1) then we hypothesized that the adolescents with the bullet type degenerated NP on LID are characterized by a typical gait pattern, in particular lumbar-pelvic region.
PURPOSE:
To reveal the character of NP of LID by measurement of size and position of NP (relative value [%] to an intervertebral disk) from MRI, and to detect gait kinetic patterns associated with the bullet type degenerated NP of LID.
METHODS: This study included 43 patients with LBP (Bullet type; 36 male and 7 female) from 12 to 21 years of age (male; 15.7±2.0ys, 167.4±10.3cm, 58.1±10.7kg / female; 13.7±1.9ys, 153.4±6.8cm, 48.4±6.8kg), and 17 patients without LBP (Control; 10 male and 7 female) from 15 to 30 years of age (male; 17.3±1.3ys, 171.3±4.0cm, 59.3±14.7kg / female; 16.0±0.8ys, 160.2±2.7cm, 51.8±4.8kg). They all were examined in our orthopedic clinic, and Bullet type was diagnosed degenerated NP on LID by MRI. The dynamic alignment of pelvic during gait at their usual cadence (4 steps within 10m walk, 6 times) was measured at our clinic using a motion analysis system (Vicon Nexus) which consisted of six cameras (100Hz), and 39 retro-reflective markers (Plug In Gait marker set). The dynamic alignment of pelvic, lateral tilt and rotation was compared Bullet type and Control by 2-way [inter group and sex] ANOVA.
RESULTS: The size of NP of Bullet type was short (64.4±7.1%) than Control (71.5±5.1%) ($p < 0.001$, effective size f = 0.56 [Large]). The position of NP of Bullet type was anterior (45.1±3.0%) than Control (48.6±3.5%) ($p < 0.01$, effective size f = 0.37 [Moderate]). The pelvic lateral tilt angle of Bullet type was large (7.1±2.9) than Control (5.8±1.3) ($p=.0506$, effective size f = 0.25 [Moderate]). The pelvic rotation angle of Bullet type was small (5.8±1.6) than Control (13.9±4.5) ($p<.001$, effective size f = 1.30 [Large]).
CONCLUSION: In the adolescent with the bullet type degenerated nucleus pulposus of lumbar intervertebral disc, the lateral instability and tonic rotation pattern of the spine-pelvic region in gait was characterized.

FUNCTIONAL ADAPTATIONS OF ACL RECONSTRUCTED SUBJECTS IN 90° WALKING TURNS

KRAFFT, F.C.1, STETTER, B.J.1, POTTHAST, W.2,4, ELLERMANN, A.3, FLECHTENMACHER, J.4, EBERLE, C.3, SELL, S.1,5, STEIN, T.1
1: KIT 2: GSU 3: ARCUS CLINICS, PFORZHEIM 4: ORTHO-ZENTRUM, KARLSRUHE 5: JOINT CENTER BLACK FOREST, NEUENBÜRG

INTRODUCTION: Functional adaptations in sagittal joint kinematics and kinetics in gait were detected in ACL reconstructed subjects to reduce loads to the reconstructed ACL (Gardinier et al. 2012). Manifestations of such functional adaptations could induce chronical musculoskeletal disorders and the onset of degenerative joint diseases (Zabala et al. 2013).
The purpose of this study was to examine potential functional adaptations of ACL reconstructed subjects in 90° turns by analyzing general locomotion strategies, and sagittal plane knee joint kinematics and kinetics.
METHODS: 20 subjects (32 ± 13.3 yrs.) with unilateral tears of the ACL (ACL group), reconstructed with the same technique, and 20 matched healthy controls (33.3 ± 13.4 yrs.; CG) performed 90° turns at four test sessions: T1 (6 wks. pre-reconstruction), T2 (7 wks. post reconstruction), T3 (3 mos. post-reconstruction), and T4 (6 mos. post-reconstruction). Kinetics were detected by two 3D force plates (1000Hz). Kinematics were sampled with a 3D Motion Capturing-System (200Hz). Inverse kinematics and dynamics were calculated using the full-body Dynamicus 9 model (Haertel & Hermsdorf 2006).

To understand the locomotion strategies of the ACL reconstructed subjects in the 90° turns, all subjects could freely choose the preferred locomotion strategy (spin vs. step turn). This led to a varying amount of subjects, performing the 90° turns with the same turning strategy at each test session. Thus, only descriptive statistics could be computed.
RESULTS: Analysis of the general locomotion strategy showed that the ACL group preferred the step turn technique.
In the step turns, the ACL group showed tendencies of deeper flexed knee joints and reduced knee extension movements, as well as increased knee flexion moments and decreased knee extension moments up to three (T3) and six months (T4) after reconstruction compared to the non-injured leg and the CG.
In the spin turns, the ACL group showed tendencies of deeper and prolonged knee flexion. Higher knee extension moments were found in the reconstructed trailing leg at six months (T4) post-reconstruction compared to the CG, while in the leading leg the loads appeared to be on the level of the CG. The non-injured leg, acting as leading leg, had to bear higher loads at all test sessions compared to the CG.
CONCLUSION: No adaptations were found in terms of the general locomotion strategy, as the ACL group showed a preference of the step turn strategy like the CG and healthy subjects (Hase & Stein 1999). However, because tendencies of functional kinematic and kinetic adaptations were found in the ACL group even at three and six months after reconstruction similar to those detected in straight ahead gait (Zabala et al. 2013), it was assumed that these adaptations bear the risk to manifest prospectively.
REFERENCES:
Gardinier et al. (2012). Med Sci Sports Exerc,44,1490-6
Haertel & Hermsdorf (2006). J Biomech,S549
Hase & Stein (1999). J Neurphysiol,81,2914-22
Zabala et al. (2013). J Biomech,46,515-20

RESTING MUSCLE HARDNESS ASSESSED BY A PRESSURE METER IN RELATION TO MUSCLE STIFFNESS ASSESSED BY ULTRASOUND SHEAR WAVE ELASTOGRAPHY

MURAYAMA, M.1, INAMI, T.1, MIYAGAWA, H.2, NOSAKA, K.3, YONEDA, T.4

1: KEIO UNIV. , 2: AICHI MEDICAL UNIV, , 3: EDITH COWAN UNIV. , 4: JUNTENDO UNIV.

INTRODUCTION: Muscle hardness is often assessed by a pressure meter (PM) that measures the force against the pressure applied to the tissue, which is related to longitudinal muscle fibre tension or muscle stiffness (Murayama et al. EJAP 2012). Recently, many studies use ultrasound shear wave elastography (SWE) to evaluate muscle stiffness, but it is not known how muscle hardness assessed by PM is associated with the shear modulus (SM) measured by SWE. The present study examined the relationship between the muscle hardness measured by PM and muscle stiffness by SWE in biceps bracchi (BB), rectus femoris (RF) and gastrocnemius medialis (GM) muscles.
METHODS: Muscle hardness and stiffness in resting BB, RF and GM were assessed by PM (TK-HS100, Tokushu-keisoku, Japan) and SWE (Aixplorer, Konica Minolta, Japan) using 15 men and 3 women (age: 21.9 ± 2.3 y, height: 169.9 ± 8.2 cm, body mass: 63.1 ± 9.8 kg). For BB, the elbow joint angle was set at 0, 30 and 90° of flexion (BB0, BB30 and BB90). For RF, the hip and knee angles were set at 0°. For GM, the ankle angle was set at 30° of plantar flexion. The measurement was taken from the belly of each muscle. The displacement-force curve obtained from the PM was divided into subcutaneous and muscle components, and muscle hardness value of E (kPa) was calculated using the slope at a specific depth of the muscle component. SWE provided SM (kPa) calculated from the shear wave speed automatically. The relationship between E and SM was analysed by a Pearson's product moment.
RESULTS: The mean and SD (range) values of E for BB0, BB30, BB90, RF and GM were 18.5 ± 4.1 (13.6-27.6), 13.9 ± 8.5 (10.8-18.5), 12.5 ± 8.5 (8.7-19.6), 31.4 ± 8.5 (14.1-79.3) and 20.9 ± 4.8 (11.6-29.4), respectively, and those of SM for the corresponding muscles were 50.1 ± 11.7 (32.3-70.5), 28.7 ± 2.6 (23.4-34.2), 11.0 ± 1.3 (9.5-14.6), 12.6 ± 2.2 (9.9-17.4), and 17.3 ± 3.7 (12.7-27.3), respectively. SM of BB0 and BB30 were greater than others, but E of RF was greater than others in PM ($P<0.01$). A significant ($P<0.05$) correlation between E and SM was evident for BB0 ($r = 0.833$) and BB30 ($r = 0.497$), but no significant correlations were found for BB90 ($r = 0.009$), RF ($r = 0.033$), GM ($r = 0.060$), and all muscles combined ($r = -0.074$).
CONCLUSION: The results showed that correlations between PM and SWE were limited to BB0 and BB30 in which muscle stiffness was greater than others. The average E and SM values did not match well except for BB90. It appears that muscle hardness assessed by PM and muscle stiffness assessed by SWE are basically different, probably represent different aspects of muscle, although they are shown in the same unit (kPa). It is interesting to investigate whether the magnitude of the changes in the two parameters after an intervention (e.g., exercise) is similar.
Reference: Murayama et al. (2012) Eur J Appl Physiol 112:105-12
Contact: murayama@z3.keio.jp

FOOT GROWTH CHARACTERISTICS OF NEPALE MAJOR ETHNIC GROUPS CHILDREN AGED 5-16 YEARS

UEDA, K.1, KOKUDO, S.2, DEVKOTA, B.3, NAKANO, T.4, SAGAWA, T.5

1 MINATOGAWA COLLEGE, 2 KOBE UNIVERSITY, 3 TRIBHUVAN UNIVERSITY, 4 NAGOYA GAKUIN UNIVERSITY, 5 KANAZAWA UNIVERSITY

INTRODUCTION: The foot status of children is influenced many factors such as heredity and environment. It is assumed that the Nepal geographical condition such as hill or mountain environment affect the growth status, especially the foot condition of children is very influenced by their walking habit in hill / mountain area. Additionally, The heredity status also quite different among ethnic groups (EG)(or Caste group) such as Brahman/Chhetri (B/C) and Janajati (JAN). This study was aimed to investigate foot growth characteristics of B/C and JAN children at Nepal hill area.
METHODS: The samples were 877 healthy children of B/C at urban area and JAN at rural area (393 boys and 484 girls) aged 5-16 years, higher secondary school in/around Kathmandu Valley, Nepal. Foot sole parameters, foot length, foot width, foot width/length ratio, arch type, were measured using sole photos of the children which were taken using a 2D foot scanner during 2015-2016. We also measured their height and weight. Descriptive statistics of foot sole parameters, height and weight were calculated by age, sex and ethnic groups (B/C and JAN). The difference of these statistics was compared between ethnic groups by age and sex.
RESULTS: Mean foot length of 5-yr of age was 16.5-17.0cm. It reached 20.0-21.0cm at 9-yr of age. There were no significant difference of foot length between B/C and JAN till 10-yr of age for boys and 8-yr of age for girls. However, the foot length of BC was significantly($p<0.05$) larger than that of JAN from 11-yr of age for boys and 9-yr for girls. The mean foot length at 15-yr of age was 24.6cm for B/C boys, 23.0cm for JAN boys, 22.6cm for B/C girls and 22.1cm for JAN girls. Mean foot width of 5-yr of age was 6.5-6.7cm. It reached 7.6-7.7cm at 10-yr of age. There were no significant difference of foot length between B/C and JAN except 14-yr boys and 9-yr girls. It seemed that foot growth, especially foot length was different between ethnic groups.

Regarding foot arch type, 4% of children was flat arch, 77.5% was normal arch, 12.2% was high arch and 6.3% was very high arch. There was no difference for arch type between EG (chi-square=2.28 and 6.96 for boys and girls, respectively). However, the arch construction rate was higher than Japanese (12% of flat arch children (Mimura (2010)). The results suggest that Nepalese children have a high rate of normal arch.
We found the height differences between BC for 14-yr boys and 9,12 and 13-yr girls. It seemed that growth spurt size of B/C children was larger than JAN children. The foot size differences between EG seemed to be appeared after these growth spurt.
CONCLUSION: The foot length of BC children is larger than JAN children after growth spurt. Foot arch construction rate of both B/C and JAN is higher than Japanese.
Mimura, K (2010) Motor ability and formation of foot sole contact surface used pidoscorp in elementary school. Memoirs of Osaka Kyoiku University, 58(2), 161-171 (in Japanese)

EFFECT OF TRANSCUTANEOUS VACUUM TREATMENT ON JOINT MOBILIZATION

KAYA, M.1, SHIBUTANI, T.2, TAKEMURA, M.3, KURITA, K.4, KAWAGUCHI, J.5, BANERJEE, A.6, TSUJITA, J.5

1) HYOGO UNIV. OF HEALTH SCIENCES, 2) MJ COMPANY, 3) ICHIHASHI CLINIC, 4) PHYSICAL CONDITIONING PRODUCTION, 5) INSTITUTE OF HEALTH & SPORTS MEDICAL SCIENCE, 6) AMAGASAKI EDUCATION BOARD

INTRODUCTION: Transcutaneous vacuum treatment improved gliding function, flexibility of muscle and fascia in vastus lateralis. However, the effect of transcutaneous vacuum treatment on joint mobility has not been investigated to date.
The purpose of this study was to investigate the effects of transcutaneous vacuum treatment on posterior thigh with straight leg raising angle, compared with passive static stretching of hamstrings.
METHODS: Seven volunteers who had not undergone any prior orthopedic treatment for the lower legs participated in this study.
Transcutaneous vacuum treatment (CVT) (vacuum and rolling [approximately 0.5Hz]) was applied to posterior thigh (ischial tuberosity to upper area of popliteal region) for 30 seconds 3 times with 15 second intervals between sets. Passive static stretching (PSS) of hamstrings was applied by pushing the heel using a hand held goniometer to the final angle of movement for 30 seconds 3 times with 15 second intervals between sets at supine position with knee extended.
We measured straight leg raising (SLR) angle with active and passive hip flexion before and immediately after CVT or PSS of hamstrings.
RESULTS: After PSS, the SLR angle statistically increased at active (89.9 ± 9.2 to 97.1 ± 12.4 degree) and passive (92.2 ± 11.5 to 99.0 ± 13.8 degree) hip flexion. After CVT, there was no change in SLR angle at active hip flexion (92.0 ± 9.8 to 92.9 ± 8.3 degree). However, it statistically increased at passive hip flexion (92.0 ± 11.5 to 99.1 ± 13.8 degree). There were no differences of SLR angle for passive hip flexion between PSS and CVT after treatment.
CONCLUSION: In this study, there was significant increase of SLR angle in passive hip flexion after CVT, and these changes were almost equivalent to the angle after PSS. However, despite the increase after PSS, the angle in active hip flexion after CVT did not change. These results suggest that the mechanism of change in active range of motion after transcutaneous vacuum treatment may be different from that of static stretching.

EMG ACTIVITY OF NECK AND TRUNK MUSCULATURE FOLLOWING EXPERIMENTALLY-INDUCED BREAST AUGMENTATION

KATEINA, C.

NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

INTRODUCTION: Breast augmentation is a procedure that is been performed by many females using external inserts or surgically implanted breast implants for improving or restoring the aesthetics of their body. However, the weight of the implant that is inevitably added onto the anterior part of the female's chest may induce musculoskeletal problems, particularly in the neck and back, if the desired prosthetic is excessive (Letterman & Schurter, 1980). The purpose of the present study is to examine the effect of experimentally-induced breast augmentation on the EMG activity of neck and back musculature during execution of common movements of everyday life.
METHODS: Twenty four healthy females with each breast's volume up to 250 ml participated in the study. Breast augmentation was achieved experimentally by increasing 1.5, 3, 4.5 and 6 times the volume of each participant's breast using silicone-gel based implants with volume/weight ratio equal to one. The EMG activity of sternocleidomastoid (SCM), the upper trapezius (UT) and the thoracic and lumbar trunk extensors (TTE and LTE) was recorded before and after augmentation of the females breasts during 45 degrees of trunk flexion from the standing and sitting positions (45TFSD, 45TFST), stand-to-sit (SDST) and 180 degrees shoulder flexion (180SF).
RESULTS: Our results revealed significant differences between loading conditions with regard to TTE during 45TFSD. Marginal were the differences for TTE during SDST. The differences between loading conditions for LTE were significant during 45TFSD and during 180SF. Upper trapezius demonstrated significant differences between loading conditions during SDST and 180SF. The greatest EMG activity for TTE was obtained during 45TFSD when breasts were augmented 4.5 times or more, for TEL was obtained during 45TFSD and 180SF when breasts were augmented 4.5 and 3 times respectively and for UT during SDST and 180SF when breasts' were augmented six fold. The differences between loading conditions for SCM were not significant during all movements tested.
CONCLUSION: Neck and trunk musculature EMG activity remain unaffected for up to 3 times augmentation of the females' breasts during almost all movements tested. The increased EMG activity of TTE, LTE and UT that was obtained when the original breasts augmented by 4.5 or more times during the majority of the movements tested was probably attributed to the fact that the silicone-gel prostheses were not only heavier but also bulkier. Therefore a greater amount of activity might be necessitated for compensating a greater load that was applied at a longer distance from the chest (Kour et al. 2014).

ASSESSMENT OF SHOULDER ASYMMETRY FOR THE DESIGN OF AN UPPER LIMB EXOSKELETON

ARGUBI-WOLLESEN, A.1, SCHUBERT, T.1, MATTES, K.2

<1> HELMUT-SCHMIDT-UNIVERSITÄT HAMBURG, GERMANY; <2> UNIVERSITY OF HAMBURG, GERMANY

INTRODUCTION: Exoskeletons for the upper limbs at the workplace are used to address musculoskeletal issues by providing additional torque to the shoulder. However, data on the underlying human strength curves, especially regarding possible imbalances, are insufficient as previous research focused mostly on (a) angles of peak torque, neglecting torque distribution over the whole ROM and (b) examined primarily athletes (Challoumas et al., 2017). To adjust torque curves of an exoskeleton, the aim of this study was twofold: (1) to evalu-

ate the torque curve of maximum isokinetic shoulder flexion and extension and (2) to analyse side-to-side strength asymmetry and flex./ext. ratio for both genders.
METHODS: An Isomed2000 Dynamometer was used to assess the isokinetic concentric muscle torque for the shoulder flexion and extension for both sides in the sagittal plane (3° to 167°; arm stretched out) at 90°/s. Test subjects (N=31; women: n=15, 25.7±3.7 years, 170.8±6.7cm, 65.5±9.2 kg; men: n=16, 28.5±3.7 years, 181.4±4.9cm, 78.6±7.2 kg) remained in a supine position and completed 2 sets of 5 maximum repetitions for each side with 5 min. rest in between. The mean side-to-side strength symmetry index (SI) and unilateral flex./ext. ratio were calculated for work and peak torque and analyzed for every 55°. To control for gender differences, a one-factor anova was conducted ($p<.05$).
RESULTS: Women showed significant ($F(1,29)=5.294$, $p<.05$, $p\eta2=0.154$) higher work asymmetry at first (SIw3-58°=7.6±8.8%) and middle (SIw58-113°=13.4±12.5%) section of flexion than men (SIw3-58°=0.1±9.2% / SIw58-113°=3.6±10.4%). No significant statistical gender diffences were detected for asymmetry at peak torque (men: -0.3±11% (flexion) / 0.1±11% (extension); women: 5.8±7.4% (flexion) / 3±15.5% (extension)).
CONCLUSION: The results of flex./ext. ratio are in line with previous studies (Dehail et al., 2008) and maximum strength asymmetry was between 5% to 10%. For flexion, both genders showed highest side-to-side asymmetry at the middle section of movement (58°-113°), whereas peak torque occured in the first section (3°-58°) with lower asymmetry. The highest asymmetry during extension was observed at the third section (113°-167°), while peak torque was located at the beginning of the motion with lower asymmetry. An analysis over joint-angle sections result in a more precise evaluation of strength asymmetry than using only peak torque angles. Creators of exoskeletons should address these findings by providing adjusted torque curves.
References:
Challoumas, D., Stavrou, A. & Dimitrakakis, G. (2017). The volleyball athletes shoulder. Biomechanical adaptations and injury associations. Sports Biomechanics, 16 (2), 220-237.
Dehail, P., Gagnon, D., Noreau, L. & Nadeau, S. (2008). Assessment of agonist-antagonist shoulder torque ratios in individuals with paraplegia: a new interpretative approach. Spinal cord, 46 (8), 552-558.

TOWARDS AN INCREASED ECONOMY OF THE RUNNING PATTERN AFTER FIVE MINUTES OF RUNNING IN UNWEIGHTED CONDITION?

CHAVET, P.1, NICOL, C.1, SAINTON, P.1, BARTHÉLEMY-MONFORT, J.1, DE GRAAF, J.1
INSTITUTE OF MOVEMENT SCIENCES

INTRODUCTION: On lower body positive pressure (LBPP) treadmill, partial unweighting is reported as resulting in a rebounding running pattern that changes biomechanics and musculoskeletal loading in a complex manner (Farina et al., 2017). Our studies highlighted the linear relationship between the bodyweight-induced changes and many mechanical stride parameters, but also revealed muscle and SSC-phase dependent neural adjustments (Sainton et al., 2015, 2017). Interestingly, an increased unweighting from 80 to 60% bodyweight did not result in any increased economy. The present study investigated whether increasing the time spent in unweighting condition might improve the running economy.
METHODS: Eight healthy male adults run at preferred speed on LBPP treadmill. The protocol included 2 runs that consisted in 3 sequences of 5 min: at 100% bodyweight (BW), 60 or 80% BW, and 100% BW. For each running sequence, vertical ground reaction force was recorded during 3 time periods of 30 s, together with surface EMG activity from 5 major muscles of the right lower limb. Heart rate (HR) was continuously recorded and perceived exertion (RPE) repeatedly rated. The statistical analysis of the unweighting effects compared the mean values of the last 30 s at 100%BW to those at the 3 time periods of the unweighted run.
RESULTS: In both runs, the unweighting resulted in immediate and proportional increases in flight time and decreases of the active peak force and mean push-off force. These changes remained then stable up to 5 min. In contrast, HR and RPE decreased similarly in both runs. The EMG analysis revealed similar reductions of the quadriceps activity during the braking phase and an overall reduction of the lower limb muscle activity during the push-off phase, but at 80%BW only. At 60%BW, only the soleus muscle presented a delayed decreased push-off activity at 5 min.
CONCLUSION: The neuromechanical and physiological changes observed right after the unweighting transition and 3 minutes later confirmed their rapidity, but also the minimized benefits in HR, RPE and muscle activity previously reported below 70% BW (Farina et al., 2017; Sainton et al., 2015). The larger drop in force at 60%BW may thus be mostly attributed to the LBPP support. Providing more time to the runners during a first practice session was found to stabilize rather than to improve their running economy. For the rehabilitation purpose, further research is needed regarding the potential effects of repeating practice sessions to induce additional gains in running economy.
Farina KA, Wright AA, Ford KR, Wirfel LA, Smoliga JM. (2017). Sports Med, 47(2):261-275.
Sainton P, Nicol C, Cabri J, Barthèlemy-Montfort J, Berton E., Chavet P. (2015). Eur J Appl Physiol, 115 (5):1135-1145.
Sainton P, Nicol C, Cabri J, Barthèlemy-Montfort J, Chavet P. (2017). PLosONE, 12(4): e0176508.
Contact: [pascale.chavet@univ-amu.fr]

IN VIVO FASCICLE LENGTH OF THE GASTROCNEMIUS MUSCLE DURING WALKING IN SIMULATED MARTIAN GRAVITY USING TWO DIFFERENT BODY WEIGHT SUPPORT DEVICES

RICHTER, C.1,2, BRAUNSTEIN, B.1,3,4, STAEUDLE, B.1,2, ATTIAS, J.5, SUESS, A.6, WEBER, T.6, MILEVA, K.7, RITTWEGER, J.8, GREEN, D.5,6, ALBRACHT, K.1,2
1: GSU , 2: UAS , 3: CHIPS , 4: MOMENTUM , 5: KCL , 6: EAC , 7: LSBU , 8: DLR

INTRODUCTION: The effect of unloading upon locomotion is of particular interest for rehabilitative gait training as well as exploration of partial gravity environments. In rehabilitation, unloading is often achieved by lower body positive pressure whereas for spaceflight horizontal suspension combined with a subject loading system has proven to be a suitable analogue for walking in partial gravity. As the plantar flexors are anti-gravity muscles contributing significantly to vertical support and horizontal progression of the human body (Lai et al., 2015), it is important to examine the behaviour of their fascicles under unloading conditions. Therefore, the aim of this study was to compare two different body weight support systems with regard to changes in fascicle and muscle-tendon-unit (MTU) length of the gastrocnemius medialis (GM) during walking at simulated Martian gravity (0.38g).
METHODS: Eight male subjects (31.9 ± 4.7 yrs) walked at 75% of their preferred walk-to-run transition speed at 0.38g on the vertical treadmill facility (VTF) and the anti-gravity treadmill AlterG. In addition, a control condition without unloading was performed on the AlterG.

GM fascicles were scanned and measured with ultrasonography. Plantar pressure and joint kinematics were analysed to determine gait-cycle events and GM MTU length. A non-parametric multiple comparison test for dependent samples was used to test whether changes in fascicle and MTU length are significantly influenced by the different walking conditions.
RESULTS: None of the three walking conditions had a significant effect on MTU and fascicle excursion or ankle and knee joint range of motion. However, with both devices, fascicles operated at longer length in the middle of the stance phase ($p \leq 0.0179$) and maximum MTU shortening velocity was significantly lower ($p = 0.0027$) in simulated 0.38g. No differences were found when comparing the effect of VTF and AlterG on the tested parameters.
CONCLUSION: The effect of unloading on fascicle behaviour was similar on the VTF and AlterG, meaning that both devices are equally suitable for body weight supported gait training. The longer fascicles and reduced maximum MTU shortening velocity under simulated Martian gravity compared to walking without unloading, suggests that the tendon must be shorter due to the reduced body weight and hence stored less energy, which can contribute to forward progression.
Reference
Lai, A., Lichtwark, G. A., Schache, A. G., Lin, Y. C., Brown, N. A., & Pandy, M. G. (2015). J Appl Physiol, 118(10), 1266-1275.
Contact: c.richter@fh-aachen.de

THE EFFECT OF FALL HISTORY ON KINEMATIC SYNERGY DURING OBSTACLE CROSSING

YAMAGATA, M.1, TATEUCHI, H.1, SHIMIZU, I.2, ICHIHASHI, N.1
1: KYOTO UNIVERSITY, 2: FUKUI GENERAL CLINIC

INTRODUCTION: Recently, the importance of kinematic synergy stabilizing the swing foot during gait has been shown. Additionally, our earlier study revealed that fall history altered VZ during gait. Falls during obstacle crossing is a problem for older people, but no study has examined the relations between VZ and fall risk during obstacle crossing. Thus, the aim of this study was to reveal the effect of fall history on VZ during obstacle crossing using uncontrolled manifold analysis.
METHODS: Older adults with fall history and without fall history participated in this study. The fall history was evaluated with self-report of questionnaire. The participants walked on a 6-m walkway; 3 m from the start, they crossed an 8-cm tall obstacle. The kinematic data during the task was collected. The swing phase during obstacle crossing was normalized by time and divided into three phases . With UCM analysis , VZ was calculated to quantify how the limb segments stabilize the swing foot in mediolateral and vertical directions. Greater VZ implies the high stability of the swing foot. For statistical analysis, 2-way ANOVAs were performed to reveal the effect of fall history and phase on VZ in each direction. The alpha level was set at 0.05.
RESULTS: In the mediolateral direction, main effects of fall history and phase were found. VZ in fallers was significantly higher than that in nonfallers, and VZ during mid-swing was higher than that during early- and late-swing. In the vertical direction, there was an interaction between fall history and phase. VZ in mid-swing was lower than the other phases for fallers, whereas VZ was constant for nonfallers. Moreover, VZ in fallers was significantly lower than that in nonfallers only during mid-swing.
CONCLUSION: In the mediolateral direction, VZ was higher during mid-swing than the other phases, and fallers had higher VZ compared to nonfallers. Healthy younger subjects increased VZ when walking carefully in complex tasks . Fallers in this study might cross the obstacle carefully because of the fear of falling. In the vertical direction, fallers had lower VZ than nonfallers during mid-swing. The collision of the swing foot and obstacle would lead to falls, so control of the swing foot in the vertical direction is crucial in mid-swing because the vertical distance between swing foot and obstacle is smallest at this phase. Thus, the observed decrease of VZ during mid-swing might heighten risk of falls.

Mini-Orals

MO-BN06 Analysis and sports performance

MATCH PERFORMANCE PROFILES OF STRONG AND WEAK TEAMS IN THE CHINESE SOCCER SUPER LEAGUE

CHANGJING, Z.1, ALBERTO, L.2, GOMEZ, M.A.3, SHAOLIANG, Z.4
UNIVERSIDAD POLITÉCNICA DE MADRID

Introduction: Nowadays, profiling techniques applied to sports performance analysis are more focused on representing the typical performance and the spread of the performance of a single player. The usefulness of performance profiles is likely to be improved when they are extended to present and compare the technical performance of football players considering their field position or the team quality (Liu, Gomez et al. 2016). Thus, the aim of the current study was to compare the differences between strong and weak teams according to players' playing positions.
Methods: The tracking data of players was collected from the 240 matches of the 2016 CSL. Teams were classified based on their final ranking as strong (1–8) and weak teams (9–16). Magnitude-based inferences were used.
Results: Compared with weak teams, (i) center defenders from strong teams made more passes, forward passes, crosses, high intensity running and better pass, forward accuracy, but fewer shots, fouls committed and ground challenges; (ii) wide defenders from strong teams made more passes, crosses, aerial challenges, sprinting distance and higher pass accuracy, forward pass accuracy; (iii) central midfielders made more passes, crosses, shots and higher pass accuracy, forward pass accuracy, but the fewer total distance covered; (iv) wide midfielders from strong teams achieved more passes, forward passes, crosses and shots, but less total distance and high intensity running distance; (v) attacker from strong teams achieved better pass and forward pass accuracy, but fewer aerial challenges.
Discussion: The main results showed different performances profiles of football players according to playing position and team quality. In passing-related actions, defenders from strong teams had better performance than weak teams because they involve more in the attacking process (Liu, Gomez et al. 2016), which will be the main trend of football development (Bush, Barnes et al. 2015). In defending-related actions, center defenders from weak teams made more fouls committed and ground challenges and attackers made more aerial challenges, possibly because strong teams make more offense from the ground (pass) and weak teams from the cross of wide midfielders. In physical aspects, defenders from strong teams covered more sprinting distance because of more involvement in the attacking while wide midfielders covered more high intensity running distance possibly due to defending attacking from the opposing defenders. These findings could be used for talent identification or position-specific physical and technical training.

References: Bush, M., C. Barnes, D. T. Archer, B. Hogg and P. S. Bradley (2015). "Evolution of match performance parameters for various playing positions in the English Premier League." Human movement science 39: 1-11.
Liu, H., M. A. Gomez, B. Goncalves and J. Sampaio (2016). "Technical performance and match-to-match variation in elite football teams." J Sports Sci 34(6): 509-518.

MODELLING PEAK RUNNING SPEED AS A FUNCTION OF TIME IN SOCCER GAMES - THE RELATIONSHIP BETWEEN THE MODEL´S

MAHLER, H.1, HEYDE, C.2, ROELL, M.1, GOLLHOFER, A.1, ROECKER, K.1,3

ALBERT-LUDWIGS-UNIVERSITY OF FREIBURG

INTRODUCTION: The evaluation of a soccer player´s peak running periods in games, as a function of time, can be modelled by a five-parameter algorithm and may deliver comprehensive diagnostic information of the most intense periods for players in a game [1]. The practical interpretation of the modelling parameters remains to be examined, however. The parameter "upper asymptote" characterizes a player´s peak running period performance in games within a short duration of time (<2sec). Even though a player has to produce a high number of sprints in a game, most with a length of up to 20 meters, the question arises, whether these sprints has to be produced at least once in a game with maximal intensity, due to tactical and playing position requirements [2]. Therefore, we examined, whether a players peak running speed in a 20-meter sprint field test (Speak20m) offers a prediction of the "upper asymptote" derived from games in regard to playing position.
METHODS: 95 amateur and professional male and female soccer players (177±7 cm, 72.2±9 kg, 23.9±3 y) performed individual 20-meter sprint tests, by wearing a 10 HZ GPS unit. Speed20m was assessed by the median of the fastest from 13 consecutive sprints, according to recommendations for using multiple trials to decrease signal to noise ratio [3]. Within three weeks the players also participated in between one and three official soccer games, whereby players wearing the same GPS unit. This resulted in 173 individual game observations (21 games in 8 different leagues). Following the model from Roecker et al. 2017, the algorithm allowed to calculate the "upper asymptote". Due to unbalanced data sets we used a mixed model approach with participant as random and Speed20m as a fixed factor to establish the relationship to the "upper asymptote" [4].
RESULTS: Speed20m was significantly and linearly correlated to the "upper asymptote" for all soccer players (r=.89, p<.0001, RMSE=0.34 m/s). This correlation was significant for each playing position. Highest correlations were assessed for external midfielders (r=.96, p<.0001, RMSE=0.26 m/s) the lowest for central midfielders (r=.74, p<.0001, RMSE=0.43 m/s).
CONCLUSION: On the basis of 80% variance declaration, Speak20m shows potential as a valid indicator of a player´s "upper asymptote" in a game. The results emphasize the importance for soccer players ability to sprint as fast as possible especially in a short distance perspective [2]. The relevance of Speed20m is dependent on playing position, which may be due specific tactical requirements [2]. Future studies should further investigate the "upper asymptote´s" variability from match to match and validity in training studies.
[1]Roecker K, Mahler H, Heyde C, Röll M, & Gollhofer A (2017). PLOS ONE, 12(7), e0181781.
[2]Haugen T, Tønnessen E, Hisdal J, & Seiler, S. (2014). Int J Sports Physiol Perform, 9(3), 432-441.
[3]Haugen, T., & Buchheit, M. (2016). Sports Med, 46(5), 641-656.
[4]Cnaan, A., Laird, N. M., & Slasor, P. (1997). Stat Med, 16(20), 2349-2380.

WHAT MAKES A WIMBLEDON SUCCESS?-MODELLING THE RELATIONSHIPS BETWEEN TENNIS PERFORMANCE AND MATCH RESULT

CUI, Y., LIU, H., GÓMEZ, M.Á.

A. TECHNICAL UNIVERSITY OF MADRID, MADRID, SPAIN; B. SOUTH CHINA NORMAL UNIVERSITY, GUANGZHOU, CHINA

Introduction: Performance analysis in tennis provides useful information to coaches and sport scientists on quantifying player behaviors in complex competition, helping to enhance the coaching process. Nonetheless, to better understand the relationship of tennis performance variables and match outcome, predictive models should be developed to highlight the prominent variables that contribute to the success of tennis players. Therefore, the study aimed to inspect the relationships of tennis performance variables and the match result (win/lose) via generalized mixed linear modelling within male tennis Grand Slam event.
Method
The study used the technical-tactical and movement performance statistics of 248 matches from 2015-16 Wimbledon, the only Grand Slam contested on grass surface court. Data were collected from the IBM SlamTracker of Wimbledon official website, and the inter-operator reliability of the notational data and the Hawk-eye System that tracks the movement data were validated. Twenty-one match variables related to serve and return, breakpoint, efficiency and movement performance were chosen as the predictor variables. While the match outcome (win/lose) was the dependent variable. A mixed-model reliability analysis with a random effect for player was performed to estimate between-player and within-player SD for each variable. Afterwards, the cumulative logistic-regression version of the generalized mixed linear model was employed to estimate separately the effect of each predictor variable on the odds of a player's winning a match,. The effect was estimated as the ratio of the odds of winning for a typically high value of the predictor (+1 between/within-player SD) compared with a typically low value (–1 between/within-player SD). Uncertainty in the true effects of the predictors was evaluated using non-clinical magnitude-based inference.
Results: Of all variables analyzed, there were 17 variables that had possibly to most likely positive between-player relationships with the probability of winning. A 2-SD increase in these serve, breakpoint, and movement performance related variables would lead to a 12.3% to 43.6% higher probability of victory. Meanwhile, 14 variables related to serve and return, breakpoint and movement performance showed possibly to most likely positive within-player relationships with the likelihood of winning. An increase of 2-SD in these variables would contribute to an 11.9% to 67.8% higher likelihood of winning. Interestingly, the variable net point won of total point won had a most likely negative within-player effect on winning possibility. Double faults was the only variable that had trivial between-player and within-player effect on the winning odds.
Conclusion
In Wimbledon, serving (especially aces, first and second serve points won) and breakpoint performance had critically positive effect on the probability of winning, while net success was also beneficial for winning a match, but attempting to finish the point in the net too much times would bring negative effects on player's winning odds. This indicated that player should optimize their serving strategies instead of chasing for a higher speed or a quicker-finish in the net. With the use of generalized mixed linear modelling, it is possible to identify the key performance indicators in tennis and help coaches to improve the training and match planning.

A CRITICAL REVIEW OF VIDEO ANALYSIS RESEARCH IN RUGBY UNION

DEN HOLLANDER, S., JONES, B., LAMBERT, M., HENDRICKS, S.

UNIVERSITY OF CAPE TOWN

INTRODUCTION: Video analysis research in Rugby Union has provided valuable insight into match performance. Studies in this field range from broad statistical studies of commercial databases to in-depth case-studies of specific match events. The range of studies using video analysis in rugby union makes it difficult to generalise and apply the findings to real-world settings. The methodology used in video analysis has also come under criticism related to the applicability of findings from variables analysed in isolation in a dynamic sport. To help in the application of video analysis research in rugby union, a critical review of this rugby research was performed.
METHODS: The methods of a systematic review were used in the literature search. Peer-reviewed journal articles, which analysed match footage of Rugby Union games, were included in the review. A total of 92 studies were identified. These studies were categorized into three groups based on the outcomes of the paper, physical demands, performance and injury. The studies were then categorised further into studies that identified what occurred in a match and studies that described how specific match events occurred. This allowed for more homogeneous comparisons. The studies were then reviewed using a number of polar questions related to the context of the variables included in the study, the provision of definitions for the variables, sample selection, and reference to practical application. Descriptive statistics were used to analyse the results.
RESULTS: In 50% of the studies, the variables were fully defined. Samples ranged from 4 studies analysing over 300 matches to 3 studies with samples of less than 5. 38% of performance related what type studies' samples were from one-off tournaments. One hundred percent of how type studies included at least one contextual variable in their analyses, with 86% of how type studies including 2 or more contextual variables. There was a reference to the practical application of the findings in 81% of studies.
CONCLUSION: The large range of sample sizes and the types of samples used raised concerns over the generalisability of some of the samples, and the adoption of the use of sample size calculations was recommended. We argue that the criticism that video analysis research tends towards reductionism should only be applied to studies who propose to answer how events occur. The results of the review show that the majority of studies describing how events occur in rugby matches attempted to provide context to their findings. There is a large emphasis on the practical application of the findings of video analysis research; however, the review raised concerns over the usefulness of some of the findings to coaches and practitioners. To facilitate the integration of research into practice, we suggest video analysis research follow a process, where the results of 'what' studies inform the research questions of 'how' studies, and the findings of 'how' studies provide the practical applications for coaches.

VIDEO ANALYSIS OF TACKLING SITUATIONS LEADING TO CONCUSSION IN COLLEGIATE RUGBY UNION

SUZUKI, K.1,2, NAGAI, S.3, IWAI, K.2, MIYAKAWA, S.1, TAKEMURA, M.1

1. UNIVERSITY OF TSUKUBA, 2. IBARAKI PREFECTURAL UNIVERSITY OF HEALTH SCIENCES, 3. TSUKUBA INTERNATIONAL UNIVERSITY

INTRODUCTION: In rugby union, the concussion prevention is still a current topic. However, a few researches on concussion scene have been carried out conducted based on video records. We need to clarify the tackling situations leading to concussion at various playing level in order to develop the concussion prevention for rugby union players. Therefore, the purpose of this study was to clarify the tackling characteristics leading to concussion in rugby union.
METHODS: Players from a Japanese collegiate rugby union team took part in the study. Over six playing seasons, the total number of 402 players participated in 265 matches. We identified 23 concussion events caused by tackling based on injury data and match video records. In addition, all tackles by an injured tackler in that match were including in the analysis. We defined the rest of tackles excluding the tackle leading to concussion as a control. All tackles were analyzed according 20 tackling characteristics by reference to previous researches. Tackle was divided into the three tackle-phases: pre-contact, contact and post-contact. In addition, we divided outcomes of the tackle into tackle performance outcomes and tackle result. Multiple logistic regression analysis was performed to clarify relationship between tackling characteristics and concussion.
RESULTS: In pre-contact phase, tacklers were significantly less likely to sustain concussion when ball-carrier performed a side step initiated by either leg (odds ratios (OR) 0.11, 95% CI 0.01–0.85), in comparison to when ball-carrier ran straight toward tacklers. In contact phase, Tacklers were significantly more likely to sustain concussion when they performed collision tackle (OR 84.00, 95% CI 8.27–853.11), in comparison to a shoulder tackle. Tacklers had a significantly higher likelihood of concussion when tacklers contacted with their head/neck as the first point of contact (OR 23.47, 95% CI 4.80–114.71), when compared with making initial contact with their shoulder. In post-contact phase, tacklers were significantly more likely to sustain concussion when they did not pull, grip or wrap ball-carrier by their arms (OR 3.54, 95% CI 1.23–10.20), in comparison to when they wrapped ball-carrier. In addition, tacklers were significantly more likely to sustain concussion when ball-carrier successfully penetrated the attempted tackle (OR 5.76, 95% CI 1.67–19.85), in comparison to tackle complete.
CONCLUSION: We found that the tackling characteristics before tackle were related to decrease the concussion risk. Further researches on tackle are needed to take among each tackling characteristics in view of tackle phase into consideration.
Contact Keita Suzuki [suzukike@ipu.ac.jp]

ANALYSIS OF KINEMATIC PARAMETERS OF MAE-GERI KICK DEPENDING ON THE LEVEL OF ADVANCEMENT OF COMPETITORS

BLASZCZYSZYN, M.1, SZCZESNA, A.2, BORYSIUK, Z.1, PAWLYTA, M.2,3

1 OPOLE UNIVERSITY OF TECHNOLOGY, OPOLE , POLAND 2 SILESIAN UNIVERSITY OF TECHNOLOGY, GLIWICE, POLAND 3 POLISH-JAPANESE ACADEMY OF INFORMATION TECHNOLOGY, WARSAW, POLAND

INTRODUCTION: Mae-geri, forms one of the most common types of attack both in training as well as in combat. It is a type of a front kick, characterized by a considerable speed and strength. The aim of this study was to determine kinematic differences in the movement patterns depending on the level of advancement in the kick conditions in: air (I), target (II), contact with the participant (III).
METHODS: Kinematic data was recorded using a motion tracking Vicon system with the sampling frequency of 250 Hz (Vicon®, 2010). Matlab 2016a with the BTK Toolkit library and the Mokka software were used to analyze the data. The non-parametric Mann-Whitney U-test was used for statistical analysis. Comparative analysis was performed in 26 players: G1 - 13 with advanced achivements, G2 – beginners.

RESULTS: In the comparative analysis, statistical differences were observed in : Time p=0.0387(I), p=0.0006(III), acceleration : p=2.17968E-05(I), p=0.0037(III), in angular values: neck flexion p=0.0247(I), abduction p=0.0003(I), p=5.08334E-05 (II), p=0.0005(III), external rotation p=0.0252(II), spine flexion p=0.0123(I), p=0.0002(II), p=0.0006(III), abduction p=0.0123(I), p=0.0328(II), p=0.0015(III), hip adduction p=0.0307(I), p=0.0172(II),p=0.0073(III), Max force p=0.0077(II).
CONCLUSION: Significant differences were observed in the performance of the motor model assessed in advanced and beginner riders. The key segments of the body were: head, trunk and hip. As the researchers emphasize, the effectiveness of karate techniques depends on the development of a motor model and the ability to repeat it in the shortest time and the highest acceleration (Portela et al. 2014, Witte et al. 2012). The analysis offered an observation regarding differences in the movement patterns performed by the competitors at difference levels of achievement. The authors anticipate that the flexed head and its adduction in the direction of the kicking leg in advanced competitors are related to visual control, whereas the abduction of the trunk in the opposite side of the kick leg is responsible balance control, and hip adduction with a slight rotation internal guarantees the limb setting so as perform the most effective movement pattern. In addition, the foot extension causes the opponent (target) to be pushed away.
References: Vicon® (2010), Plug-in Gait Product Guide - Foundation Notes. Vicon® Motion Systems Ltd., Oxford Metrics Group, Oxford, UK.
Portela BS, Barbosa MR, Cavazzotto TG et al.(2014), Kinematics analysis of the front kick with and without impact on traditional karate. Arch Budo Sci Martial Art Extreme Sport 10:47-51.
Witte K, Emmermacher P, Langenbeck N. and Perl J. (2012), Visualized movement patterns and their analysis to classify similarities – demonstrated by the karate kick mae-geri. Kinesiology 44,2:155-165.
Contact: mblaszczyszyn@wp.pl

A COMPARISON OF MARKER SET USE IN ASSESSING KINEMATIC VARIABLES IN CYCLING

JONGERIUS, N.1, WAINWRIGHT, B.1, BISSAS, A.1

LEEDS BECKETT UNIVERSITY

INTRODUCTION: Kinematic analysis in cycling via videography is becoming increasingly popular. Accuracy of commercial systems is improving rapidly and a shift is seen from 2D to multi-camera systems. Research shows a potential increase in validity and accuracy from 2D to 3D data (Fonda et al. 2014). Factors still affecting data accuracy in 3D systems are camera quality, calibration settings, marker sets and marker placement. The quality of camera systems is continuously increasing whilst marker placement is a trainable skill. However, uncertainty exists on how the 3-point angle method typically used in such systems differs from joint angles obtained through more valid modelling methods. Such information is crucial to understand how accurate these commercial setups can become when camera quality and operator training are optimised.
METHODS: Data from 25 males were collected using a Qualisys (Sweden) system. Two marker sets were used: a 3-point angle (Trochanter Major, Lateral Femoral Epicondyle, Lateral Malleolus) and a modelling based set with extra markers on the Medial Femoral Epicondyle, Medial Malleolus and four tracking markers on the thigh and shank. Three 60s trials were captured at 250Hz for each participant and the following variables were calculated: peak knee flexion (PF), peak knee extension (PE) and mean knee angle (KA). Agreement between the two sets was tested through 95% Limits of Agreement (LoA), 95% Coefficient of Variation (CV) and Intraclass Correlation Coefficient (ICC).
RESULTS: Regarding PE, LoA, CV and ICC were 9.6°±3.9, 4.7% and 0.92 respectively. For PF, LoA were 0.8°±5.5, CV=2.6% and ICC=0.71. In terms of KA, LoA were 5.3°±4.2, whereas CV and ICC were 3.6% and 0.82 respectively.
CONCLUSION: The largest difference between sets is seen in PE, though the large systematic error could be easily corrected for. Random errors are highest for PF whilst ICCs may not provide a clear picture of the absolute error. Random errors of 4-6° need to be considered when measuring knee angles through a 3-point angle. However, modelling derived angles are also prone to some error, mainly due to marker placement, skin artefacts and individual anatomical differences, albeit to a smaller extend than in 3-point angles. Literature suggests cyclists should aim for knee angles of 25° to 35° at PE (Peveler et al. 2011). The size of random errors found in this study questions the applicability of simplified marker sets when measuring knee angle in cycling. System developers are advised to critically look at marker sets used with their systems in order to provide a more accurate alternative and apply correction factors when appropriate.
REFERENCES:
Fonda B, Sarabon N, François-Xavier L. (2014). J Sports Sci, 32(10), 940-946.
Peveler WW, Green JM. (2011). JSCR, 25(3), 629-633.
CONTACT:
n.jongerius@leedsbeckett.ac.uk

WEIGHT TRANSFER STYLES IN FULL AND PARTIAL GOLF SHOTS

OUTRAM, T., GOODMAN, S.

UNIVERSITY OF DERBY

INTRODUCTION: In full golf swings with a driver or iron, a golfer's centre of pressure pattern follows one of two distinct weight transfer styles: the "front foot" or the "reverse" (Ball and Best, 2011). Different weight transfer styles may also be important for meeting mutual requirements of submaximal speed and accuracy in partial golf shots. This could inform how a player should train and be coached. The aim of this study was to identify if skilled golfers use different weight transfer styles in partial golf shots.
METHODS: Twelve skilled golfers (handicap 3.1 ± 3.1 stokes) performed five full swings with a driver and pitching wedge to hit a ball into a net 5 m away while standing on 2 forces plates. Using ball flight data (Flightscope) from full wedge shots, 2 sub-maximal distances (75% and 50%) were identified and participants performed five partial swings to each. Centre of pressure parallel with the line of shot and relative to the feet (CPy%) was quantified at 6 swing events (Ball and Best, 2007). Weight transfer style was determined (Ball and Best, 2007) and the effect of shot type and swing style on CPy% was assessed using two-way mixed model ANOVA's.
RESULTS: In all shot conditions, both weight transfer style groups produced a large backwards shift in CPy% during the backswing. A large forwards shift in CPy% also occurred during early downswing. However, significant interactions at ball contact ($F(3, 30) = 4.51$, $p = 0.01$) and mid follow through ($F(3, 30) = 8.90$, $p = 0.00$) indicated that the reverse style was present in full golf swings. Compared with front foot players, reverse players positioned CPy% significantly closer to the back foot at ball contact (CPy% difference = driver 27%; pitching wedge 30%) and mid follow-through (CPy% difference = driver 33%; pitching wedge 32%) in full golf shots. This trend was not apparent in partial shots where all players conformed to the front foot style.

CONCLUSION: In full golf shots, skilled golfers adopted either the front foot or reverse style (Ball and Best, 2011). During partial shots, all players conformed to the front foot style suggesting that players who adopt a reverse style in full swings may use different movement strategies when shot emphasis is placed on distance control and accuracy (Okuda et al. 2010). As coaching cues will differ depending on style (Ball and Best, 2007) these findings further highlight the importance of weight transfer style identification. Future studies should examine whether reverse style players rely on different kinematic movement strategies in full shots and whether this impacts on kinematics used in partial shots.
References: Ball K, Best R. (2007). J Sports Sci, 25 (7), 757 – 770.
Ball K, Best R. (2011). J Sports Sci, 29 (6), 587 – 590.
Okuda I, Gribble P, Armstrong C. J Sports Sci Med, 9, 127 – 133.
Contact: Dr Tom Outram: t.outram@derby.ac.uk

TIME UNDER TENSION AS AN INDICATOR FOR GATE-TO-GATE RUNTIME IN ALPINE SKIING

NILSSON, R., LINDBERG, A.S., THEOS, A., FERGUSON, R., PIETERS, E., MALM, C.

SPORTS MEDICINE UNIT

INTRODUCTION: Competitive alpine skiing is a complex sport that places high demands on its practitioners (Turnbull, Kilding et al. 2009). Since the time difference between first place and lower placings is small (Hebert-Losier, Supej et al. 2014), a quantification of the performance on skis can be of utmost importance. A widely used method of determining skiing performance in alpine skiing is the use of video capture (Federolf 2012). Using video footage to identify performance indicators (PI) for alpine skiing can be problematic as analysis of video footage is subjective (Hughes and Franks 2015), thus potentially affecting the reliability of the analysis (Franks and Miller 1986). The aim of this study is to investigate whether or not time under tension (TUT) can be used to estimate gate-to-gate (G2G) runtime in competitive alpine skiing.
METHODS: Two video analysts used frame by frame method in a video analysis software. TUT and G2G were calculated in for skiers placing 1, 10 and 20 in four different WC competitions (a total of 12 different slalom runs). A linear regression calculation was conducted to predict G2G skiing performance during the last third of a run based on the TUT during the first two-thirds of the same run. Standard telecasting footage (25 fps) was used for all analyses.
RESULTS: A strong correlation was found in two races (R2 = 0.943 – 0.957) and medium correlation (R2 = 0.432 – 0.725) was found in the other two. However, none of the models reached statistical significance ($p > 0.05$).
CONCLUSION: The results of this study indicate that less TUT could be beneficial for the sport-specific performance in alpine skiing as less TUT leads to faster run time. Due to the lack of significant models, it is not possible to establish TUT as a valid PI for competitive performance. For coaches in alpine skiing, however, these results suggest that there are performance benefits to gain from focusing on technique with the intention of completing the turns as quickly as possible and minimizing the TUT.

MODELING THE PERFORMANCE STRUCTURE IN ELITE TRIATHLON: A STRUCTURAL EQUATION APPROACH

HOFFMANN, M.1, SEIDEL, I.1,2, MOELLER, T.3,4, STEIN, T.1

1: KARLSRUHE INSTITUTE OF TECHNOLOGY , 2: OLYMPIC TRAINING CENTRE LOWER SAXONY < GERMANY>, 3: GERMAN TRIATHLON UNION , 4: INSTITUTE FOR APPLIED TRAINING SCIENCE

INTRODUCTION: Triathlon as a classic endurance sport comes along with high training loads. Therefore, training science needs to provide a scientific basis for complex statements on training schedules by identifying relevant performance parameters (Hohmann & Brack, 1983). Thus, the aim of the present study was to assess the performance structure in Olympic distance triathlon of elite athletes by structural equation modelling (SEM) based on anthropometric and physiological variables measured during regular performance diagnoses.
METHODS: 19 anthropometric and 16 physiological parameters of 25 laboratory tests of eleven male elite triathletes (23.38±2.79 years) were collected at the Institute for Applied Training Science (Germany) between 2008 and 2012. After necessary preprocessing steps (e.g. normalization of race times) a SEM was developed based on theoretical considerations about the performance structure in triathlon as well as a preselection of measured parameters based on the expertise of four professional German triathlon coaches and estimated using robust maximum likelihood (MLR) estimation. Comparative Fit Index (CFI), robust Tucker-Lewis-Index (TLI), root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR) were used to evaluate the model (Schreiber et al., 2006).
RESULTS: The SEM yielded a well-fitting model (CFI=0.99, TLI=0.99, RMSEA=0.03, SRMR=0.11, DOF=7). Thereby, the most important performance parameters considered in the SEM were BMI [kg/m2], body weight [kg], maximum running pace [m/s], running pace at 3-mmol/l blood lactate [m/s] and relative VO2max [ml/min/kg].
CONCLUSION: The development of a SEM considering two anthropometric and three physiological variables provide a significant contribution to clarify the performance structure in male elite Olympic distance triathlon. While creating or optimizing training schedules, one should pay attention to the identified parameters to exploit further capacities. Regarding previous studies mainly predicting individual triathlon performance (Schabort et al., 2000; Hoffmann et al., 2017), SEMs lead to a clearer understanding of the interaction between parameters and performance. However, the present study should be regarded as a first step, since the sample size is considerably small leading to a limited generalizability of the results.
REFERENCES:
Hohmann A, Brack R (1983). Leistungssport, 13(2), 5-10.
Hoffmann M, Moeller T, Seidel I, Stein T (2017). Int J Comp Sci Sport. 16(2), 101-116.
Schabort EJ, Killian SC, Gibson A, Hawley JA, Noakes TD (2000). Med Sci Sports Exerc, 32 (4), 844-849.
Schreiber JB, Nora A, Stage FK, Barlow EA, King J (2006). J Educ Res, 99(6), 323-338.
CONTACT:
marian.hoffmann@kit.edu

Mini-Orals

MO-PM14 Children and adololescents

BONE MINERAL AND TISSUE COMPOSITION AMONG FEMALE ADOLESCENT ATHLETES CONTRASTING IN MECHANICAL IMPACT

VALENTE-DOS-SANTOS, J.1,2,3,4, TAVARES, O.M.5, DUARTE, J.P.1,6,7, COSTA, D.1, SOUSA-E-SILVA, P.M.1, MARTINHO, D.V.1,7,8, RAMA, L.M.1,2, FONTES-RIBEIRO, C.3,5, COELHO-E-SILVA, M.J.1,2

1: UNIVERSITY OF COIMBRA, 2: UNIVERSITY OF COIMBRA, 3: FCT, 4: ULHT, 5: POLYTECHNIC INSTITUTE OF COIMBRA, 6: FCT, 7: UNIVERSITY OF COIMBRA, 8: FCT

INTRODUCTION: Exploring the osteogenic effect of different bone-loading sports is particular relevant to understand the interaction between skeletal muscle and bone health during growth. The aim of the present study was to examine the effects of long term participation in competitive sports contrasting in mechanical loading on bone mineral content (BMC) and density (BMD) among female adolescent athletes. It was hypothesized that the distinct stimuli differently affect their skeleton.
METHODS: A total of 46 adolescent female athletes were evaluated. The high impact group included 26 volleyball players (16.20±0.77 years). The nonimpact group consisted of 20 swimmers (15.71±0.93 years). Lean soft tissue and fat tissue, BMC and BMD were assessed using dual-energy X-ray absorptiometry. Dietary intake was obtained using food frequency questionnaires. Cohen's d effect sizes and thresholds (0.2, 0.6, 1.2, 2.0, 4.0 for trivial, small, moderate, large, very large and extremely large) were used to evaluate the magnitude of the differences.
RESULTS: Volleyball group displayed moderately higher (d=0.76-1.06, p<0.05) skeletal BMC (12.4%, 13.8%, 15.1% and 15.8% respectively for whole body, subhead, trunk and lower limbs) and BMD (5.5%, 6.5%, 7.6% and 6.4%, respectively) than swimmers. Likewise, lean soft tissue at the lower limbs (d=0.72, +5.9%, p<0.05) and fat tissue for the whole body (d=0.87, +29.4%, p<0.05) and trunk (d=0.73, +28.2%, p<0.05) were also moderately greater in the volleyball players.
CONCLUSION: Youth female athletes who participate in high-intensity mechanical loading activities such as volleyball exhibit moderate gains in BMC and BMD at all skeletal sites, except at the upper limbs. The mechanical and non-mechanical stimuli associated with swimming may not be sufficient to trigger the responsiveness of bone cells.

CAN BODY MASS INDEX PREDICT THE OCCURRENCE OF MENARCHE IN ATHLETES?

TSUKAHARA, Y., NAMBA, S., KAMADA, H., YAMASAWA, F.

WASEDA UNIVERSITY

INTRODUCTION: Female athletes are in danger of the female athlete triad (FAT) and relative energy deficiency in sport (RED-S). Even though screening questionnaires and other tools have been used to identify female athletes at risk, determining factor differs in each sport or individual, which makes it harder to screen FAT and RED-S. Amenorrhea is one of the female athlete triad and earlier treatment is important especially for adolescent athletes. However, some athletes do not take it seriously and though having not reached menarche at the age of fifteen, many athletes do not go for treatment since they think it will happen soon. Low body mass index (BMI) leading to amenorrhea should be considered. However, previous studies have not shown the minimum BMI for menarche to occur in female adolescent athletes. Our purpose of this study is to elucidate the specific BMI for menarche to occur in female adolescent athletes.
METHODS: 227 national level, track and field, ninth grade female athletes at age of fifteen were enrolled in this study, including sprinters, long distance runners, hurdlers, jumpers and throwers. They filled in a questionnaire including questions regarding menarche when they participated in a national event.
RESULTS: As BMI increase, percentage of primary amenorrhea has a tendency to decrease. Cutoff point of BMI for primary amenorrhea was 17.4 by receiver operating characteristic (ROC) analysis. That for sprinters and jumpers was 17.3 and for long distance runners, 17.4.
CONCLUSION: Track and field ninth-grade female athletes are likely to reach menarche when their BMI is 17.4 or more.

MULTIDISCIPLINARY OBESITY TREATMENT PROGRAM IMPROVES BODY COMPOSITION, CARDIORESPIRATORY FITNESS AND AUTONOMIC CARDIAC FUNCTION IN ADOLESCENTS OF DIFFERENT DEGREES OF EXCESS BODY MASS

LOCATELI, J.C., LOPES, W.A., DA SILVA, D.F., SIMÕES FERRAZ, C., MENDES, V.H.S., NARDO JUNIOR, N.

STATE UNIVERSITY OF MARINGA

INTRODUCTION: Obesity negatively influences autonomic cardiac function, measured as resting heart rate variability (rHRV), even in youths (Zhou et al., 2012). Cardiorespiratory fitness and fatness play a role on autonomic function (da Silva et al., 2014); however, the combined effects of a multidisciplinary intervention on these variables are still poorly understood. Thus, we aimed to study the effects of a multidisciplinary obesity treatment program on body composition, cardiorespiratory fitness and rHRV indices according to the degree of excess body mass.
METHODS: Twenty-five adolescents were separated into two groups: overweight (OWG=11) and obese (OBG=14). A 16-week multidisciplinary intervention were performed. Weekly group meetings with the psychologists, nutritionists, and exercise professionals, as well as the three times per week water-based exercise program were held. Both pre and post intervention periods had the assessments of body fat (absolute and relative), cardiorespiratory fitness (i.e., estimated VO2max), and autonomic cardiac function (e.g., rMSSD, HF [ms² and nu], and SD1 indices). The adaptations observed were analyzed by magnitude-based practical inferences, based on Hopkins' statistics. The correlations between changes in rHRV indices and changes in body composition and VO2max were checked with Pearson's correlation.
RESULTS: Both groups enhanced parasympathetic activity (e.g., SD1) (OWG: Δ 8.5 [CI 1.7-15.3] "Likely"; OBG: Δ 11.4 [CI 4.3-18.4] "Very Likely") and cardiorespiratory fitness (OWG: Δ 2.0 [CI 1.1-2.8] "Likely"; OBG: Δ 2.4 [CI 1.5-3.3] "Almost certain") with a slightly better enhancement for the OBG (i.e., greater magnitude of change). The OWG showed greater changes in body composition (e.g., %body fat) (e.g., Δ -4.4 [CI -6.0 - -2.8] "almost certain") when compared to the OBG (Δ -3.2 [CI -4.6 - -1.8] "very likely"). Large and negative correlations were noted for percentage changes in body fat markers and percentage changes in parasympathetic indices of rHRV (i.e., rMSSD and SD1).
CONCLUSION: A multidisciplinary program improves parasympathetic activity, body composition, and cardiorespiratory fitness regardless the degree of excess body mass, with slightly better improvement in OWG for body composition and in OBG for the other variables. Changes in parasympathetic indices of rHRV were largely and negatively associated with changes in body composition (Buchheit, 2014).

References:
Zhou Y, Xie G, Wang J, Yang S (2012). Can J Cardiol, 28, 477–482.
da Silva DF, Bianchini JA, Antonini VD, Hermoso DA, Lopera CA, Pagan BG, McNeil J, Nardo Junior N (2014). Pediatr Cardiol, 35, 684–690.
Buchheit M (2014). Front Physiol, 5, 1–19.
Contact: joao17_carlos@hotmail.com

RELATIONS OF FITNESS PARAMETERS AND MORPHOLOGICAL CHARACTERISTICS OF EIGHT-YEAR-OLD OBESE CHILDREN

ZIVKOVIC, D.1, DJORDJEVIC, M.2, BJELAKOVIC, L.J.1, MALOBABIC, M.3, RANDJELOVIC, N.1

UNIVERSITY OF NIS

INTRODUCTION: The global increase in childhood overweight and obesity has become a worldwide epidemic. The World Health Organization (WHO) claims that there were 41 million obese children in the world under the age of 5 and over 340 million obese children and adolescents aged between 5 and 19 in 2016. The data indicate that the prevalence of excessive nutrition and obesity has increased from 4 (1975) to over 18 percent (2016) (WHO, 2016). Gender differences were no of particular significance, and in the year the study was conducted there
METHODS: The sample of participants consisted of 273 obese children (104 girls and 169 boys), first grade students (mean age 8,26 girls and 8,34 boys) of elementary schools in Nis, Serbia. The following fitness parameters were measured: HR in load, VO2max (ml), HR in peace, bend forward - bend backward – throw test, hand taping, 20m dash with a standing start, Abalakov test and forward bend on the bench test. Morphological characteristics were determined by measuring 13 parameters of longitudinal and transversal dimensions of skeleton, volume and body weight, as well as subcutaneous fat tissue (body height, leg length, arm length, shoulder width, pelvic width, hip width, body mass, thorax volume, upper arm volume, thigh volume, upper arm skinfold, back skinfold and abdominal skinfold). For all of the data we calculated the Mean and standard deviation (SD). Canonical correlation analysis was used to determine the relations between the set of variables representing fitness parameters and the set of variables of morphological characteristics.
RESULTS: Based on the coefficients of canonical correlation analysis, it can be concluded that the spaces of morphological characteristics and fitness parameters are interconnected with two pairs of statistically significant canonical factors at the level of .01 and one pair at the level of .05. The general analysis of the relationships between the first pair of canonical factors suggests that subjects with higher circular dimensionalities of the body, accentuated adiposity and body mass tend to have poorer results in the parameters of cardiorespiratory fitness. Relations of the second pair of canonical factors indicate that subjects with higher dimensions of longitudinal and transversal dimensionality of the skeleton with higher volume and mass of the body achieve worse results in motor tasks requiring the speed of alternative movements. Relations of the third pair of canonical factors indicate that the children with more subcutaneous fatty tissue, greater body height and BMI had statistically significant lower results in Abalakov test, which measured explosive strength of the legs, higher results of HR in peace and in load, and they were slower in 20m dash with a standing start, which confirms the result of some previous studies.
CONCLUSION: It can be concluded that obesity in young school age has negative implications on the fitness parameters in obese children, and therefore on their overall growth and development.

EFFECT OF A SHORT-TERM PHYSICAL ACTIVITY INTERVENTION ON BODY COMPOSITION, BIOMARKERS AND LIFESTYLE PATTERNS IN METABOLICALLY HEALTHY OBESE CHILDREN.

ROMANCE, A.R.1, BENÍTEZ-PORRES, J.1, MOORE, J.B.2, VARGAS CANDELA, A.3, MUÑOZ MELERO, M.3, VILCHES PÉREZ, A.4, MOYA RODRÍGUEZ, P.3, BERNAL-LÓPEZ, M.R.3,4

1: UMA , 2: WFSM , 3: IBIMA , 4: CIBER .

INTRODUCTION: Despite considerable efforts the prevalence of overweight and obesity in children remains high. Visceral adiposity has been identified as a risk factor of cardiovascular disease, type 2 diabetes as well as insulin resistance (Rodicio et al., 2018; Skoczen, Wojcik, Fijorek, Siedlar, & Starzyk, 2015). The purpose of this study was to analyse the effect of a 4-months physical activity programme on visceral adipose tissue (VAT), biomarkers and lifestyle in metabolically healthy obese child population.
METHODS: Data from 131 (n=70 boys, n=61 girls) healthy children (Age: 7.8±1.4 years, BMI: 24.6±3.4 kg/m2) enrolled in primary schools were used. The Actigraph GT3X monitor device was used to assess PA. Accelerometers were set to register 60-second epoch cycles, and were programmed to assess 7 days. We selected the cut points from Pulsford et al. to determine the time spent on different intensity levels of PA and sedentary time. Blood analysis was carried out to obtain biomarkers. Total and regional body composition were estimated using dual-energy x-ray absorptiometry (DXA). Children performed 5 days of aerobic PA per week (1h). A repeated-measures T-Student test was conducted to examine temporal changes (4 months).
RESULTS: Significant changes for moderate and vigorous PA were found between both moments (Moderate PA min/d 15.3±15.5 vs. 35.5 ± 14.8, p<0.001; Vigorous PA min/d 1.2±3.1 vs. 9.1±6.3 p<0.001 respectively). Some nutritional variables at second moment were significantly lower than baseline (Energy kcal 2180.2 ± 378.1 vs. 2007.5 ± 350.0 p<0.01; Carbohydrates g/d 228.8 ± 44.1 vs. 205.4 ± 44.9 p<0.001). In contrast, a significant reduction in HDL cholesterol was seen between baseline and 4 months cut (49.4±11.3 vs. 45.9±11.6, p=0.05). There were no significant differences for the rest of biomarkers and body composition variables, VAT included.
CONCLUSION: Our results suggest that there are signs of improvement in lifestyle patterns and some biomarkers. However, 4 months of PA intervention seem to be insufficient to obtain a significant change on body composition and VAT in metabolically healthy obese children. A longer temporal follow-up is required to observe changes.
References:
Pulsford RM, Cortina-Borja M, Rich C, Kinnafick FE, Dezateux C, Griffiths LJ (2011). Plos One, 6(8), e21822.
Rodicio MM, de Miguel VD, Jimenez MG, Guldris SC, Franco MML, Gestal AE, . . . Trabazo MRL (2018). Nutrition, 46, 83-89.
Skoczen S, Wojcik M, Fijorek K, Siedlar M, & Starzyk JB (2015). Experimental and Clinical Endocrinology & Diabetes, 123(4), 252-259.

PHYSICAL ACTIVITY AND CHILDREN OVERALL HEALTH STUDY (PACH STUDY) – DESIGN AND BASELINE CHARACTERISTICS

REIHMANE, D., OZOLINA-MOLL, L., SLEZINA, L., JUSTAMENTE, I., TREIJA, E.M., RAUDENIECE, J., SILINA, L.

UNIVERSITY OF LATVIA

INTRODUCTION: Latvian Olympic Committee has developed a pilot project The Sport for All Class (SFA Class) which is exploring innovative solutions aimed at promotion of overall health of children through regular physical activities in schools outside the curriculum. To clarify whether extra school based physical education (PE)/ SFA Class) can prevent chronic cardio-metabolic diseases and facilitate emotional/psychological wellbeing in children a prospective 4 years study was designed.
METHODS: In fall (2017) 105 3rd grade students (46 boys and 59 girls) were enrolled in the study (convenience sampling); SFA class (N=56) and Control (N=49) students having 5 vs. 2 * 40 min PE lessons, respectively. During research groups 1st visit to schools corresponding baseline characteristics among others were determined: body mass index (BMI), waist circumference (WC), heart rate (HR) (3-min Kasch Pulse Recovery Test) and serum biomarkers. The Physical Activity Questionnaire for Older Children (PAQ-C) was used to determine daily activity levels. Data were analyzed with SigmaPlot12.5. Descriptive data are represented as mean ± SEM and Sperman correlation analysis was performed. Second screening is going to be 6 months later, when impact of SFA Class will be evaluated analyzing the differences between the study groups.
RESULTS: Baseline characteristics are as follows: age (9 – 10 years); BMI 17.6 ± 0.3 kg/m2; WC 60.5 ± 0.8 cm, hsC-reactive protein (CRP) 1.01 ± 0.17 mg\L, insulin resistance index (HOMA-IR) 1.70 ± 0.13, triacylgylcerides (TAG) 0.76 ± 0.04 mmol/l; leptin 4.9 ± 0.6 pg/ml; adiponectin 200 ± 18 pg/ml. PAQ-C score was 1.79 ± 0.07n (1 indicates low whereas 5 - high physical activity). HR at 3rd min of Kasch Pulse Recovery Test reached 163 ± 1 beats/min and 112 ± 2 beats/min during 1 min of recovery.
There were significant ($p < 0.05$), positive correlations in between BMI, WC, hs-CRP, HOMA-IR, TAG and leptin, except, no correlation between WC and TAG ($r = 0.17$; $p = 0.09$) was found. In addition, PAQ-C score was negatively correlated with HR ($r = -0.235$), TAG ($r = -0.206$), HOMA-IR ($r = -0.216$).
CONCLUSION: Baseline data suggests that aerobic fitness level and serum biomarkers which usually are predictors for chronic diseases in adults are in normal ranges within children in our study group. However, the PAQ-C score which shows reduced physical activity levels in children and is related to increased HR during physical activity raises concerns that inactive lifestyle could cause health problems later in adolescence. PACH-Study also evaluates cognitive functions, thus follow up data, larger study groups (enrolment of children of the same age in next fall) and comparison between them in all various aspects, will answer the question, whether extra school based PE can promote general health of children.

PHYSICAL ACTIVITY PREFERENCES IN TEN-YEAR OLD NORWEGIAN SCHOOLCHILDREN

RESALAND, G.K.

WESTERN NORWAY UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: A worrying number of children do not meet the physical activity recommendations, and physical activity levels steadily decline with age in schoolchildren. Moreover, patterns of reduced amounts of physical activity appear to persist into adulthood, which could negatively affect children's future health. As such, it is critical to intervene early to provide opportunities for increased physical activity throughout the childhood and school provide an ideal target for physical activity interventions. Most school-based interventions focus on the dose and intensity of physical activity, but few consider the type and the content of the activities that children prefer. To this end, we investigated physical activity preferences in a large sample of ten-year old Norwegian schoolchildren to provide researchers and practitioners with better tools to design interventions and programs in schools that are tailored to the preferences of the children.
METHODS: In total, 1026 ten-year-olds completed a questionnaire indicating their preferences for physical activities. We utilized principal component analysis to derive five component patterns of physical activity and studied whether gender, cardiorespiratory fitness and abdominal adiposity were associated with these patterns.
RESULTS: Combined, boys and girls reported soccer and slalom skiing as their most preferred activities. The most pronounced gender differences were for activities favored by girls: dancing, gymnastics, exercise to music and jumping rope . Only two of the activities, soccer and strength training, were significantly more preferred by boys. To better understand patterns across these activities, the five, derived component patterns of a physical activity were analyzed via linear mixed-effect models. Results showed a strong girl preference for component 2 . Also, cardiovascular fitness was negatively associated with component 3 , and positively associated with component 4 and 5 .
CONCLUSION: These results inform future school-based physical activity interventions to provide more relevant and appealing options for those children who might otherwise be missed by "one-size-fits-all" school-based physical activity interventions.

Mini-Orals

MO-PM10 Hypoxia

HOOK BREATHING AND SAO2 RECOVERY AFTER DEEP APNEA DIVES

FERNÁNDEZ, F.A., RODRÍGUEZ-ZAMORA, L., SCHAGATAY, E.

CENTRO SUPERIOR DE ESTUDIOS UNIVERSITARIOS LASALLE

INTRODUCTION: One of the main risks of deep apnea diving is hypoxic syncope at the surface (Lindholm, 2007). After diving, most freedivers perform a breathing protocol called "hook breathing" (HB), involving an interrupted exhale to build up some intrapulmonary pressure (Whinnery, 1990), said among freedivers to facilitate restitution of the basal oxygen saturation values. We examined the influence of HB on arterial oxygen saturation (SaO2) recovery, compared to normal breathing (NB) after ~30 msw dives.
METHODS: Twenty-two experienced competition male breath-hold divers participated. They performed free immersion dives (FIM), i.e. pulled down and up on a vertical line using arms only. Their mean(SD) personal best was 57(26) m. Divers performed two 30 m FIM dives, followed by HB or NB throughout recovery, at a weighted order. SaO2 and heart rate were recorded using pulse oximetry.

RESULTS: During early recovery NB resulted in a tendency for higher SaO2, but after 25 s SaO2 was slightly higher after HB. When the divers were subgrouped according to their ability to "squeeze", thus fail to reach 95% SaO2 in 2 minutes (squeezers; n=5), or not (non-squeezers; n=17), a clearly higher SaO2 resulted after HB in the squeezers (P<0.05), while non-squeezers showed no effect.
CONCLUSION: The results suggest that HB is highly efficient in "squeezers", showing delayed SaO2 recovery, while in subjects with less proneness to squeeze the effect is less evident, as NB is sufficient to recover. The proposed mechanism is that the increased pulmonary pressure created with HB will counteract the pulmonary edema developed and facilitate oxygen uptake in divers prone to squeeze.

4-WEEKS HHL TRAINING IMPROVES ROWERS CUTANEOUS MICROCIRCULATION AND ENDOTHELIAL FUNCTION

ZHIJUN, M.

SHANGHAI UNIVERSITY OF SPORT

INTRODUCTION: Sport scientists always pay attention to cardiorespiratory and hematologic system on benefit of hypoxic training, but peripheral circulation may be one of these benefit, which is one cause of improving performance. So, in order to know whether or not hypoxic training affect athletes cutaneous microcirculation, we test rowers microcirculation during 4 weeks High live-High train-Low exercise(HHL)
METHODS: Sport scientists always pay attention to cardiorespiratory and hematologic system on benefit of hypoxic training, but peripheral circulation may be one of these benefit, which is one cause of improving performance. So, in order to know whether or not hypoxic training affect athletes cutaneous microcirculation, we test rowers microcirculation during 4 weeks High live-High train-Low exercise(HHL)
RESULTS: HHL training improve rowers blood flow (9.69±3.66PU VS12.66±5.60PU) and PORH reserve capacity(4.92±1.23VS5.30±1.54) of forearm and remains for three weeks after HHL training(blood flow 10.03±5.07PU,PORH reserve capacity 5.44±1.69). Nomoxia training also increase blood flow of forearm(8.50±2.27PU VS 10.40±4.50PU), but do not increase PORH reserve capacity(5.64±1.91VS 4.93±1.92)
CONCLUSION: 4 weeks HHL training of rowers increase forearm blood flow, but no thigh. This is because thigh is main working muscle of rowers, which may be affected by training status and fatigue. And also, PORH reserve capacity is an indicator of endothelial function. In this study, we find HHL rowers increase their PORH reserve capacity, which means endothelial function is improved by hypoxia training. So, besides the traditional research of Hematologic System on hypoxia training, we find 4 weeks HHL training increase forearm blood flow and improve endothelial function. This may be one mechanism of improving performance, which need more studies to confirm.

EFFECTS OF PERIODIC HYPOBARIC HYPOXIC ENVIRONMENTS ON PHYSIOLOGICAL RESPONSES DURING UNSTEADY WORKLOAD EXERCISE

NISHIMURA, K., NAGASAKI, K.

HIROSHIMA INSTITUTE OF TECHNOLOGY

INTRODUCTION: We developed a periodic pressure-controlling system in a chamber to mimic a hypobaric hypoxic environment. The characteristics of this system varied between a decreased pressure at an altitude of 1500 m for 180 s and an increased pressure at an altitude of 0 m for 180 s. Furthermore, the relative concentration of oxygen was alternated between 20.9% and 16.9%. The present study aimed to determine the effects of periodic hypobaric hypoxic environment (PHHE) on physiological responses during unsteady workload exercise.
METHODS: This study included 15 healthy men, all of which provided written informed consents. We set developed two experimental conditions with subjects exercising in a PHHE system (periodic-condition) or at an altitude of 750 m (fixed-condition). In the periodic condition, the atmospheric pressure was changed periodically from 967 to 817 hPa (the external pressure was 1,008 hPa), while in the fixed condition, the atmospheric pressure was fixed at 892 hPa. All subjects performed a two-stage cycling exercise for 32 min. The steady-state exercise test consisted of three 4 min bouts of exercise at 20%, 60%, and 40% of the maximal oxygen intake (VO2 max), while the unsteady-workload exercise test consisted of five 4 min bouts of exercise with a gradual increase and decrease in the workload between 20% and 60% of the VO2 max. The heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), arterial oxygen saturation (SpO2), and rating of perceived exertion (RPE) were measured under both conditions. The HR maximal values, minimal values, amplitude, and phase lag (response to maximal/minimal workload) during unsteady-workload exercise were calculated. Each subject participated in the two conditions in a random order 1 week apart.
RESULTS: During exercise, HR and SBP were significantly lower in subjects under the periodic-condition compared to those under the fixed-condition, whereas the RPE was significantly higher in subjects under the periodic-condition. DBP and SpO2 did not show a significant difference between the two conditions. In addition, the phase lag and amplitude of HR did not show significant differences between the two conditions. Previous studies reported that the SpO2, HR, and SBP were significantly lower during exercise in subjects exposed to PHHE compared to those who were not. Furthermore, the brachial-ankle pulse wave velocity was significantly decreased in subjects after their exposure to PHHE. Our results show that during exercise in a PHHE, cardiocirculatory responses were decreased.
CONCLUSION: We conclude that PHHE may be an effective training method during highland stays.

TISSUE OXYGENATION RESPONSE TO DIFFERENT RELATIVE LEVELS OF BLOOD-FLOW RESTRICTION EXERCISE

FATELA, P.1,2, REIS, J.F.1,2, MENDONCA, G.V.2, INFANTE, J.2, VALAMATOS, M.J.2, ALVES, F.2, MIL-HOMENS, P.2

1 UNIVERSIDADE EUROPEIA - LAUREATE INTERNATIONAL UNIVERSITIES ; 2 UNIVERSIDADE DE LISBOA - FACULDADE DE MOTRICIDADE HUMANA

INTRODUCTION: Recently, the effect of blood-flow restricted exercise (BFRE) in tissue oxygenation has been compared with that seen in non-restricted conditions (Ganesan, 2015). Unfortunately, the acute effect of BFRE performed at different relative levels of pressure has never been investigated. Therefore, we aimed to analyse the acute response of deoxyhemoglobin (HHb) concentration and tissue oxygen saturation (TOI) to different relative levels of BFRE in the vastus lateralis (VL) muscle using near-infrared spectroscopy (NIRS).
METHODS: Fourteen healthy active men (24.8±5.4 yrs; height: 175.2±4.4 cm; body mass: 71.1±6.9 kg) were tested for unilateral knee extension exercise (20% 1RM: 4 sets of 30+15+15+15 reps, with 30-s recovery), on 4 different conditions: no-BFR (NO) or by 3 BFR levels normalized to the value of absolute vascular occlusion determined at rest (40, 60 and 80% BFR). HHb concentration and TOI were measured using a continuous-wave tissue oximeter (NIMO, Nirox srl, Brescia, Italy). The relative change in each parameter was calculated from the end of each set to the end of the respective recovery period. A two-way repeated measures ANOVA [condition (NO vs. 40 vs. 60 vs. 80% BFR) x time (rest1 vs. rest2 vs. rest3)] was used to determine the impact of each condition on HHb and TOI. Paired t tests were computed to explore differences in both parameters for each condition (NO, 40, 60 and 80% BFR).

RESULTS: HHb concentration was differently affected by all conditions in each recovery period (F=101,76; p>0.00). In each condition, there were significant differences in the changes of the HHb concentration between the end of each set and that of each recovery periods (p>0.01). Importantly, the changes in the HHb concentration values were from: -68.6 to -75.8%; -28.6 to -34.1%; -3.1 to -9.9%; and +13.2 to +17.7% for the NO, 40, 60 and 80% BFR, respectively. The TOI values were similarly affected by exercise between the NO and the 40% BFR condition and between the 60 and the 80% BFR condition (p>0.05). However, the differences in this parameter, between the end of the sets and the end of the resting periods were significant (p>0,01). TOI values changed from: +79.2 to +80.0%; +71.8 to +76.8%; +47.6 to 53.3%; and +32,2 to +39,9% in the NO condition, 40BFR, 60BFR and 80BFR, respectively.
CONCLUSION: This study demonstrates that exercising at different levels of relative blood flow restriction affects the fractional oxygen extraction during the interset recovery period. Accordingly, oxygen saturation is affected in similar fashion. However, in this parameter, the NO condition is not significantly different from a low-restricted condition (40BFR), as well as, high-restricted conditions (60 vs. 80BFR) are not different between each other. These results indicate that, when tissue oxygenation is analysed during BFRE, there may be a maximum threshold for the level of relative restriction, beyond which no further significant effect is promoted.

SALIVARY CORTISOL RESPONSE POST 15 S MAXIMAL-ANAEROBIC EXERCISE AT ALTITUDE

KRUSCHE, T., MATIAS SANTOS, V., DE MARÉES, M., SONNEBORN, M., PLATEN, P.

RUHR-UNIVERSITÄT BOCHUM

INTRODUCTION: Serum and salivary cortisol increase after psychological and physical stress. Previous studies mostly report a rise in resting and post aerobe exercise cortisol at altitude (e.g. Chen et al., 2006 & Zaccaria et al., 1998). However, little is known about the cortisol response (CR) post maximal-anaerobic exercise in hypobaric hypoxia. Therefore, the aim of the study was to analyse the effect of 15 s maximal-anaerobe exercise on rapid salivary CR.
METHODS: The CR of 9 healthy moderately trained subjects (m: n=7, f: n=2; 24±5 yrs; BMI: 23.1±2.0 kg/m2; VO2max: 52.4±5.0 ml/min/kg) was investigated before, after (d-4 and d+10; ~ sea level), and at moderate (d2; 2375 m) and high altitude (d4; 3647 m). In the morning between 9-11 am salivary cortisol levels was measured immediately before and after 15 s skipping test to maximum exertion (number of skips video-documented: SN). The CR is defined as delta values between pre- and post-exercise cortisol levels. In addition, morning heart rate variability (mRMSSD) was measured to asses' physiological stress based on sympatho-vagal activity (Thayer et al., 2011). Further, resting oxygen saturation (SaO2) and maximal capillary blood lactate accumulation after exercise (Lac max) were determined. Data are presented as median, and 1st and 3rd quartile.
RESULTS: The SN and mRMSSD remained stable at all testing times (SN: d-4 = 64 (61/70), d2 = 64 (59/67), d4 = 64 (61/69), d+10 = 68 (60/71); mRMSSD: d-4 = 93.0 (58.5/114.0), d2 = 67.5 (33.3/122.0), d4 = 67.0 (40.5/129.0), d+10 = 60.5 (32.0/95.5) ms, p>0.05, respectively). However, determined CR remained initially unchanged at 2375 m compared to d-4 and d+10 (d-4 = 0.14 (-0.26/0.94), d2 = -0.24 (-0.57/0.50), d+10 = 0.12 (-0.41/0.97) nmol/l, p>0.05), but rose significantly at 3647 m compared to d2 and d+10 (d4: 1.09 (0.14/1.99), nmol/l, p<0.05, respectively). Lac max was higher and SaO2 was lower at both altitude levels compared to sea level (Lac max: d-4 = 5.1 (4.0/6.1), d2 = 6.0 (5.7/7.8), d4 = 6.7 (5.9/8.1), d+10 = 5.9 (5.4/7.4) mmol/l; SaO2: d-4 = 98% (96%/100%), d2 = 95% (95%/98%), d4 = 91% (88%/92%), d+10 = 99% (97%/100%), p<0.05, respectively).
CONCLUSION: In conclusion, our findings are in line with previous studies of an elevated cortisol level after exercise. Hypobaric environment is known to induce lower SaO2 and physiological stress, which is reflected in higher cortisol excretion (Woods et al., 2012). This provides an explanation for a pronounced CR in high and a lack thereof in moderate altitudes. However, heart rate variability did not reflect a stress response in this particular context. Furthermore, increased Lac max values at altitude indicate metabolic changes during anaerobic exercise which may have contributed higher post-exercise cortisol levels as well.
REFERENCES: Chen SM et al. (2006). Appl Physiol Nutr Metab, 31, 726-30.
Thayer et al. (2011). Neurosci Behav Rev, 36, 747-56.
Woods DR et al. (2012). Horm Metab Res, 44, 1-4.
Zaccaria M et al. (1998). J Clin Endo Metab, 83, 570-4.

REPEATED MAXIMAL DYNAMIC APNEAS ELICIT HIGHER SERUM ERYTHROPOIETIN CONCENTRATIONS THAN MAXIMAL STATIC APNEAS IN ELITE AND NON-DIVERS

ELIA, A.1, BARLOW, M.J.1, DEIGHTON, K.1, WILSON, O.J.1, OHARA, J.P.1

LEEDS BECKETT UNIVERSITY

INTRODUCTION: Hypoxia is a condition of reduced oxygen (O2) concentration in breathable air or blood. During static (STA) and dynamic (DYN) apneas breath-hold divers are regularly exposed to transient acute hypoxic conditions, interspersed with periods of normal breathing. Increases in serum erythropoietin (EPO) are reported to occur 30-minutes after static apnea-induced hypoxia and return to baseline five hours after. However, no data currently exist regarding the level of circulating EPO following a series of repeated maximal DYN apneas performed by either non-divers (ND) and/or elite breath-hold divers (EBHD). Therefore, this study investigated the effects of maximal STA and DYN apneas on EPO concentrations in ND and EBHD.
METHODS: 18 healthy male participants were recruited, of which 8 were EBHD (national team members) and 10 were sedentary ND. Each participant performed five maximal DYN apneas in a swimming pool with a two-minute rest between each apnea. Subsequently, within a week participants performed two sets of five maximal STA apneas with a ten-minute rest in between sets and a two-minute rest between each apnea. Peripheral oxygen saturation (SpO2) was assessed at completion of each apnea. Following completion of each apneic protocol, venous samples were drawn at 30, 90 and 180 minutes after the last apnea to assess circulating EPO levels.
RESULTS: DYN apneas induced lower SpO2 values in both groups (EBHD 62 10.45%,p=0.024; ND 85 5.8%, p=0.020) when compared with STA apneas (EBHD 76 7.44%; ND 96 1.43%), with EBHD attaining significantly lower SpO2 values during both conditions than ND (STA p=0.006; DYN p=0.0001). EBHD EPO concentrations were higher after 30 (10.82 2.5mlU/mL,p=0.017) and 180 minutes (10.87 2.1mlU/mL,p=0.024) and with a trend at 90 minutes (10.13 2.04mlU/mL,p=0.058) of DYN apneas when compared to baseline (6.85 0.9mlU/mL). ND EPO concentrations were unchanged at 30 (6.48±2.54mlU/mL,p=1), 90 (5.65±2.08mlU/mL,p=1) and 180 (6.49±2.44mlU/mL,p=1) minutes of DYN apneas when compared to baseline (6.45±3.43mlU/mL). STA apneas did not induce a significant increase in serum EPO at 30 (EBHD 6.78±1.22mlU/mL,p=1; ND 6.27±1.68mlU/mL,p=1), 90 (EBHD 6.67±2.27mlU/mL,p=1; ND 6.43±1.62mlU/mL,p=1) and 180 minutes (EBHD 7.69±2.48mlU/mL,p=1; ND 6.55±1.90mlU/mL,p=1) when compared to baseline in either group.

CONCLUSION: Serum EPO concentrations increased from baseline after the DYN protocol in the EBHD group only, whereas no changes were observed after the STA protocol for either group. These data suggest that the lower SpO2 levels attained by the EBHD during the DYN protocol lead to a greater physiological stress and that this was associated with an increase in circulating EPO.

THE EFFECTS OF GRADED REDUCTIONS IN INSPIRED OXYGEN FRACTION ON COGNITIVE FUNCTION

WILLIAMS, T.1, CORBETT, T.1, MCMORRIS, T.2, THELWELL, R.1, TIPTON, M.1, COSTELLO, J.1

1: UNIVERSITY OF PORTSMOUTH 2: UNIVERSITY OF CHICHESTER

INTRODUCTION: Whilst it is generally accepted that cognition is impaired under hypoxia, the large disparity in methodologies employed in the existing literature has made drawing definitive conclusions problematic. Moreover, it is still unclear i) at what level of hypoxia cognitive impairment begins, ii) the cognitive domain(s) that is/are affected, and iii) the mechanism(s) responsible for these deteriorations. Therefore, the aim of this study was to assess a variety of central executive and non-executive tasks and the concurrent changes in physiology over a range of simulated altitudes. It was hypothesised that there would be a linear relationship between fraction of inspired oxygen (FiO2) and cognitive performance, with non-executive tasks displaying greater resilience to hypoxia than executive tasks.
METHODS: A within participant, balanced, cross over design was employed. Twelve healthy male participants (mean [SD] 22[4] yrs, 75[9]kg, FEV1/FVC ratio 85[5] %) completed a 4-task cognitive testing battery designed to examine the cognitive domains of inhibition, selective attention (Eriksen Flanker), working memory (N-back) and simple and choice reaction time (Deary-Liewald). The battery was completed before and after 60 minutes of exposure to each of the following FiO2 values: 0.21 (sea level), 0.17 (~1600m), 0.15 (~2800m), and 0.12 (~4300m). Peripheral oxygen saturation (SpO2), cerebral oxygenation (measured via near-infrared spectroscopy), minute ventilation, mood disturbance and acute mountain sickness were also recorded.
RESULTS: As designed, SpO2 decreased as altitude increased (FiO2 0.21: 96[0] %, FiO2 0.17: 94[2] %, FiO2 0.145: 89[2] %, FiO2 12: 81[4] %, $P < 0.05$). Despite a significant reduction from baseline in cerebral oxygenation (-5.72[2.9] %, $P < 0.001$) and an increase in mood disturbance ($P = 0.049$) following exposure to FiO2 0.12, cognitive performance was maintained for both central executive and non-executive tasks across all conditions (all $P > 0.05$). Cognitive performance was not associated with cerebral oxygenation or any other physiological or perceptual measures.
CONCLUSION: These results suggest that a simulated altitude of up to ~4300m and the resultant physiological changes do not provide a sufficient stimulus to impair cognitive function at rest.

EFFECTS OF MEAN SLEEPING HEIGHT INCREMENTS OF 870 M PER NIGHT UP TO 3600 M ON SLEEP QUALITY DURING HIKING AT HIGH ALTITUDE

SCHÄFER, H.1, KRUSCHE, T.1, KÖLLING, S.2, MATIAS SANTOS, V.1, DE MARÉES, M.1, PLATEN, P.1

FACULTY OF SPORT SCIENCE, RUHR-UNIVERSITÄT BOCHUM

INTRODUCTION: Sleep is essential for regeneration and health during altitude exposure. A decrease in sleep quality (SQ) has been described in the first nights at high altitude [1,2,3]. Impaired SQ is characterized by perceived restlessness, frequent awakenings (wake after sleep onset; WASO) and reduced sleep duration, resulting in decreased sleep efficiency (SE) [2,3]. High-altitude medicine recommendations for increase in height include increments in sleeping height of not more than about 500 m per night from 3000 m. Aim of the study was to analyse the effect of high altitude exposure on SQ when sleeping height increases by 870 m per night in the first 4 days of a typical high altitude sojourn.
METHODS: 9 healthy moderately trained subjects (m: n=7, f: n=2, 23.3±3.9 yrs, BMI: 23.1±2.0 kg/m2) were investigated in a 6-day baseline window (BL: d-6 – d-1: 156 m) before a 9-day-period (d1 – d9) hiking and sleeping at moderate to high altitude. Sleeping height was 1190 m at the 1st night (d1), 2375 m at the 2nd and 3rd nights (d2 – d3) and 3647 m from 4th to 9th night (d4 – d9)), leading to a mean daily increase in sleeping height of 870 m. Daily sleep monitoring was conducted objectively with multi-sensor actigraphy (SenseWear™) and subjectively using sleep diary. Parameters included SE, wake frequency (WF) and WASO. In addition, the Lake Louise Score (LLS) and oxygen saturation (SaO2) was measured every morning. Significance was set at 0.05. Data are presented as median (M), interquartile range (IQR) and total data.
RESULTS: Objectively determined SE, WF and WASO remained unchanged compared to BL (SE: BL: M=89%, IQR=4.6; d1: M=90%, IQR=5.0; d2: M=89%, IQR=10.2; d4: M=82%, IQR=10.0; d9: M=89.2%, IQR=7.0; WF: BL: M=11.0, IQR=6.5; d1: M=7.0, IQR=5.5; d2: M=12.0, IQR=11.0; d4: M=10.0, IQR=7.0; d9: M=8.0, IQR=7.5; WASO: BL: M=30.0, IQR=19.5; d1: M=10.0, IQR=23.5; d2: M=30.0, IQR=51.0; d4: M=35.0, IQR=39.0; d9: M=12.0, IQR=25.0; $p>0.05$). In contrast, subjectively determined WF and WASO increased on d4 compared to BL (WF: BL: M=0.3, IQR=0.7; d4: M=2.0, IQR=3.0; WASO: BL: M=1.0, IQR=3.5; d4: M=10.0, IQR=17.5; $p<0.05$). Subjectively determined SE was not analysed due to missing data. The respective sleeping score item of LLS showed no differences between BL and d1, d2, d4, and d9 (BL=0, d1=0, d2=3, d4=7, d9=2; $p>0.05$). During the study one subject was diagnosed with mild acute mountain sickness on d4 (LLS=4). All subjects had SaO2 values higher than 85% throughout the sojourn (range = 85% – 99%).
CONCLUSION: Objectively determined sleep quality remained unaffected through the chosen strategy of sleeping height increase. In contrast, subjectively perceived SQ was poorer at the first night of sleeping above 3000 m. More research is needed to explore the difference between objectively and subjectively determined sleep quality at high altitude.
REFERENCES: [1] Bloch E et al. (2015). J Appl Physiol 119:1466 [2] Pramsohler S et al. (2017). Pneumol 71.3:146 [3] Weil JV (2004). High Alt Med Bio. 5:180

INFLUENCE OF MODERATE AND HIGH ALTITUDE ON GUSTATORY PERCEPTION

FRON, K., RIEMER, J., KRUSCHE, T., PLATEN, P.

FACULTY OF SPORT SCIENCE, RUHR-UNIVERSITY BOCHUM

INTRODUCTION: Nutrient intake plays an essential role for safety and performance in sports. Mountaineering at high altitude requires sufficient energy intake to guarantee physical performance and safe acting under such conditions. Previous studies showed that appetite and hunger were inhibited in hypobaric hypoxia [1]. The sensory experience of eating is an important determinant of food intake control, often attributed to the positive response associated with certain sensory cues [2]. The purpose of the study was to investigate whether gustatory thresholds (GT) are altered at moderate and high altitude.
METHODS: Gustatory detection threshold (DT) and variation threshold (VT) of 17 healthy young moderately trained subjects (m=11; w=6, age=25.0±8.1 yrs, BMI=22.8±1.5 kg/m2) were measured 4 days before (d-4:156m) and during (d2:890m, d5:3950m, d7:4550m,

d10:890m) a 7-day ascent to the top of Mt. Kilimanjaro (5895m). GT was tested with dilute aqueous solutions in several concentrations of four flavors (umami, bitter, salty, sweet) [3;4]. For umami we used a monosodium glutamate and for bitter a magnesium sulphate heptahydrate solution. Natrium chloride was used for salty and glucose for sweet solutions. 1 ml of each solution was directly given in the subject's mouth with a dropping glass. The mouth was rinsed with water between the different tests. GT was requested with a scale from 0-2 (0=no taste, 1=variation taste, 2=detected taste).
RESULTS: Mean DT of all flavors remained unchanged at all altitude conditions (d2, d5, d7, d10) compared to d-4 (umami: 2.9±1.3, 3.6±1.5, 3.4±1.4, 2.9±1.7, 2.6±1.7; bitter: 4.2±1.3, 4.4±1.3, 4.9±0.2, 4.6±1.2, 4.5±0.9; salty: 4.5±1.2, 4.6±0.9, 4.8±0.7, 4.2±1.4, 4.6±1.0; sweet: 4.2±1.3, 4.1±1.6, 4.2±1.4, 4.9±0.3, 4.6±0.9 p>0.05). Coherent to DT, mean VT also remained unchanged to d-4 at all altitude conditions (umami: 1.5±0.9, 1.6±1.0, 2.0±0.9, 2.0±1.5, 2.0±1.3; bitter: 2.4±1.5, 3.1±1.9, 3.6±1.7, 3.0±1.7, 3.1±1.5; salty: 2.2±1.5, 2.6±1.5, 2.9±1.7, 2.6±1.6, 2.5±1.6; sweet: 2.2±1.5, 1.9±1.3, 3.0±1.6, 2.6±1.7, 2.7±1.7 p>0.05).
CONCLUSION: Our data show no effect of moderate and high altitude on GT in healthy young people. The results are contradictory to recent data suggesting an impairment on gustatory perception at 1500m and 3000m [4], while animal studies showed an increase of gustatory perception under hypoxic stress [5]. In these studies, changes in GT were found during acute hypobaric hypoxia in contrast to our study with a 5-day-acclimatization. In this context, we assume that good acclimatization might prevent alterations in gustatory perception. Further studies are necessary to fully understand possible time courses of gustatory sense adaptation to high altitude.
REFERENCES:
[1] Yan X et al (2011). Exp Brain Res, 209, 495.
[2] McCrickerd K et al (2016). Ob Rev, 17(1), 18.
[3] Ikeda K et al (2002). Chem Senses, 27, 847.
[4] Maga JA et al (1972) Percep Motor Skills, 34, 667.
[5] Pocock R et al (2000). Nat Neuro Sci, 13, 610.

INFLUENCE OF UPPER LIMB CIRCULATORY OCCLUSION ON CYCLE ERGOMETER TIME TRIAL PERFORMANCE IN NORMOXIA AND HYPOXIA

BELL, C., ACKERMAN, A.A., HOSKOVEC, L.C., TRIKA, S.R.J.

COLORADO STATE UNIVERSITY

INTRODUCTION: The availability of blood, and hence oxygen, to exercising muscle is an important physiological determinant of endurance performance. The purpose of this study was to investigate a novel procedure that may increase the amount of blood available to exercising limbs: upper limb circulatory occlusion. We hypothesized that upper limb circulatory occlusion would improve cycle ergometer time-trial performance and attenuate hypoxia-mediated decrements in endurance exercise.
METHODS: Following screening and habituation, 16 healthy young adults (9 male, 7 female, age: 23 ± 1 years, body mass index: 23.9 ± 0.8 kg/m^2; maximal oxygen uptake: 46 ± 2 ml/kg/min; mean ± SE) completed four randomly ordered stationary cycle ergometer time trials, equivalent to 5 km, in normoxia (fraction of inspired oxygen (FiO2)=0.21) and hypoxia (FiO2=0.15), with and without circulatory occlusion of the arms. At the start of each circulatory occlusion trial, participants raised their arms above their head for 60-seconds, and automated blood pressure cuffs were rapidly inflated to 200 mmHg before participants returned their arms to cycling position. Circulatory occlusion was confirmed by the absence of a radial pulse and the inability to measure peripheral oxygen saturation at the fingers.
RESULTS: Time trial performance was as follows: normoxia without occlusion 568.6 ± 16.4 s; normoxia with occlusion 563.3 ± 16.8 s; hypoxia without occlusion 602.3 ± 16.1 s; hypoxia with occlusion 594.4 ± 17.2 s. Two-way repeated measures analysis of variance revealed a potential main effect of occlusion (faster with occlusion P=0.082), a main effect of FiO2 (slower in hypoxia P<0.001), and no interaction (occlusion x FiO2 P=0.525).
CONCLUSION: These preliminary data suggest that upper limb circulatory occlusion may have ergogenic potential, presumably via a temporary increase in central blood volume, leading to greater blood and hence oxygen availability for the lower limbs. Noteworthy, the magnitude of improvement in time trial performance was greater than that required to determine medal positions in the track cycling pursuit (men's) events at the London and Rio Olympics (2012 and 2016, respectively).

HYPOXIA PROMOTES SKELETAL MUSCLE DIFFERENTIATION IN C2C12 SKELETAL MUSCLE CELLS.

SAKUSHIMA, K., YOSHIKAWA, M., HASHIMOTO, T.

RITSUMEIKAN UNIVERSITY

INTRODUCTION: It is well-known that mechanical stress causes muscle hypertrophy. Interestingly previous study demonstrated that muscle hypertrophy elicited by resistance exercise training in hypoxic environment was greater than that in normoxic environment (Nishimura et al., 2010). However, the effect of hypoxia on skeletal muscle morphological characteristics remains unknown. To assess this effect, we cultured C2C12 skeletal muscle cells in 10% oxygen environment and examined their morphological characteristics.
METHODS: At the onset of cell differentiation, C2C12 skeletal muscle cells were divided into two groups: Control group cultured in 20.9% oxygen environment (CON) and hypoxia group cultured in 10% oxygen environment (HYPO). After 6 days incubation, we evaluated expressions of differentiation-related proteins such as Myogenin, MyoD, Myosin heavy chain protein (MHC) using Western blotting. We also conducted immunocytochemical analyses to assess myotube diameter and Differentiation Index, an indicator of muscle differentiation (Oishi et al., 2015). As well, immunostaining of Ki67, a marker of cell proliferation, was conducted for the assessment of cell proliferation.
RESULTS: The myotube diameter in the HYPO was significantly greater than that in the CON ($p < 0.05$). The Differentiation Index was significantly higher in the HYPO than in the CON ($p<0.05$). The protein expression of myogenin was significantly higher in the HYPO than in the CON ($p < 0.05$). The number of Ki67 positive nuclear in the HYPO was significantly smaller than that in the CON ($p < 0.05$).
CONCLUSION: The findings suggest that hypoxic environment may promote skeletal muscle cell growth and hypertrophy by accelerating the cell differentiation cycle.
REFERENCES:
Nishimura, A., Sugita, M., Kato, K., Fukuda, A., Sudo, A., & Uchida, A. (2010). Hypoxia increases muscle hypertrophy induced by resistance training. International journal of sports physiology and performance, 5(4), 497-508.
Oishi, Y., Tsukamoto, H., Yokokawa, T., Hirotsu, K., Shimazu, M., Uchida, K., ... & Hashimoto, T. (2015). Mixed lactate and caffeine compound increases satellite cell activity and anabolic signals for muscle hypertrophy. Journal of Applied Physiology, 118(6), 742-749.

Mini-Orals

MO-PM09 Health and disease modulation

POOR CORRELATION BETWEEN GAINS IN VO2PEAK AND IMPROVEMENT IN METABOLIC SYNDROME AFTER 16-WEEK OF AEROBIC INTERVAL TRAINING

MORA-RODRIGUEZ, R., ORTEGA, J.F., MORALES-PALOMO, F., RAMIREZ-JIMENEZ, M.

UNIVERSITY CASTILLA-LA MANCHA

INTRODUCTION: The purpose was to examine the relationship between cardiorespiratory fitness (CRF; estimated by VO2max) and metabolic syndrome after an exercise training intervention to confirm/contradict the findings in cross-sectional observational studies.
METHODS: A group (n=155; 50% women) of middle-aged (54±8 yrs old) untrained (VO2max of 20.3±7.1 mLO2·kg-1·min-1) individuals with obesity (BMI of 32±5) and metabolic syndrome (MetS), where randomly allocated to either an aerobic exercise interval training group (AIT group; n=133) or remained sedentary (CONT group; n=22) in a 6:1 ratio. Metabolic syndrome factors were measured at baseline and after 16 weeks in AIT and CONT groups and results expressed as a summed Z-score continuous variable (MetS Z-score). Body fat, weight and exercise responses (VO2max; HRmax; POmax) were also measured. We used correlation (R Pearson) and stepwise multiple regression analysis to study associations between changes in MetS Z-score and health related outcomes.
RESULTS: At baseline, body composition, exercise responses and MetS components were similar between groups (all P>0.05). After 16 weeks of intervention AIT reduced body weight, waist circumference (-1.21±0.22 kg and -2.7±0.3 cm; P<0.001), mean arterial blood pressure and MetS Z-score (-7.06±0.77 mmHg and -0.21±0.03; P<0.001). Only in the AIT group, CRF (i.e., VO2max) increased by 16% (0.30±0.02 mLO2·min-1; P<0.001). However, in AIT, CRF was not a predictor contributing significantly to MetS Z-score (R = -0.246; β = -0.002) while changes in body weight and POmax were contributing (R=0.508; β = 0.429 and R=-0.368; β = -0.193).
CONCLUSION: This prospective exercise intervention trial disputes a causal relationship between increases in CRF with exercise training and improvements in health risk factors in obese MetS individuals. In contrast, the body weight and fat losses with exercise seem to contribute to the improvements in MetS Z-score.

CARDIOVASCULAR DISEASE RISK FACTORS IN ADOLESCENT AND YOUNG ADULT SURVIVORS OF CHILDHOOD ACUTE LYMPHOBLASTIC AND ACUTE MYELOID LEUKAEMIA.

LONG, T.M., WALLMAN, K.E., WALWYN, T.S., CHOONG, C.S., NAYLOR, L.H.

THE UNIVERSITY OF WESTERN AUSTRALIA

INTRODUCTION: Leukaemia is the most common childhood cancer [1]. Although incidence is high, worldwide 5-year survival rates for the predominant diagnoses - acute lymphoblastic (ALL) and acute myeloid (AML) leukaemia - are approaching 90% and 65%, respectively [1]. However, leukaemia therapy is highly toxic to the developing organs and systems of children and many survivors develop late-effects that significantly increase the risk of cardiovascular disease (CVD) [2]. Furthermore, poorly organised transition periods from paediatric to adult care can result in a decline in, or complete loss of, long-term monitoring of health, further exacerbating this risk [1]. As a result, death rates from CVD among the adolescent and young adult (AYA) survivor population are significantly higher than those in the healthy population [2]. Modifiable risk factors for CVD include endothelial dysfunction, hypertension, overweight and obesity, and poor aerobic fitness [2]. Early detection of such factors allows for optimal intervention and a subsequent reduction in CVD risk. Here, we implemented a battery of health assessments to determine CVD risk in a combined group of ALL and AML survivors.
METHODS: Twenty three survivors (14 ALL, 9 AML; 11 female; age 19±3 y) were compared to 17 healthy controls (9 female; age 22±2). Resting blood pressure and heart rate (HR) were taken using an electronic cuff at the conclusion of a 20 min rest period. Following this, endothelial function was assessed using the flow mediated dilation technique. Standard procedures were used to measure anthropometry, while body composition was determined using dual x-ray absorptiometry. Aerobic fitness (VO2 peak) was assessed using a modified chronotropic treadmill protocol.
RESULTS: Compared to controls, survivors had greater total percent body fat (p=0.023), central percent body fat (p=0.036) and regional percent body fat (p=0.025). This was reflected in increased amounts of total fat mass (p=0.031), central fat mass (p=0.046) and visceral adipose tissue mass (p=0.017) and volume (p=0.017). Additionally, the survivors demonstrated elevated resting HR's (p=0.038), as well as decreased peak (p=0.002) and recovery (p=0.001) HR's in the VO2 peak assessment. Ratings of perceived exertion (p=0.043), minute ventilation (p=0.000), and VO2 peak (L.min-1, p=0.05; ml.kg-1.min-1, p=0.021) were also lower compared to controls.
CONCLUSION: This study demonstrated that AYA survivors of childhood ALL and AML are at a heightened risk of CVD compared to healthy controls as a result of excessive fat mass and poor aerobic fitness. These findings highlight the importance of early intervention to reduce the risk of CVD in this population.
1. Ward, E., et al., Childhood and adolescent cancer statistics, 2014. CA: a cancer journal for clinicians, 2014. 64(2): p. 83-103.
2. Oeffinger, K.C., et al., Cardiovascular Risk Factors in Young Adult Survivors of Childhood Acute Lymphoblastic Leukemia. Journal of Pediatric Hematology/Oncology, 2001. 23(7): p. 424-430.

PHYSICAL FITNESS AND QUALITY OF LIFE IN CANCER PATIENTS

REINICKE, M.1, ELLWANGER, N.1, HOFMANN, H.1, OBERHOFFER, R.1, SCHULZ, T.1

CHAIR OF PREVENTIVE PEDIATRICS

INTRODUCTION: Cancer is the second most frequent cause of death worldwide. Advances in medicine have led to a significant increase in survival in recent years (WHO, 2017). As a result, the factor of a good quality of life (QoL) for cancer patients is becoming increasingly important. Today, it is well known that physical activity improves QoL for individuals struggling with cancer (Rogers et al., 2016). Therefore, it is of interest to find out if the QoL in cancer patients can be further increased by enhanced physical fitness. The aim of this work was to compare the physical fitness level of cancer patients with different diagnoses (breast cancer/other cancer) and therapy status (therapy/post therapy) to find out if a higher fitness level caused by increased physical activity improves QoL.
METHODS: 72 subjects with different cancer diagnoses (51.6±12.7 years) participated in this cross-sectional study (April-August 2017). Participants were enrolled via Outdoor against Cancer and Bavarian Cancer Society and interviewed about their QoL using two questionnaires (SF-36 and QLQ-C30). Physical fitness was measured with four tests: handgrip and sit-to-stand test (strength), shoulder stretch

(flexibility) and 6-min walk test (endurance). Statistical analysis was performed by Mann-Whitney-U-Test and Spearman correlation. The significance level was set at p≤.05.
RESULTS: Mental health was negatively impaired in both groups compared to normative values (p<.05). All groups achieved significantly better results in physical functioning compared to reference values for cancer patients (p<.001). QoL in patients with breast cancer was significantly better compared to other diagnoses (p=.002). The more time patients spent in physical activity the better results in physical functioning were noticeable (r=.450, p<.001).
CONCLUSION: Physical fitness is positively associated with QoL in cancer patients. All subjects showed a similar good physical functioning compared to the general population and better results than other cancer patients that was even better when they were physical active regularly. On the other hand, all subjects had an impaired mental health compared to standard values of the normative population. Further investigations need to figure out how mental health in cancer patients can be improved.
REFERENCES:
WHO (2017). www.who.int/mediacentre/factsheets/fs297/en, accessed: 01.12.17
Rogers LQ, Courneya KS, Anton PM, Verhulst S, Vicari SK, Robbs RS, McAuley E (2016). Psychooncology 26 (11), 1901-1906.
CONTACT:
mascha.reinicke@tum.de

THE ASSOCIATION BETWEEN DIVERSITY OF PHYSICAL ACTIVITIES AND SELF-REPORTED MUSCULOSKELETAL PAINS

MÄKELÄ, S., AALTONEN, S., KORHONEN, T., MIKKELSSON, M., KUJALA, U., KAPRIO, J.
UNIVERSITY OF HELSINKI

The associations between diversity of sport activities and self-reported musculoskeletal pains
Mäkelä, S.1, Aaltonen, S.1, Korhonen, T.1, Mikkelsson, M.2, Kujala, U.3, Kaprio, J.1
1University of Helsinki, Finland, 2University of Tampere, Finland, 3University of Jyväskylä, Finland
Background
Low back pain (LBP) and neck-shoulder region pain (NSP) are public health problems causing large-scale disability and socio-economic burden. Cost-effective prevention is warranted, yet the widely studied risk factors, such as physical activity (PA), remain under debate. Our objective is to investigate the effect of PA on LBP and NSP from a relatively unexplored viewpoint, i.e. the association of diversity of sport activities with LBP and with NSP.
Methods: In the FinnTwin16 cohort study, twins (57% women) at the mean ages of 17 and 34 reported their participation in different leisure-time sport activities, categorized as 1, 2, 3, 4, and 5+ sport activities. In their mid-thirties, they reported the frequency of LBP (N=3361) and NSP (N=3368), categorized as seldom, monthly, or weekly. The severity of pain was not assessed. The associations of diversity of sport activities with LBP and with NSP were examined both in cross-section and longitudinally with multinomial logistic regression analyses, adjusted for multiple covariates. Due to an interaction effect between diversity of sport activities and work activity in LBP model, these analyses were conducted separately in three work activity groups. Furthermore, we conducted a conditional logistic regression model, for the twin pairs discordant for LBP (N=154) and for NSP (N=164), to explore the possible additional confounding due to familial factors.
Results: In the cross-sectional analyses, participation in 5+ sport activities, compared to single sport participation, associated with significantly less weekly LBP only among individuals with physically demanding work with OR 0.44 (95% confidence interval (CI), 0.21-0.90). For monthly LBP OR was 0.78 (CI 0.46-1.35). Yet, in the longitudinal analyses consistent participation in 5+ sport activities, compared to consistent single sport participation, in adolescence and mid-thirties related to significantly and substantially less weekly LBP in mid-thirties (OR 0.37, 95% CI 0.16-0.86).
On the contrary, no significant associations were detected between diversity of sport activities and NSP, in cross-section or longitudinally. The results of the within-pair analyses, limited by small sample size, did not replicate the results of the individual analyses.
Conclusions
Consistent diversity of sport activities from adolescence to mid-thirties may protect individuals from frequent LBP in their mid-thirties, and current diversity of sport activities can protect individuals with physically demanding work from frequent LBP. These associations may not be independent of shared familial factors.
Contact: sara.makela@helsinki.fi

DIFFERENTIAL EFFECTS OF RESISTANCE AND EDURANCE TRAINING ON GUT MICROBIOTA

FERNÁNDEZ-SANJURJO, M., FERNÁNDEZ, J., DÍEZ-ROBLES, S., TOMÁS-ZAPICO, C., LOMBÓ, F., FERNÁNDEZ-GARCÍA, B., VILLAR, C.J., IGLESIAS-GUTIÉRREZ, E.
UNIVERSITY OF OVIEDO

INTRODUCTION: Regular exercise shows a systemic beneficial effect on health, and it is strongly associated with a lower risk of mortality and lower incidences of chronic pathologies (1).
Several studies have described a relationship between endurance exercise and a variation on the diversity of gut microbiota (2, 3), which has been related to an improved health status and physical performance. However, the effect of resistance exercise is completely unknown.
The aim of this study was to compare the effect of resistance and endurance training on gut microbiota in mice.
METHODS: Twenty-five C57BL/6 male mice performed a 4-week training protocol, 5 days/week, after 2 weeks of adaptation. Mice were randomly assigned to either a non-exercised control group (CTL), endurance training on a treadmill (END) or resistance training on a vertical ladder at -5 degrees from vertical (RES).
The training programme was humanized and with increasing intensity during and along the weeks. In the case of END, the velocity in the treadmill varied between 15-40 cm/s and 50-60 minutes of duration. The RES group trained four days a week lifting weights attached to the tail ranging from 25-200% of their body mass. In the middle of the week a recovery training day was performed without external overload.
Mice followed the same standardized diet ad libitum.
To study gut microbiota, gDNA was extracted from frozen caecum feces using EZNA DNA Stool Kit. gDNA samples were PCR amplified following the protocol of Ion 16TM Metagenomics kit. PCR amplification products were sequenced using ION PGMTM Hi-QTM Sequencing Metagenomics kit on a ION 318TM Chip. The consensus table for each metagenomics was downloaded from ION Reporter 5.6 software and used for comparing individuals. For statistical purposes ANOVA with Dunnett's post-hoc test was used.

RESULTS: Both exercise models differentially changed the bacterial profiles of mice gut microbiota, without differences in dietary intake. Alpha diversity index revealed a higher diversity on microbial communities on END compared to CTL and RES. Endurance training significantly increased bacterial phylum Tenericutes, as previously described (2) and families Anaeroplasmataceae, Oxalobacteraceae, Desulfovibrionaceae and Erysipelotrichaceae, while decreased Lactobacillaceae family. On the other hand, resistance training significantly increased Peptococcaceae, Veillonellaceae and Erysipelotrichaceae families. Other significant alterations were observed at the genus and species levels of taxonomy, some of them related to intestinal inflammation and gut immune cell homeostasis. Interestingly, significant correlations between relative proportion of specific taxa and performance improvements were observed.
CONCLUSION: Resistance and endurance training modify gut microbiota but diverge on defining specific profiles.
1. Hawley JA, et al. Cell. 2014;159(4):738-49.
2. Allen JM, et al. J Appl Physiol. 2015;118(8):1059–66.
3. Barton W, et al. Gut Published Online First: 30 March 2017.

HIGHER CIRCULATING ANDROGENS AND PHYSICAL ACTIVITY LEVELS ARE ASSOCIATED WITH LESS CENTRAL ADIPOSITY AND LOWER RISK OF CVD EVENTS IN OLDER MEN.

CHASLAND, L.C., KNUIMAN, M.W., DIVITINI, M.L., MURRAY, K., HANDELSMAN, D.J., RIDGERS, N., NAYLOR, L.H., YEAP, B.B., GREEN, D.J.

SCHOOL OF HUMAN SCIENCES , UNIVERSITY OF WESTERN AUSTRALIA, PERTH.

INTRODUCTION: As men age, testosterone (T) levels decline and the incidence of cardiovascular disease (CV) disease rises. Low T is associated with increases in fat mass and decreases in muscle strength and bone mineral density (1), which all respond positively to physical activity (PA) (2). We assessed whether higher circulating sex hormones and higher PA levels were additively associated with lower indices of central adiposity and metabolic syndrome, and whether these factors predict CVD events and mortality.
METHODS: A total of 3,351 men were included in the analysis. Mean age was 77 years at baseline, with 865 CVD events and 499 CVD deaths occurring during 10-year follow-up. Baseline T, dihydrotestosterone (DHT), estradiol (E2), sex hormone-binding globulin (SHBG) and luteinizing hormone (LH) were assayed and free T calculated (cFT). Levels of PA were ascertained via questionnaire. Men were stratified using median splits into high hormone+high PA (H/H), high hormone+low PA (H/L); low hormone+high PA (L/H) and low hormone+low PA (L/L) groups.
RESULTS: Men with higher T, cFT, DHT or SHBG and higher PA had the lowest BMI, waist circumference and risk of metabolic syndrome. Men with higher T or cFT had the lowest risk of incident CVD events, irrespective of PA level (e.g. hazard ratios for T/PA H/H 0.811 p=0.032; H/L 0.730 p=0.002; L/H 0.896 p=0.240; L/L 1.00). Men with higher T, cFT or DHT, and higher PA, had the lowest risk of dying from CVD (e.g. hazard ratios for T/PA H/H 0.757 p=0.031; H/L 0.854 p=0.222; L/H 0.800 p=0.075; L/L 1.00).
CONCLUSION: In older men, higher PA levels and higher circulating androgens are associated with less central adiposity and lower CVD risk. A randomised trial is needed to assess the effect of combining exercise training and T therapy on CVD risk in men.
References: 1. van den Beld AW, et al. Measures of bioavailable serum testosterone and estradiol and their relationships with muscle strength, bone density, and body composition in elderly men. JCEM. 2000;85:3276-82.
2. Nelson ME, et al. Physical activity and public health in older adults: recommendation from the ACSM and AHA. Circ. 2007;116:1094-105.

ANTI-FIBROTIC EFFECTS OF EXERCISE TRAINING COMBINED WITH 17B-ESTRADIOL ON OVARIECTOMIZED RAT HEARTS.

LIN, Y.Y., YANG, A.L., LEE, S.D.

CHINA MEDICAL UNIVERSITY

INTRODUCTION: Estrogen deficiency at menopause could cause left ventricular hypertrophy and systolic dysfunction as well as potentially develop heart failure. 17β-estradiol (E2) or exercise training is well known to provide protection against cardiovascular disease. The purpose of this study was to investigate whether combined 17β-estradiol (E2) and exercise training is better than 17β-estradiol (E2) treatment alone on cardiac anti-fibtotic effects in ovariectomized rats.
METHODS: Histopathological analysis, TUNEL assay, and Western blotting were performed on the excised hearts from four groups of female Sprague–Dawley rats, which were divided into a sham-operated group (Sham), a bilaterally ovariectomized group (OVX), an OVX treated with 17β-estradiol (OVX-E2; 10mg/kg/day, s.c.), and an OVX with 17β-estradiol and treadmill exercise training (OVX-E2-EX; 60 min/day, 5 days/week) for 10 weeks.
RESULTS: The OVX group exhibited abnormal myocardial architecture and interstitial fibrosis relative to Sham group, whereas those parameters were improve in either the OVX-E2 or OVX-E2-EX group when compared with OVX group. After ovariectomy caused the protein levels of ERα and ERβ to become more decreased in the OVX group compared with Sham group, whereas those were significantly increased in either the OVX-E2 or OVX-E2-EX group when compared with OVX group. The protein levels of AT1R, TGF-β, p-JNK, CTGF and MMP9 were increased in the OVX group compared with Sham group, whereas those were significantly decreased in either the OVX-E2 or OVX-E2-EX group compared with OVX group. Furthermore, when compared with the OVX-E2 group, the protein level of ER-β was further enhanced in OVX-E2-EX group as well as the protein levels of AT1R, TGF-β, CTGF and MMP9 were further decreased in the OVX-EX-E2 group.
CONCLUSION: Our results suggest that combined 17β-estradiol (E2) treatment and exercise training exhibited sub-additive protective effect on ovariectomy-induced cardiac fibrosis through suppressing TGF-β/CTGF–driven fibrotic pathways in ovariectomized rats, which might provide a more effective therapeutic effect than 17β-estradiol (E2) treatment alone in menopausal or bilaterally oophorectomized women.
REFERENCES:
Mori T, Kai H, Kajimoto H, Koga M, Kudo H, Takayama N, Yasuoka S, Anegawa T, Kai M, Imaizumi T. (2011). Hypertension Research, 34, 496–502
Atsma F, Bartelink ML, Grobbee DE, and van der Schouw YT. (2006). Menopause 13, 265-279.
Haddock BL, Marshak HP, Mason JJ, Blix G. (2000). Sports Med, 29(1), 39-49.

BRAIN MONOAMINE AND BLOOD HORMONE MEASUREMENTS IN GROUP HOUSED RATS

YANAGITA, S., KUBOTA, N.
TOKYO UNIVERSITY OF SCIENCE

INTRODUCTION: Measuring monoamine and blood hormone such as glucocorticoid and ACTH is essential for studying psychological disorders. Numerous studies using laboratory rodents have shown that physical exercise could change the function of monoamine transmissions and/or blood hormone secretions, and then it have beneficial effects to improve the psychological disorders. However, current methods are either using laboratory rodents that individually housed in the cage with attached running wheel or group housed rodents performing treadmill running in another environments. Because laboratory rodents are social animals, these unnatural experimental conditions might influence the outcomes of physical exercise for psychological disorders and its underlying physiological mechanisms such as monoamine transmissions and hormone secretions. In order to improve this issue, it is necessary to conduct new experimental condition that enable rats to live socially and to perform exercise voluntary. In this study, we performed a high resolution, high fidelity assessment of social homecage behavior using radio-frequency identification (RFID) tags to constantly track the position and movements of rats in a social and group housing cage (three rats per cage) with attached running wheel. This study explores the connections between social group- housing, and neuroendocrine functions, and how these traits are influenced by spontaneous physical activity.
METHODS: Wistar rats were implanted with microchips subcutaneously providing each with a unique identification number and group-housed in plastic cages with running wheel. Each cage was equipped to monitor an individual animal's access to running wheel using RFID system. Daily wheel revolutions in each cage were recorded digitally from counters attached to the running wheel. Four weeks later, we obtained a lot of sequential data of individual access to running wheel in group housing by RFID system, and estimated individual running distance to be calculated by multiplying wheel circumference by the number of revolutions based sequential access data.
RESULTS: The result from our behavioral monitoring system using RFID technology numerically showed individual differences in wheel running activity in group housing condition, suggesting that application of RFID technology to laboratory animal study could reveal novel behavioral aspects in group housing condition. The results from measurements of brain monoamines and blood hormone showed considerable differences between group housed- and individual housed- rats.
CONCLUSION: The results of this study indicate that actually social and group housing can influence neuroendocrine functions enhanced by voluntary wheel running, and suggest that it is necessary to use group housing conditions in order to examine the effects of physical exercise for psychological disorders.

Mini-Orals

MO-BN07 Testing and training muscle strength

RELATIONSHIP OF REACTIVE STRENGTH INDEX MODIFIED WITH ANTHROPOMETRIC MEASURES AND BODY COMPOSITION IN JUNIOR ATHLETES

PETRIDIS, L., KALABISKA, I., UTCZÁS, K., TRÓZNAI, ZS, PÁLINKÁS, G., SZABÓ, T.
UNIVERSITY OF PHYSICAL EDUCATION

INTRODUCTION: Reactive strength index modified (RSImod) is used as a measure of explosiveness and is calculated by dividing jump height with the time to takeoff during a countermovement jump. Body composition and body dimensions may have a direct or indirect effect on RSImod. An increase in muscle mass, and thus in strength, can help to increase performance in explosive movements, whereas body height may negatively affect the ability of an athlete to perform a rapid countermovement and therefore decrease time to takeoff. The purpose of this study is to examine the relationship of RSImod with anthropometric measures and body composition in elite junior athletes.
METHODS: 86 male athletes (16.5±1.0 years old) were measured participated in soccer (n=50), handball (n=18) and basketball (n=18). Body height (BH), body weight (BW), sitting height, thigh length, calf length were collected according to the Martin method. Body composition was measured using Dual Energy X-ray Absorptiometry (Lunar Prodigy). Countermovement jump was measured on a force platform (HUR labs, model FP4). The athletes performed three maximal vertical jumps with one minute passive rest between the jumps; the best jump was recorded for statistical analysis. Time to takeoff was calculated from the start of the countermovement to the instant of takeoff. Three groups were formed based on the mean±0.5sd in RSImod: low RSImod group (mean: 0.34±0.05 m/s; n=27), mid RSImod group (mean: 0.45±0.03 m/s; n=32) high RSImod group (mean: 0.57±0.06 m/s; n=26). Descriptive statistics and ANOVA for inter-group comparisons were performed in Statistica 13.2 software.
RESULTS: Low RSImod group had a slightly higher BW and BH, however there were no differences between the three groups in none of the examined anthropometric measures. Significant difference was found in legs and total body fat mass (FMtotal) in both absolute and relative to BW values. Low RSImod group had higher values compared to the mid and high RSImod groups (FMtotal: 14.9±8.0 vs. 10.9±2.7 and 10.5±2.0 kg respectively or 22.1±6.4 vs. 18.3±3.4 and 17.2±2.7 percent of total BW). There were no differences between the mid- and high RSImod groups. Lean body mass (LBM) differed significantly only as a percentage of total BW; low RSImod group had lower percentage compared to the mid and high RSImod groups (LBM: 76.6±6.1 vs. 80.3±2.7 and 80.9±1.9 percent respectively).
CONCLUSION: Our data suggest that RSImod is not influenced by body dimensions, thus taller of heavier athletes can also achieve high values in RSImod or short times in time to takeoff. Body composition has a significant effect in RSImod, absolute and relative fat mass negatively affects the ability to perform an explosive vertical jump. Lean body mass results indicate that strength and conditioning training should be aiming to obtain an optimal muscle mass, emphasizing, besides the hypertrophy aspects, also the neuromuscular adaptations of strength training.

RELATIONSHIP BETWEEN HAMSTRING ISOMETRIC STRENGTH, FRONTAL PLANE CORE STRENGTH AND DYNAMIC VALGUS DURING A BILATERAL VERTICAL JUMP IN ADOLESCENT FEMALE SOCCER PLAYERS.

BIKANDI, E.

ATHLETIC CLUB DE BILBAO

INTRODUCTION: Due to the devastating impact of the ACL injury on the athlete´s career, many multifactorial prevention screenings have been widely designed specially in female soccer, in order to reduce injury incidences. Functional, biomechanical and neuromuscular contributors have been described. Among the latest, lower limb strength and jumping mechanics, are considered as the main factors that should be evaluated during any ACL injury risk screening procedure. The causal relationship between maximal hamstring muscle force output, frontal plane core strength and knee valgus excursion during the vertical bilateral drop jump (VBDJ) remains controversial. Thus, the objective of this cross-sectional preliminary study was to analyse if players demonstrating greater valgus angular excursions would present with significant correlations with hamstring and or core strength related variables.
METHODS: 19 adolescent female soccer players (age 18,5 1,56) completed a pre-season ACL injury prevention screening conformed by functional, biomechanical and performance testing battery. Bilateral hamstring isometric peak torque (HPT) at 30º knee flexion and 90º hip flexion (long fascicle length), proximal hip muscle abduction strength and core complex stabilization capability in the Side Bridge Test (SBT) and dynamic knee valgus angle (KVA) during a vertical bilateral drop jump landing were registered. Strength measures were normalized by weight. Correlation and significance level between variables interaction were analysed.
RESULTS: Significant correlation at p = <0,05 significance level was observed between SBT and KVA of the left limb (r = -0,537; p = 0,018). Other significant correlations were detected among limb sides in hamstring and hip abduction peak torque, resulting irrelevant for a subsequent interpretation.
CONCLUSION: A considerate level of relation between the hip-trunk-core complex stability and knee valgus angular excursion was the main finding at the present study. According with previous research, the neuromuscular performance of the proximal lower limb segment may influence knee stability during dynamic tasks. However, higher hamstring isometric muscle strength values does not seem to be related to a reduced valgus collapse, exemplifying the controversy existing through the literature. Thus, more exhaustive screening methodologies with stronger measurement procedures are needed in order to detect the main contributors for ACL injury mechanics.

MUSCLE ACTIVITY AND FORCES DURING TRADITIONAL AND SUSPENDED LUNGE

AGUILERA-CASTELLS, J.1, PEÑA, J.3, SOLANA-TRAMUNT, M.1, FORT-VANMEERHAEGHE, A.1,2, MORALES, J.1, BUSCÀ, B.1

1: FPCEE BLANQUERNA RAMON LLULL UNIVERSITY , 2: FCS BLANQUERNA RAMON LLULL UNIVERSITY , 3: UNIVERSITY OF VIC

INTRODUCTION: The assessment of muscle activity and forces had been examined in different upper body exercises like push-ups, inverted row and plank , all of these performed in traditional and suspended conditions. In lower body exercises, Malliaropoulos et al. <2015> assessed the suspension device effect on muscle activity in hamstring curl exercise. However, it seems that there is a lack of evidence about the effect of using a suspension device in the lower body exercises. Thus, the aim of the study was to compare the muscle activation and vertical ground reaction forces when performing traditional lunge and suspended lunge exercises .
METHODS: Ten physically male subjects performed five TL and five SUL. SUL was performed using a TRX Suspension Trainer . Surface electromyography was used to measure the muscle activation and expressed in normalized value <% Maximum Voluntary Isometric Contraction>. The analysed muscles were rectus femoris, biceps femoris, gluteus medius, vastus medialis and lateralis. VGRF <% body mass resistance> were assessed using a Wii Balance Board . Paired samples T- tests were used to determine the exercise conditions effects. EMG and forces values were expressed as mean ± SD.
RESULTS: For the analyzed muscle, biceps femoris showed a significant greater activation during TL in comparison with SUL; t<9> = 3.890, p<0.05. However, no significant activations for quadriceps and gluteus medius were found, but overall mean of all muscles revealed significant differences between TL and SUL; t<9> = 3.267, p<0.05. SUL showed a significant higher VGRF in comparison with TL; t<9> = -3.251, p<0.05.
CONCLUSION: According to Andersen et al. <2014>, biceps femoris activation increases in a TL in comparison with unstable lunge. It seems that SUL condition did not provoke the appropriate degree of instability to lead changes in muscle activation. Conversely, VGRF was higher in SUL, due to body mass resistance is projected in the forward leg, thus body load in TL is more balanced between rear and forward leg. Further research is needed to make a comparison.
REFERENCES:
Andersen, V., Fimland, M. S., Brennset, O., Haslestad, L. R., Lundteigen, M. S., Skalleberg, K., & Saeterbakken, A. H. <2014>. Int. J. Sports. Med., 35<35>, 1196–1202.
Malliaropoulos, N., Panagiotis, T., Jurdan, M., Vasilis, K., Debasish, P., Peter, M., & Tsapralis, K. <2015>. Open Access J. Sport. Med., 26<6>, 209–217.
Mok, N. W., Yeung, E. W., Cho, J. C., Hui, S. C., Liu, K. C., & Pang, C. H. <2014>. J. Sci. Med. Sport., 18<2>, 189–194.
Contact: joanac1@blanquerna.url.edu

PERCEIVED LOADING AND MUSCLE ACTIVITY DURING PULL DOWN EXERCISES: COMPARISON OF ELASTIC RESISTANCE BAND AND MACHINE EXERCISES

CHIU, S.C., LEE, H.J.

NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: Upper body strength training can be performed using a broad variety of different exercises, including machines with self-selected workload or using participant own individually bodyweight as workload. Some studies have demonstrated exercises with elastic resistance band , which can be a feasible alternative to heavyweights in certain situations. Previous research has shown that both lat-pull down and chin-up exercise can exhibit unique training stimulus. However, there is limited research regarding the comparison of muscle activations between pull-down exercises by using LPD machine and ERB. Therefore, the purpose of this study was to compare muscle activity of upper back muscles between two pull down exercises by using LPD machine and ERB.
METHODS: There were 10 healthy males with at least 12 months of resistance training experience participated in the study. EMG activities were recorded from 5 muscles at the upper body during pull-down exercise, using ERB and LPD machines. These recordings were normalized to EMG signals during maximal voluntary contraction. Five muscles have been analyzed during two pull down exercises were latissimus dorsi , pectoralis major , biceps brachii , triceps brachii , and posterior deltoid. The exercises were performed at four levels of

perceived loading reported using the Borg scale of perceived exertion: light , moderate 2–<5>, heavy and near maximum . One-way Anova with repeated measures was conducted for statistical analysis.
RESULTS: Strong associations were observed between perceived loading and EMG signals during the pull-down exercises with ERB as well as in LPD machine. Average normalized EMG showed significant greater muscle activations in the eccentric phase than in concentric phase in both LPD and ERB exercises. For ERB, TB was greater than BB and PM in the concentric phase, whereas TB, LD, PD were greater than BB and PM in the eccentric phase in level moderate, heavy and near maximum. For LPD, BB was greater than LD in the concentric phase in all levels, whereas PM was greater than LD, TB in the eccentric phase in level near maximum. Overall, the results showed that using ERB could facilitate a higher level of muscle activations for upper back muscles.
CONCLUSION: ERB may be able to increase muscular strength of the upper back and arm muscles similar to that of the LPD exercise. This study identified that greater normalized EMG values were found for the TB, LD, and PD during ERB than during LPD. Current results indicated that ERB creating an unstable condition which would require more efforts for the muscle to control and execute. Therefore, significant muscle activations were required to maintain stability throughout the ERB exercises. As a result, ERB could be a useful alternative training method to an LPD exercise, especially when the availability of training equipment is limited.

PREDICTION OF STRENGTH PERFORMANCE BY THE ANALYSIS OF ANTHROPOMETRIC VARIABLES AND AGE

ISENMANN, E., INGLESON, F., FLENKER, U., HETTENKOFER, C., DIEL, P.
INSTITUTE OF CARDIOVASCULAR RESEARCH AND SPORTS MEDICINE,GERMAN SPORT UNIVERSITY

INTRODUCTION: Comparing individual strength performance in human studies has proven to be quite difficult as there are many influencing factors. Bodyweight has been identified to be a strong predictor of strength performance. However the influence of anthropomorphic variables, like length of leg or arm and age has only been marginally investigated so far. The aim of this study was to analyse the influence of specific variables (age, individual length of the body levers used and individual bodyweight) on strength performance using statistical analysis.
METHODS: 160 healthy male subjects with barbell experience were recruited. Age was recognised and bodyweight, length of the femur and total arm length were measured. The subjects performed either a one repetition squat or a one repetition bench press or both at their individual maximum power.
Force (F, expressed in kg lifted, one repetition maximum) was modeled by multiple linear regression. The investigated independent variables were age [y], weight [kg], and for the levers depending on the exercise, length of the femur (LF) or of the total arm (LA), respectively. The software was R in its latest version. Regression models generally were fitted top-down. Starting from the full model, insignificant terms were stepwise removed. Models were then compared by ANOVA.
RESULTS: The multiple R-squared of the model fitted to the squats data is 0.98. LF and allometrically scaled weight (W2/3) are highly significant. By contrast, age turned out to be fully insignificant in combination with LF and W2/3.The multiple R-squared of the model fitted to the bench press data is 0.41. All factors, Age, LA, and W are required and are statistically significant. The effect of age exhibits curvature and can well be described by incorporation of a second order term (Age2). Moreover, sufficient quality of fit requires an intercept.
CONCLUSION: In the squat performance, there is a clear influence of the length of the femur and the body weight both being statistically significant with $p<0.001$ which is again emphasized through the multiple R-squared. Age has no influence, which might be lead back to the small number of subjects or to the subjects being homogenous in regard to age. However, in the bench press performance all three variables show to have a highly significant influence. Following these results more data sets needs to be analysed in order to fully exclude age as an influencing variable on strength performance in squats. Furthermore, it can be said that there is a necessity to include these variables when comparing human strength performance. An outlook hereunto would be a formula combining all three variables to result in a coefficient that could be used to rank each subject on the basis of these variables in their individual strength performance.

CONCENTRIC AND ECCENTRIC ISOKINETIC PERFORMANCE OF SHOULDER EXTERNAL AND INTERNAL ROTATORS IN CHINESE ADOLESCENT VOLLEYBALL ATHLETES

REN, X.
SHANGHAI RESEARCH INSTITUTE OF SPORTS SCIENCE

INTRODUCTION: Volleyball is a sport characterized by overhead throwing actions. Chinese athletes start volleyball training and participating in high –performance sports in early childhood. Sport-specific adaptations at the glenohumeral joint could occur in adolescent volleyball athletes. The main of this study is to analyze the concentric and eccentric muscular performance of shoulder external rotators and internal rotators in the Chinese adolescent volleyball athletes.
METHODS: Thirty adolescent volleyball athletes （20 males, 10 females age = 16.33 ± 1.67years, height = 190.13 ± 7.67 cm, mass = 76.67 ± 10.71 kg, body mass index = 21.17± 2.36 kg/m^2） were tested. Concentric and eccentric isokinetic internal and external strength were measured at 60°/s using Iso-Med 2000. The measurements were taken with the participants in a seated modified neutral position, with 90° of elbow flexion, 30° of glenohumeral joint flexion, and 30° of glenohumeral abduction; the participants wore stabilization straps across the hip and upper body. Gravity compensation was employed. Concentric and eccentric strength of the shoulder internal and external rotators and total ROM were tested bilaterally.
RESULTS: The mean of total ROM was 94.6°± 1.04°in the dominant shoulder, 96.07°±0.91° in the non-dominant shoulders. The total ROM was less in the dominant shoulder. The mean peak torque （PT） of concentric IR's and ER's were 38.17±10.46N/M and 26.43±8.85N/M in the dominant shoulder, 37.67±11.12N/M and 29.73±8.85N/M in the non-dominant shoulder. The mean PT of eccentric IR's and ER's were 27.47±8.87N/M and 35.03±11.28N/M in the dominant shoulder, 29.87±8.78N/M and 31.13±9.17N/M in the non-dominant shoulder. There were no significant differences between D and ND in the concentric and eccentric PT of IR and ER. The concentric strength ratios of ER/IR were 0.70±0.16 in the dominant shoulder, 0.82±0.26 in the non-dominant shoulder. Eccentric ER-to concentric IR strength ratio was 0.92 ±0.18 in the dominant shoulder, 0.85±0.20 in the non-dominant shoulder.
CONCLUSION: Chinese adolescent volleyball players had a good performance of concentric and eccentric strength, and proper ratios of ER/IR and eccentric ER to concentric IR. However the total ROM in the dominant shoulder was less in the non-dominant shoulder. In order to prevent shoulder injuries, improving the ROM of dominant shoulder and routine screening to keep the performance of the strength.

ACUTE EFFECTS OF WHOLE BODY ELECTRO STIMULATION DURING A SINGLE MAXIMAL STRENGTH TRAINING SESSION

BURGOS POSTIGO, S., TOBIA, D., RECAREY, A., FERNÁNDEZ-RODRÍGUEZ, A., FERNÁNDEZ-ELÍAS, V.E.

UNIVERSIDAD EUROPEA DE MADRID

INTRODUCTION: Whole body electrostimulation (WB-EMS) devices have been used in both performance and health related training programs and the scientific literature has shown that it can be an effective tool to improve training adaptations. However, WB-EMS efficiency is being questioned nowadays. Further, it has been suggested that WB-EMS could lead to excessive physical strain and health problems due to the lack of a scientific based specific WB-EMS training method and professional formation of coaches. The aim of this study was to assess the training effects of two protocols of WB-EMS during a single maximal strength session.
METHODS: Eleven subjects with previous experience in strength training of 3-5 days/week during, at least, the past 3 years participated in the study. They performed a familiarization trial with the WB-EMS device and a 1RM test based on mean propulsive velocity analysis for bench press and full-squat to stablish their 90%1RM load. Then, subjects performed three maximal strength sessions consisting of 5 sets of 5 repetitions with 3 minutes of rest between sets of bench press and full-squat using different protocols: WB-EMS with continuous stimulus (85 Hz, 250/350 µs ; Cont-EMS), WB-EMS with stimulus coordinate with the movement concentric phase (85 Hz, 250/350 µs, 1 s strain to 2 s rest; Coord-EMS) and a session without WB-EMS (No-EMS).
RESULTS: During sessions, heart rate, peripheral capillary oxygen saturation and perceived exertion showed no significant differences. Also, no differences were found among trials in heart rate variability, squat jump, countermovement jump, Abalakov jump, handgrip and frequency of striking for 5 seconds. Blood lactate (BL) was significantly increased only after Coord-EMS (1.8 ± 2.2 mmol/L: $p<0.05$). Creatine kinase increased significantly immediately after Cont-EMS (12.3 ± 16.7 IU/L) and No-EMS (30.6 ± 47.0 IU/L; $p<0.05$), but not after Coord-EMS (4.5 ± 39.5 IU/L). No differences were found in CK levels 24 after training sessions.
CONCLUSION: According to these data, strength training with WB-EMS device did not mean risk for athlete´s health, in fact, the greatest increased in CK level after training was produced after No-EMS training. In the other hand, BL was higher after Coord-EMS, this could mean that coordinating the electrostimulation with the movement concentric phase provokes a higher impact training due to larger anaerobic effect.
This study was partially supported by Myofx. Authors declare no conflict of interests.
References: Filipovic, A. et al. J Sports Sci Med. 2016; 15(4):639-648
Herrero, A. et al. Rev Andal Med Dep. 2015; 8:155-162
Pallarés, J.G. et al. J Sports Sci. 2014;32(12):1165-1175

DIFFERENTIAL NEUROMUSCULAR RESPONSES TO EXPLOSIVE VS HEAVY RESISTANCE TRAINING IN STRENGTH-TRAINED MEN

VAJDA, M., SCIBRÁNI, A., BUZGÓ, G., CVECKA, J., VANDERKA, M., SEDLIAK, M., KAMPMILLER, T.

COMENIUS UNIVERSITY

INTRODUCTION: This study examined the effects of a 6 weeks explosive resistance training (EXPLO) versus heavy resistance training (HYP) on neuromuscular adaptation in young strength-trained men.
METHODS: Thirty eight physical education students, who experienced at least 6 months of resistance training during the last 2 years, were assigned to perform either EXPLO (load 50–60% of 1RM, 6-20 reps, 2–3 sets and 90 s/5 min rest) or HYP (load 75–80% of 1RM, 8–10 reps, 3–4 sets and 90 s rest) training program with progressive overload for 3/wk on nonconsecutive days. Neuromuscular responses were assessed through isometric maximal voluntary contraction (MVC) and the rate of force development (RFD) in half squat position, the power output (Pmean) with 40 kg, 60 kg, 80 kg and 100 kg barbell in half squat jump and one repetition maximum (1RM) in bench press.
RESULTS: There was an increase of the MVC in both EXPLO and HYP (Main effect, $p=0.007$, T-test HYP $p=0.022$). Also, the Pmean was improved significantly for EXPLO with 60 kg, 80 kg and 100 kg (T-test, $p=0.007$, $p=0.002$, $p=0.002$) but not for HYP with time × groups interaction with 60 kg ($p=0.008$) and 80 kg ($p=0.001$) barbell. Finally, the 1RM was improved in both EXPLO and HYP (Main effect, $p=0.003$, T-test, EXPLO $p=0.002$, HYP $p=0.002$).
CONCLUSION: In conclusion, the present training programs were designed to be as similar as possible to those used in practice in strength and explosive training among recreational and elite athletes, for increasing strength and power output. Our results indicate that the 6 week explosive resistance training induce improvements in maximal strength and power, without the negative effect on ability to produce power associated with heavy resistance training. Therefore, our explosive resistance training program may be a practical and widely applicable form to accelerate power development and strength gains in a short-term training cycle.

EVALUATION OF ISOKINETIC CONTRACTION AND BALANCE, MUSCLE ACTIVITY AND FOOT PRESSURE DURING WALKING IN PATIENTS WITH FUNCTIONAL ANKLE INSTABILITY

LEE, S.A.1, KIM, A.R.2, YOO, K.T.2, LEE, H.S.1

1: DANKOOK UNIVERSITY, 2: NAMSEOUL UNIVERSITY.

INTRODUCTION: Functional ankle instability (FAI) patients exhibit during walking are not only different than healthy counterparts, but it has no regard to inappropriate coping strategy may have negative consequences for ankle rehabilitation (Feger et al., 2015). Accordingly, dynamic stability such as walking must be assessed when researching FAI. Moreover, although several functional assessment tools of strength and balance in patients with FAI have been suggested (Susanne et al., 2011), the relationship between the dynamic stability deficits and FAI during walking has not been clearly delineated in the studies. Therefore, the purpose of this study was to investigate to evaluate of the isokinetic contraction and balance, muscle activity and foot pressure during walking in patients with FAI.
METHODS: Nine healthy subjects (CON = 9) without FAI and 11 patients (FAI = 11) with FAI participated in the study after they had been screened for the ankle instability instrument and balance error scoring system. In addition, FAI was classified to non-involved (N-FAI) and involved (I-FAI), and dominant and non-dominant as CON. All subjects were evaluated isokinetic contraction (plantar flexion, dorsiflexion, inversion, and eversion of 30˚/sec and 60˚/sec) and balance (static and dynamic), muscle activity (tibialis anterior, peroneus longus and gastrocnemius) and foot pressure (static and dynamic) during walking.
RESULTS: The results showed that the plantar flexion ($p<0.05$), dorsiflexion ($p<0.05$), inversion ($p<0.01$) and eversion ($p<0.001$) of 60˚/sec, gastrocnemius of dynamic muscle activity ($p<0.01$), anterior posterior of weight distribution of static foot pressure ($p<0.001$), and pressure distribution of dynamic foot pressure ($p<0.001$) were significantly decreased in I-FAI than N-FAI. C90 of static balance with the eyes

opened (p<0.01) and closed (p<.001) were significantly increased in FAI than CON. Forward position of dynamic balance (p<0.01) was significantly decreased in FAI than CON.
CONCLUSION: Generally, FAI relates to muscle strength and proprioception of the ankle joint (Tabrizi et al., 2000), and the decreased muscle strength of the ankle while standing and walking was reported to be a compensatory mechanism in response to the displacement of the center of pressure (COP) (Donath et al., 2016). Thus, the decreased muscle strength might be associated with caused flexion of the ankle and hip joints to increase the shifting of the forward of COP (Rachel et al., 2018). According to previous study, during walking, the muscles that seemed the most affected for the FAI are the gastrocnemius and peroneus longus (Moisan et al., 2017). With regard to kinematic parameters, an increased rearfoot inversion, a more externally rotated shank, an increased ankle joint inversion, a decreased ankle joint dorsiflexion and a greater forefoot inversion were observed during walking cycle in the FAI. Our results seem to suggested that patients with FAI undergoing proprioceptive and neuromuscular deficits of the ankles.

ALTERATIONS IN RELATIVE LEG STIFFNESS AND REACTIVE STRENGTH INDEX DURING A TYPICAL TRAINING WEEK IN ELITE YOUTH SOCCER

DE STE CROIX, M.B.A., LEKUE, J., CALLEJA-GONZALEZ, J., MARTIN GARECHANA, I., O'DOHERTY, P., RITSON, D.C., MOSQUEIRA, M., HUGHES, J.D.

UNIVERSITY OF GLOUCESTERSHIRE

INTRODUCTION: Soccer matches can elicit exercise induced changes in neuromuscular function which can be attributed to the high physical demands of landing, accelerating and decelerating experienced during match-play. Evidence shows that neuromuscular parameters may not return to baseline prior to the next competitive match. Even within youth soccer the pressure to re-perform on a weekly basis, means that recovery durations may be shorter than 72 h due to the need to train during the week leading up to subsequent matches. The congested nature of training and matches may increase the risk of injury incidence in maturing players. Increased incidence of injury has been reported during the later stages of training and competition when fatigue is evident, however few studies have tracked neuromuscular recovery after match-play and during the subsequent training week, whilst determining the weekly training load. Therefore, this study sought to explore the potential time frame for neuromuscular variables to return to pre-game levels in elite youth players following competitive match-play and during a typical training week.
METHODS: 44 elite male soccer players were split into three age groups according to chronological age (U13 n = 16; U15 = 13; and U17 n = 15). Relative leg stiffness (RLS) and reactive strength index (RSI) were taken pre-, immediately post competitive match-play and pre-training on 3 occasions (48 h, 72 h and 120 h) during the training week and pre- a 2nd match (168 h). Match and training activities were collected using global positioning system (GPS) (StatSport).
RESULTS: Significant time effects were reported for leg stiffness (P = 0.011). All age groups reported a significant decrease in RLS immediately post-match. RLS was significantly lower than pre-match 1 at all training sessions and before the next competitive match. There were no significant age group differences in RLS at any time point (P > 0.05). There we no significant interaction effects for time*group or main effects of time for RSI. Percentage change in RLS and RSI from pre-match 1 to pre-match 2 was not correlated to total distance covered, total number of accelerations, total number of decelerations or total number of sprints (determined from match 1 and all training sessions).
CONCLUSION: In conclusion 7 days may be insufficient for stretch shortening cycle recovery in youth male soccer players. The reduction in leg stiffness at training sessions and subsequently before the next competitive match may have implications for sprint and jump performance and injury risk. It appears that load parameters, including total distance covered, total number of sprints, accelerations and decelerations are not related to the decrease in RLS. Therefore, specific monitoring strategies to assess neuromuscular recovery between match-play and subsequent training sessions should be considered to track recovery and potentially maintain performance and reduce injury risk.

Mini-Orals

MO-SH03 Performance and training

HOW TO SERVE FASTER IN TENNIS: THE INFLUENCE OF AN ALTERED FOCUS OF ATTENTION AND AUGMENTED FEEDBACK ON SERVICE SPEED IN ELITE PLAYERS.

KELLER, M., KUHN, Y.A., LÜTHY, F., TAUBE, W.

UNIVERSITY OF BASEL

INTRODUCTION: Different approaches such as providing augmented feedback (AF), adopting an external focus of attention (EF), or grunting have been shown to directly enhance performance in recreational athletes [1-3]. Furthermore, in recreational athletes combining AF and EF (AF+EF) was superior compared to AF and EF alone [4]. Here we test in elite tennis players the influence of AF, EF, AF+EF and an internal focus (experiment 1) and grunting (experiment 2) on service speed.
METHODS: In both experiments, elite players were asked to serve to a target zone with maximum speed. Service speed was measured using a speed gun. The precision of the players was evaluated by the number of serves that were landed in the target zone.
RESULTS: In experiment 1, a significant main effect of condition was found ($p \leq 0.001$). Post-hoc comparisons revealed faster serves for AF compared to control serves without instruction/feedback ($p < 0.01$) and compared to EF ($p < 0.05$), whereas no significant difference was found between EF and IF ($p = 0.81$). The fastest service speeds were found in the AF condition, while the combination of AF+EF did not further promote performance. In experiment 2, players served significantly faster when grunting compared to a condition without grunting ($p = 0.03$).
CONCLUSION: In both experiments, no speed-accuracy trade-off was found indicating that enhanced service speeds did not result in more service errors. Thus, the previously reported performance-enhancing effect of grunting in recreational players can also be found in elite players. Furthermore, AF seems most beneficial to instantly enhance performance whereas EF was less effective and did not differ from IF, providing further evidence that expertise level and task-relevant instructions mediate the influence of attentional focus on motor performance.
[1] Lauber B, Keller M. Improving motor performance: Selected aspects of augmented feedback in exercise and health. Eur J Sport Sci 2014;14:36-43. doi:10.1080/17461391.2012.725104

[2] Wulf G. Attentional focus and motor learning: a review of 15 years. Int Rev Sport Exerc Psychol 2013;6:77-104. doi:10.1080/1750984X.2012.723728
[3] OConnell DG, Hinman MR, Hearne KF, Michael ZS, Nixon SL. The effects of "grunting" on serve and forehand velocities in collegiate tennis players. J Strength Cond Res 2014;28:3469-75. doi:10.1519/jsc.0000000000000604
[4] Walchli M, Ruffieux J, Bourquin Y, Keller M, Taube W. Maximizing Performance: Augmented Feedback, Focus of Attention, and/or Reward? Med Sci Sports Exerc 2016;48:714-9. doi:10.1249/mss.0000000000000818

THE VALIDITY AND RELIABILITY OF CHAMPDAS MASTER SYSTEM: A LIVE FOOTBALL MATCH PERFORMANCE ANALYSIS SYSTEM

GONG, B., CUI, Y., GAI, Y., YI, Q., GÓMEZ, M.Á.

A.TECHNICAL UNIVERSITY OF MADRID, MADRID, SPAIN; B. BEIJING SPORT UNIVERSITY,BEIJING,CHINA

Introduction: One of the main research areas of performance analysis is the data validity and reliability of players and teams' behaviors during competition. The human errors may limit the reliability of manual data collection and measurements in performance analysis of sport. Therefore, the current study was aimed to investigate the validity of match variables and the reliability of Champdas Master System used by trained operators in live association football match.
Methods: The study consisted of a qualitative and a quantitative analysis. The qualitative analysis (coaches' expert point of view) involved twenty professional football coaches (UEFA-A/PRO, AFC-A/PRO) with 13.4±7.3 years of coaching experience from Europe and China. They voluntarily participated in the validation of match variables used by Champdas Master System by completing a questionnaire that aimed to evaluate: i) the degree of variable pertinence to match performance; and ii) the correct definition of each variable. The answers were chosen on a Likert scale of 10 levels (1=none to 10=maximum). Aiken's V was applied to quantify the validity of each item. The quantitative analysis of system reliability was executed by two well-trained operators that independently collected twice (with an interval of two weeks) the match data of the 19th round of Spanish La Liga Santander (2017-2018) between Real Madrid and Villarreal. Afterwards, the intra- and inter-operator reliability of collected match statistics were determined using Kappa statistic, typical error (TE) and intra-class correlation (ICC).
Results: The qualitative analysis showed that the Aiken's V averaged at 0.84±0.03 for the degree of variable pertinence to match performance and 0.85±0.03 for the correct definition of variable, showing high values in relation to content validity of all variables. The quantitative analysis showed that the Kappa values of the events for both teams were 0.97 and 0.89 for Real Madrid and Villarreal, and the ICC and TE ranged from 0.90 to 1.00 and from 0.01 to 0.24 for different groups of match performance variables for two operators within two data collections, showing a very good inter-operator agreement. While Kappa statistics between the first and second data collection of both teams were 0.92 and 0.90 for Operator One, and 0.91 and 0.88 for Operator Two. The ICC and TE varied from 0.93 to 1.00 and from 0.01 to 0.34 for both operators. These exhibited a high level of intra-operator reliability.
Conclusion
The results of the evaluation from professional coaches showed that the system offers a valid tool for gathering tactical and technical performance data from the live matches. Moreover, the high Kappa values, high intra-class correlation coefficients and low typical errors represented a high level of intra- and inter-operator reliability. This suggests the validity and reliability of Champdas Master System in collecting live football match statistics by well-trained operators.

INVESTIGATING SCORING STRATEGIES IN FIBA EUROBASKET 2017

CONTE, D., LUKONAITIENE, I.

LITHUANIAN SPORTS UNIVERSITY

INTRODUCTION: Previous research suggested that assists, successful 2-point field goals and defensive rebounds are the performance indicators best discriminating winning and losing teams in professional basketball (Garcia et al., 2014). However, no information is available about possible different scoring strategies discriminating winning and losing teams. The aim of the study was to examine the scoring strategies able to predict to win or lose a basketball game during FIBA EuroBasket 2017.
METHODS: Data were gathered from the official website of the FIBA EuroBasket 2017. During the tournament 76 games were played, but only 75 games were considered for the analysis since data for one qualification game were not freely available. The considered game-related statistics referred to scoring strategies were: fast break points (FBP); points in the paint (PP); points from the bench (PB); points from turnover (PT) and second chance point (SCP). Games were classified based on their score difference as close, balanced and unbalanced through a hierarchical cluster analysis using Wards method and the Squared Euclidian distance as interval. Furthermore, a univariate binary logistic regression analysis was performed for the total number of game and in each cluster. Game outcome (winning vs. losing) was adopted as dependent variable, while the scoring strategies were used as independent variables. Data were analyzed using the software SPSS (version 25.0; IBM Corporation, Armonk, NY, USA), and the level of significance was set at $p<0.05$.
RESULTS: Cluster analysis grouped the analyzed games in 31 close, 33 balanced and 11 unbalanced games (score difference: 1-10 points; 11-24 points; >24 points, respectively). The analysis of the pooled games showed a statistical significance value for PP ($p=0.004$), PB ($p=0.008$), PT ($p=0.003$) and SCP ($p=0.001$). The analysis of each cluster showed no significant statistical values ($p>0.05$) for any independent variable in close games. In balanced games, winning teams were more likely to score using PB ($p=0.022$) and SCP ($p=0.003$) compared to losing teams, while in unbalanced games the most adopted scoring strategies were PP ($p=0.016$), PB ($p=0.037$) and PT ($p=0.031$).
CONCLUSION: All the scoring strategies adopted seems able to discriminate between winning and losing teams in professional basketball except for FBP. However, none of the analyzed parameter is able to discriminate between winning and losing teams in close games but only in balanced and unbalanced games. These results indicate the importance of the analyzed scoring strategies and might provide useful data for basketball coaches to optimize their training methodologies and game strategies.
Reference
García, J., Ibáñez, S. J., Gómez, M. A. and Sampaio, J. (2014). Basketball Game-related statistics discriminating ACB league teams according to game location, game outcome and final score differences. International Journal of Performance Analysis in Sport 14(2), 443-452.

SELECTION IN WATER SPORTS IN HUNGARY – COACH PREFERENCES: FARKAS, A., SZMODIS, M., ALMÁSI, G.
UNIVERSITY OF PHYSICAL EDUCATION

INTRODUCTION: Sport selection, as being the base of the successful future sport career, depend on long-term well-organized and planned training process. It is important to be able to recognize and select the talented youngsters, as soon as possible. In our present study we were interested in the selection in water-sports and related branches. It was supposed that the more successful the sport event the more conscious the selection was.
METHODS: Hungarian coaches mostly working with young athletes were asked by questionnaire about their preferences in the selection. The sport events of the coaches were: pentathlon n=5, triathlon=7, swimming n=8, water-polo n=27, swimming and pentathlon n=6 and swimming and water-polo n=4. Altogether 36 questions were asked in relation to their sport event, about the age-group they trained, the duration of the training sessions and about their main aspects of selection.
Data were analyzed by basic satistics, Student t-test, and correlation analysis for the regional and sport event specific comparison.
RESULTS: When comparing the sport event numerous significant differences were found, e.g.: in water-polo, the avergae age at starting regular training was 8.79 years, while in other swimming-related sports was 7.1 years. When starting the competitive period the mean age of the youngsters was 1.65 years, that was near to the ideal opinion of the coaches. The mean age of starting competitions was 8.3 years, despite the opinion of the coaches about ideal starting age of 9.58. Among the selective body parameters the body height was preferred by water-polo coaches most.
The coaches working in the country were younger, preferred shoulder width among body parameters and thought to start regular training and competition earlier, besides, they thought that accelerated children could maintained their better pereformance level. Coaches were graduated at university level in 41 %. Though 82,1% intended to use the knowledge of professionals in the selection, they were more „hanging on" the intuitions and the experience of older practicing coaches. By the answers, 46% of the coaches thought to be able to maintain the performance level of accelerated children, only a quarter of them would choose them.
CONCLUSION: By our results, most of the coaches „believe" and lean on the practical experiences of older colleagues in the selection process. By the age of the coaches some differences, such as younger coaches prefer starting sport events earlier, was seen. It could be explained to reach higher performance level earlier, that is the base of „evaluating"/judging the quality of work of the coaches.

A RELIABILITY AND VALIDITY ASSESSMENT OF AN ATHLETE READINESS TO TRAIN (ART) QUESTIONNAIRE IN FEMALE YOUTH SOCCER PLAYERS

SONGANE, F.1, SPEARS, I.2, WRIGHT, M.1, WESTON, M.1
1: TEESSIDE UNIVERSITY (MIDDLESBROUGH, UK), 2: PRO-FOOTBALL SUPPORT (HUDDERSFIELD, UK). "

INTRODUCTION: Daily monitoring is integral to athlete management with self-report measures frequently being used to assess readiness to train. Practitioners often select and implement recovery items most commonly reported in literature without fully assessing reliability and validity required (Saw et al., 2017) for their own playing squad. Here, we aimed to assess the reliability and validity of an athlete readiness to train questionnaire (ART) within a squad of youth female soccer players in a talent development programme.
METHODS: Thirty female youth soccer players from a Football Association (FA) Regional Talent Club (under 14 and 16 years) were monitored across a 12-week period during the competitive season. The players maintained their usual coach-prescribed training, and reported perceived recovery scores prior to all sessions (<15min) via the ART. The ART contained items most sensitive to recovery status: mood, illness, fatigue, sleep quality, soreness and nutrition (Saw et al., 2017). These items were scored on a 5-point Likert scale (very poor [1] to very good [5]) presented via a mobile app developed in-house. Recovery items were subjected to internal consistency testing via Cronbachs Alpha and exploratory factor analysis via Principal Component Analysis (PCA), with an extraction criterion eigenvalue of > 0.75.
RESULTS: The mean +/- SD scores reported were: mood (4.0 +/- 0.8), illness (3.9 +/- 0.8), fatigue (3.6 +/- 0.9), sleep (3.9 +/- 0.8), soreness (3.7 +/- 0.9), nutrition (4.1 +/- 0.8). Internal consistency was rated good (0.85; +/- 90% limits 0.01). The Kaiser-Meyer-Olkin measure of sampling adequacy was rated great (0.88), with Bartletts test of sphericity (Chi-Square = 1623.52, p<0.001) confirming sufficient item correlations for PCA. The PCA extracted one factor (eigenvalue = 3.49) from the ART which contained all six items, explaining 58.1% of the variance. Factor loadings were lower for soreness and nutrition (<0.69), and higher for the remaining items (>0.75).
CONCLUSION: A high level of internal consistency combined with the extraction of only one factor suggest the ART in its current form may be reduced to just one item, thus potentially facilitating data collection practices for practitioners. As literature suggests readiness is multidimensional, a limitation here may have been that despite some education on the ART the young players failed to differentiate between its items. Therefore, future research should examine the players understanding of the readiness to train items presented within the ART.

AWARENESS AND PERCEIVED VALUE OF EYE TRACKING TECHNOLOGY IN CONCUSSION ASSESSMENT AMONG SPORTS MEDICINE PRACTITIONERS

SNEGIREVA, N.1, DERMAN, W.1,2, PATRICIOS, J.3,4, WELMAN, K.1
1: STELLENBOSCH UNIVERSITY, 2: IOC RESEARCH CENTRE, 3: UNIVERSITY OF PRETORIA, 4: UNIVERSITY OF THE WITWATERSRAND

INTRODUCTION: Sports concussion is a potentially serious and frequently occurring injury. Currently, even though its management has evolved significantly, there is still no one universally accepted tool to detect concussion and determine when it is safe to return to sport. This is aggravated by athletes often being young, motivated individuals who may under-report symptoms. Eye tracking technology (ETT) holds promise as an objective diagnostic biomarker to assess the presence of sports-related concussion. The primary objective of this study was to assess the awareness of sports medicine practitioners about ETT and determine its perceived value in concussion assessment.
METHODS: A cross-sectional survey consisting of eighteen items was distributed internationally online from January until December 2017 and was completed by 171 sports medicine practitioners. The variables included questions regarding utilization of the current concussion diagnostic tools and their perceived limitations, frequency of observed occurrence of eye movement deficits in concussed patients, level of awareness regarding ETT, and perceived benefits of this technology for diagnosing sports concussions.
RESULTS: The survey showed that the subjectivity of assessment criteria remains the major limitation of currently used diagnostic tools, including the SCAT, which was utilised by 75% of the respondents. ETT, despite its potential to attenuate this limitation (42% of the respondents named objectivity as a potential benefit of this technology), was used only by 12% of the respondents. A positive relationship existed between the experience of using eye tracking and its perceived benefit (p = 0.02). Furthermore, a significant relationship was

found between the profession of the respondents and their familiarity with the ETT ($p < 0.01$). General practitioners (GPs) showed the lowest and neuropsychologists the highest level of exposure to eye tracking. A remarkably low frequency of eye movement deficits (observed only in 12.3 ± 21.0 % of patients) was reported by the respondents. Furthermore, with an exception of the abnormal pupil light reflex, which was checked by 68% of the respondents, eye movement deficits were rather infrequently inspected (on average only by 41.1 ± 17.5 % of respondents).
CONCLUSION: The findings of this study suggest that i) there is insufficient awareness that concussion can lead to abnormal eye tracking behaviour even in this "professionally exposed" population; and ii) Despite the potential promise that ETT holds, sports medicine practitioners seem unfamiliar with this technology and therefore reluctant to implement it in their practice. Increasing the education opportunities and practical experience of sports medicine practitioners regarding concussive signs and symptoms, as well as potential innovative technology (including ETT) is strongly advocated.

Mini-Orals

MO-PM25 Sprinting and Jumbing

A SHORT-DURATION, LOW-INTENSITY HALF-TIME RE-WARM UP INCREASES INTERMITTEN SPRINT PERFORMNCE OVER THE 10-MIN FOLLOWING HALF-TIME

YANAOKA, T.1,2, HAMADA, Y.1,2, KASHIWABARA, K.1, KURATA, K.3, YAMAMOTO, R.1, MIYASHITA, M.4, HIROSE, N.4

1: WASEDA UNIVERSITY, 2: RESEARCH FELLOW OF JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE, 3: TOKYO GAKUGEI UNIVERSITY, 4: WASEDA UNIVERSITY

INTRODUCTION: In intermittent team sports, a 7 min of moderate-intensity half-time re-warm up (RW) has been shown to be a favourable strategy to avoid decrements in exercise performance after half-time (Yanaoka et al., 2018). However, a 7 min of RW would not fit into a half-time since a short time (i.e., ~3 min) would typically be available for a RW in actual matches (Russell et al., 2015). Moreover, although a low-intensity warm-up was as effective in increasing intermittent sprint performance as a moderate-intensity warm-up (McGowan et al., 2015), it is not known whether performing low-intensity RW has similar benefits for increasing intermittent sprint performance. Therefore, the present study aimed to investigate the effect of a short-duration, low-intensity RW on intermittent sprint performance after half-time and compare its influence with a moderate-intensity RW when matched for total duration.
METHODS: Using a randomised crossover design, 11 healthy men (age: 22.7±2.4 years, height: 1.73±0.06 m, body mass: 65.3±10.0 kg, maximal oxygen uptake [VO2max]: 52.6±6.2 mL/kg/min) performed three trials in thermoneutral environment (temperature: 20.6±0.5°C, humidity: 50.8±1.4%). In the main trials, participants performed the first 40-min intermittent exercise followed by a 15-min half-time. Half-time interventions were a 15-min of seated rest (control), a 3-min of moderate-intensity RW (cycling at 60% of VO2max; 60% RW) and a 3-min of low-intensity RW (cycling at 30% of VO2max; 30% RW). After half-time, participants performed a 10-min of the Cycling Intermittent-Sprint Protocol (CISP), which consisted of 10 s of rest, 5 s of sprint and 105 s of active recovery at 50% of VO2max, with the cycles repeated (Hayes et al., 2013). Work for each sprint in the CISP was calculated. The surface electromyograms (EMG) from the muscle bellies of the right vastus lateralis was recorded and the mean value of the root mean square (RMS) during the sprints in the CISP was calculated.
RESULTS: The mean work was higher in both RW trials than in the control trial (control: 3976±1055 J; 60% RW: 4258±1045 J, $p=0.009$; 30% RW: 4142±1000 J, $p=0.040$). The mean RMS was higher in both RW trials than in the control trial (control: 144±27%; 60% RW: 156±28%, $p=0.039$; 30% RW: 164±39%, $p=0.037$). There was no significant difference between both RW trials for the mean work and RMS.
CONCLUSION: The major findings of the present study were a 3-min of low-intensity RW increased intermittent sprint performance over the 10-min following half-time compared with a passive rest and was as effective as a moderate-intensity RW when matched for total duration. Our findings indicate that enhanced intermittent exercise performance following both RWs is likely to be mediated by an increase in EMG activity during each sprint.
REFERENCES:
Hayes M et al. (2013). J Sports Sci, 31, 565-572.
McGowan CJ et al. (2015). Sports Med, 45, 1523-1546.
Russell M et al. (2015). Sports Med, 45, 353-364.
Yanaoka T et al. (2018). J Strength Cond Res, 32, 211-216.

INFLUENCE OF AGE ON PERFORMANCE IN A REPEATED SPRINT TEST IN YOUNG SOCCER PLAYERS.

SÁNCHEZ-SÁNCHEZ, J.1, GARCIA-UNANUE, J.1, HERNANDO, H.2, LÓPEZ-FERNÁNDEZ, J.2, UBAGO, E.2, COLINO, E.2, LEÓN, M.2, GALLARDO, L.2

1. UNIVERSIDAD EUROPEA DE MADRID, 2. UNIVERSIDAD DE CASTILLA-LA MANCHA

INTRODUCTION: Previous studies have shown that the ability to recover and reproduce the performance in repeated sprints is a specific requirement of football physical fitness. The Repeated Sprint Ability (RSA) test has demonstrated to be a discriminatory variable between professional and amateur footballers. However, few studies have analyzed its effect on different age categories in terms of performance and fatigue. Therefore, the objective of this study was to analyze the influence of age on performance in a repeated sprint test in young soccer players.
METHODS: A total of 62 amateur young football players from 3 different age categories (U14, n=21; U16, n=20; and U18, n=21) participated in the study. Subjects were recruited from an elite football academy, with which was signed an agreement for the realization of this study. The RSA test Included 7 repetitive 30-meters long sprints with 20 seconds of recovery between them. Four pairs of photocells (Witty, Microgate, Bolzano, Italy) placed in 0, 5, 25 and 30 m assessed the performance in this test. The best time of sprint (RSABEST), the mean time (RSAMEAN), the total time (RSATT), the percentage of decreasing (RSADEC) and the difference between the best and worst sprint during the RSA test (RSACHANGE) were calculated. Two-way ANOVA and Bonferroni post-hoc test was used to analyse the differences in RSA time (age category x sprint number).
RESULTS: The analysis of the RSA test according to the category revealed greater sprint times in the U14 players throughout the complete test and all the sections analyzed ($p <0.01$). Differences were greater in the 30-m sprint analysis (ES: U14 vs. U16: 0.92-3.17, U14 vs. U18: 1.11-4.08). However, the comparison between U16 and U18 did not show any significant difference ($p> 0.05$), except a lower RSABEST in U18 (- 0.122 s, ES: 1.09, 95% CI: -0.236 to -0.008, $p = 0.031$). The deterioration of the performance with respect to the first sprint in the

analysis of the 30-meter RSA test is evident from the fifth sprint in all the categories analyzed (p <0.01), although the RSADEC and the RSACHANGE were not significantly different between age categories (p> 0.05).
CONCLUSION: The ability to repeat sprints is differs according to age. Therefore, the results of the RSA test can constitute a discriminatory variable of the age category of the soccer player. However, the deterioration of performance in the RSA test was independent of the age category.

EFFECTS OF WICKET RUN METHOD IN STEP FREQUENCY AND LECNGHT

GONZALEZ-FRUTOS, P.1, MORENCOS, E.1, ARIAS-TOMÉ, A.2, VEIGA, S.3

1: UNIVERSITY FRANCISCO DE VITORIA, 2:UNIVERSITY AUTÓNOMA DE MADRID, 3:UNIVERSITY POLITÉCNICA DE MADRID

INTRODUCTION: An athlete's running velocity is the product of step frequency (SF) and step length (SL). Some researchers have studied which of these factors, SF or SL, had more impact in the maximal running velocity, with different results (Hunter et al., 2004; Mackala & Mero, 2013; Salo et al., 2011).
The aim of the study was to compare the natural pattern of SF and SL with the results of optimal SL and SF wicket run in maximal velocity test.
METHODS: A total of 51 athletes (18 University Students of sport sciences, 18 athletes U-16 and 19 athletes U-14) performed different flying 20 m sprints at maximal-effort: flat and wicket runs at different distances (1.50 – 2.30 m). Sprint velocity, step length and step rate were calculated by high speed video analysis and photocell split times. The speed of the previous 15 m to the flying 20 m was controlled at the last 5m. The difference between the first and second part of the flying 20 m was calculated with a halfway time. The fastest wicket run was selected to compare with the flat sprint.
RESULTS: Results didn´t show differences (p=0.12; ES=0.20) between the first and second part of the flying 20 m of the flat sprint (0.00 ± 0.04s) and the fastest wicket run (0.02 ± 0.10s). Acceleration phase speed in flat condition (6.68 ± 0.69 m/s) showed higher values (p=0.00; ES=0.36) than fastest wicket run (6.43 ± 0.76 m/s). The flying 20 m speed was higher (p=0.00; ES=0.56) in the flat sprint (7.07 ± 0.82 m/s) than in the fastest wicket run (6.52 ± 0.98 m/s). The SL was lower (p=0.01; ES=0.46) in the flat sprint (1.75 ± 0.14 m) than in the fastest wicket run (1.82 ± 0.15 m). The SF presented higher rate (p=0.00; ES=0.84) in flat sprint (4.03 ± 0.37 Hz) than in the fastest wicket run (3.59 ± 0.52 Hz). The analysis of each group showed similar results, except in the SL, that didn´t present significant differences.
CONCLUSION: The flying 20 m after previous 15 m seems to be a maximal speed phase in this level of performance. The difference between the speed in the previous 15 m in flat and wicket run conditions could perhaps decrease with an adaptation phase. The lower speed in the wicket run could be explain by the change in the running technique (mayor elevation of the feet and knees). These modifications lead to an increase of the SL and a high decrease of SF.
The use of a wicket run test modifies the natural pattern of SF and SL. New studies are needed to analyze the improvements in the SF and SL pattern with the wicket runs skills in a long-term training.
References: Hunter JP, Marshall RN , McNair PJ (2004) Interaction of step length and step rate during sprint running. Med Sci Sports Exerc, 36(2), 261-271.
Mackala & Mero (2013) A kinematic analysis of three best 100 m performances ever. Journal of Human Kinetics, 36 (3), 149-160.
Salo AI, Bezodis IN, Batterham AM, Kerwin DG (2011) Elite sprinting: are athletes individually step frequency or step length reliant? Med Sci Sports Exerc, 43, 1055–1062.
Contact: p.gfrutos.prof@ufv.es

COMPARISON OF THE TWO TYPES OF COMPLEX TRAINING WITH INTENSITY OVER 90 % PMAX

KRÁLOVÁ, T.1, VRBAS, V.1, HAMMEROVÁ, T.1, VANDERKA, M.2, CACEK, J.1, KALINA, T.1

MASARYK UNIVERSITY, BRNO1; COMENIUS UNIVERSITY IN BRATISLAVA2;

INTRODUCTION: The alteration of training methods to enhance performance is the main goal of sports training. MacDonald, Lamont and Garner (2012) note, that complex training may be considered an optimal training method for sport-specific athletic strength development, while thanks to the enhanced neural activity it might be more effective at enhancing strength, and perhaps strength-power. According to many types of complex training (Docherty, Robbins, & Hodgson, 2004), the aim of this study was to compare the influence of different combination of squats jumps on intensity over 90 % maximal average power output (90 % Pmax) with plyometrics drops jumps on performance in countermovement jump (CMJ).
METHODS: Fourteen male students randomly assessed into the two groups, performed 8-week training with two practice sessions per week. The performance in CMJ was regularly measured every week. Data were collected using Myotest. External loads for squat jumps were tested individually to achieve 90 % Pmax using the FitroDyne Premium. Group EX1 trained using the complex pairs: squat jumps with a load over 90 % Pmax immediately followed by drop jumps. Group EX2 conducted first the series of squat jumps with a load over 90 % Pmax, then series of drop jumps. For statistical analysis was used one-way ANOVA with repeated measures (group*time).
RESULTS: The major finding was that both groups EX1 (+ 5,93 %) and EX2 (+ 4,99 %) had a significant increase in the CMJ (p<0.05), however, there were no significant differences between EX1 and EX2 in effect on CMJ (p>0.05). There was no significant increase in CMJ within the first four weeks in both groups EX1 and EX2 compared to the pre-test (p>0.05). Significant differences through the 8-weeks period was registered between result in a 5th week compared to post-test in both groups EX1 and EX2 (p<0.05).
CONCLUSION: Both complex training methods are useful for enhancing the performance in CMJ. We recommend coaches to change the type of methods periodically to avoid repeating the same training. These methods can be periodically substituted.

SHORT-TERM PLYOMETRIC TRAINING IMPROVES NOT ONLY CHANGE OF DIRECTION, SPEED, AND JUMP PERFORMANCE BUT ALSO REPEATED-SPRINT ABILITY IN PREPUBERAL MALE SOCCER PLAYERS

CHAABENE, H., NEGRA, Y., FERNANDEZ-FERNANDEZ, J., SAMMOUD, S., BOUGUEZZI, R., PRIESKE, O., GRANACHER, U.

POTSDAM UNIVERSITY, GERMANY. HIGHER INSTITUTE OF SPORTS AND PHYSICAL EDUCATION OF KSAR SAID, TUNIS, TUNISIA, UNIVERSITY OF LEON, LEON, SPAIN

INTRODUCTION: Exercises involving the stretch-shortening cycle of the muscle, commonly referred as plyometric training , are frequently used to improve soccer players' high-intensity actions. Although there is preliminary evidence on the effects of PT in prepuberal soccer players on components of physical fitness , further research still needed to strengthen the effect of it on prepuberal soccer players' measures of physical fitness. Additionally, despite the frequently occurring repeated-sprint ability demands during youth soccer game ,

the effect of PT on such a fitness quality is presently unknown in prepuberal soccer players. Therefore, this study aimed at examining the effects of 8 weeks PT program on CoD, speed, jump-performance, and RSA in prepuberal male soccer players.
METHODS: Thirty-one healthy players were randomly assigned to a PTG or a CG . Pre-and post-training tests included CoD , speed , jumping-performance , and RSA . The PTG conducted five training sessions per-week, including two PT sessions in substitution of some soccer drills. The CG continued their regular soccer training with five sessions per-week. The PT protocol was based on a previously published study .
RESULTS: Within-group outcomes derived from magnitude-based inferences showed large performance improvements in T-test, DJ20, DJ40, THT, and RSAtotal for the PTG compared with pre-test. For 20m sprint and RSAbest, PTG showed small performance improvements from pre- to post-test. For the CG, small performance improvements were shown in the 20m sprint-time test compared with the pre-test. However, T-test, RSAbest, and RSAtotal were substantially altered from pre- to post-test. Between-group analyses showed greater performance improvements in PTG compared with CG in all tests except RSAFI.
CONCLUSION: Eight-weeks of an in-season plyometric training in addition to regular soccer training induced larger increases in measures of physical fitness in prepuberal male soccer players compared with regular soccer training only. More specifically, plyometric training was, particularly, effective in improving RSA performance.

EFFECTS OF 4-WEEKS PLYOMETRIC TRAINING ON MUSCLE ACTIVATION AND DROP JUMP PERFORMANCE IN JUNIOR ELITE FEMALE FOOTBALL PLAYERS.

WALSH, G., DELEXTRAT, A.
OXFORD BROOKES UNIVERSITY

INTRODUCTION: Sex differences in knee joint biomechanics appear to develop during the pubertal growth spurt (Hewett et al., 2004), increasing the risk of injury in young female athletes and highlighting the importance of training strategies to reduce injury risk factors. Plyometrics training has been used to improve performance and reduce the risk of lower limb injuries (Pfile et al., 2013). Therefore, the aim of this study was to determine the effect of plyometrics training in addition to normal football training on drop jump performance and quadriceps-hamstrings coactivation and onset timings during drop jumps in junior elite football players.
METHODS: Seventeen junior elite female football players (14±1 years) were randomised into a plyometrics (PLYO: n=8) or control (CON: n=9) group. Both groups continued with their normal football training and the PLYO group did 3 additional lower body plyometrics sessions per week for 4 weeks. In the week before (PRE) and after (POST) the training period participants performed 3 30 cm drop jumps onto a force plate while activity of the Vastus Lateralis (VL) and Semimembranosus (SM) was recorded. Jump height (JH) and reactive strength index (RSI), VL-SM coactivation and activation onset timings prior to landing were calculated.
RESULTS: There was an interaction for RSI with greater RSI POST than PRE training for PLYO ($p=0.025$, $d=0.81$) but no change for CON. There were no effects for JH. There was also an interaction for VL ($p=0.005$, $d=1.90$) onsets time which occurred earlier before landing POST training in PLYO with no change in CON. VL-SM coactivation was increased between PRE and POST training ($p=0.013$, $d=1.62$) but there was no interaction.
CONCLUSION: The increases in RSI found in this study are in agreement with those found previously for adolescent males following plyometric training (Llyod et al., 2016). Earlier VL activity is also congruent with greater RSI as the quadriceps contract in preparation for the rebound jump, likely developed by plyometrics as the tasks involved required frequent landing and rebound activities. The increased VL-SM coactivation for PLYO is indicative of reduced quadriceps dominance which has been associated with reduced injury risk (Urabe et al., 2005), however the lack of interaction effect suggests this may be the result of normal football training.
REFERENCES:
Hewett T., Myer G., Ford K. (2004). J Bone Joint Surg AM, 86A, 1601-1608.
Lloyd R., Radnor J., De Ste Croix M. Cronin J., Oliver J. (2016). J Strength Cond Res, 30(5), 1239-1247.
Pfile K., Hart J., Herman D., Hertel J., Kerrigan C., Ingersoll C. (2013). J Athl Train, 48(4), 450-462.
Urabe Y., Kobayashi R., Sumida S., et al. (2005). Knee, 12, 129-134.
CONTACT:
gwalsh@brookes.ac.uk

EFFECTS OF PLYOMETRIC AND DIRECTIONAL TRAINING ON SPEED AND JUMP PERFORMANCE IN ELITE YOUTH SOCCER PLAYERS.

BEATO, M.
UNIVERSITY OF SUFFOLK

INTRODUCTION: Soccer players perform approximately 1350 activities , such as accelerations/decelerations, and changes of direction during matches. It is well established that COD and plyometric training have a positive impact on fitness parameters in football players. This study analyzed the effect of a complex COD and plyometric protocol compared to an isolated COD protocol training on elite football players.
METHODS: A randomized pre-post parallel group trial was used in this study. Twenty-one youth players were enrolled in this study . Players were randomized into two different groups: CODJ-G and COD-G , training frequency of 2 times a week over 6 weeks. Sprint 10, 30 and 40 m, long jump, triple hop jump, as well as 505 COD test were considered.
RESULTS: Exercise-induced within-group changes in performance for both CODJ-G and COD-G: long jump = 0.32 and ES = 0.26, respectively>, sprint 10 m , after 6 weeks of training. Moreover, CODJ-G reported substantially better results in long jump test .
CONCLUSION: This study showed that short-term protocols are important and able to give meaningful improvements on power and speed parameters in a specific soccer population. CODJ-G showed a larger effect in sprint and jump parameters compared to COD-G after the training protocol. This study offers important implications for designing COD and jumps training in elite soccer.

EMG STRUCTURE OF MOVEMENT AND MUSCLE ACTIVATION PHASES DURING THE SPRINT START

KATARZYNA, P.
UNIVERSITY OF TECHNOLOGY IN OPOLE

INTRODUCTION: The primary purpose of the paper was to identify the pattern of movement of sprinters sprint start. Also, assessment was conducted as to the movement structure expressed by EMG indicators (muscles bioelectric voltage [μV] and timing in muscles activity

[ms]) in the group of sprinters and in the group of students. Identification was made as to the total interdependency in muscles activity in the pre-and post-start phase of sprint start in both tested groups. The research covered a group of 25 specialist stage sprinters of 1st and 2nd sport class and a group of 36 students of masters study programs in physical education major. The sprinter run test was conducted at a distance of 30m from start block along with registration of the EMG signal.
METHODS: The research was conducted using specialized equipment: telemetric system configured with two quick cameras, 16-channel surface electromyography system (EMG) as well as a system for triggering the sound signal synchronized with EMG equipment.
RESULTS: It was presented the movement pattern of the start phase by the best athlete in the group of sprinters. Also, EMG activation timing was presented, supplemented with the actual values of bioelectric voltage signal of muscles at particular phase of pre- and post-start activation of muscle fibres. According to the sprint start sequence structure before appearance of the sound signal, among others, the following muscles were stimulated: TB, RF and BB. Directly after the signal, the following muscles were activated: VL, STN, BF and GAS MED.
A comparison was made also for the aggregate movement structure indicators understood as the number of activated muscles before and after the sound signal in both examined groups. Comprehensively, the number of activated muscles before and after start in the group of students was expressly greater than in the group of sprinters. Sprinters in the pre-start phase, on average, activated 8 basic muscular parts (R = -0.51), while students stimulated, in the same phase, 10 groups. Directly after the signal, the average number of stimulated muscles amounted to 11 in both groups (the sprinters group R = -0.70). According to the sprint start movement structure, stimulation was showed by the following muscles: BB and TB of the right and left limb (as flexors and extensors of the upper limb) and the following muscles: RF and VL of the right and left limb. It can be noticed that the pre- and post-start muscle activation structure demonstrated the anticipated regularities. This confirmed a growth in sprint start effectiveness at reduced number of activated muscles at the level of specialist stage sprinters. A reverse tendency characterized students on second degree studies in the major of physical education.
In conclusion, the analyses of activation of muscle groups using EMG recording proved that advanced sprinters generate movement patterns typical for their level, both at the pre-and post-start phase and then, when running the distance of 30 m.
CONCLUSION: 3

16:15 - 17:45

Invited symposia

IS-BN01 Advances in the study of muscle plasticity using real time ultrasonography

EFFCT OF RESISTANCE TRAINING AND INACTIVITY ON VISCOELASTIC PROPERTIES OF HUMAN TENDINOUS TISSUES

FUKUNAGA, T.

NATIONAL INSTITUTE OF FITNESS AND SPORTS

INTRODUCTION: For the last two decades, real time B-mode ultrasonography has been extensively used to examine in vivo mechanical property of human tendon-aponeurosis complex . The purpose of this presentation is to review the significance of viscoelastic property of TAC for human movements.
METHODS: The ULT was used for in vivo scanning of the muscle tendon complex and a realistic determination of the interactions between muscle and TAC during human movement.
RESULTS: Some ULT studies indicated that the TAC-VEP significantly influences performance and efficiency during stretch-shortening cycle exercises such as jumping and walking . In addition, Kubo et al <2000> indicated that the elasticity of knee extensor TAC associated with 100-m sprint time. Furthermore, it is known that the TAC stiffness of plantar flexors for good endurance runners is lower , and that of knee extensors for the most economical runners is more compliant .
The aforementioned evidence suggests that the TAC elasticity will be associated with the magnitude of storage and recoil of tendon elastic strain energy during SSC exercises. At the same time, the previous findings have tempted researchers to examine whether the VEP of human TAC is changeable due to exercise training and/or inactivity. It has been shown that the stiffness and Young's modulus of human TAC increased considerably after isometric training . The training-induced change in TAC-VEP may be an advantage for increasing the rate of torque development and for shortening the electromechanical delay . On the other hand, a prior study failed to find significant change in TAC stiffness after plyometric training, whereas the time to peak torque shortened significantly . Thus, while the available information is limited, the previous findings suggest that the training-induced changes in the human TAC-VEP might differ with the exercise modalities adopted. In any case, further studies are needed to elucidate the influences of physical exercises on the VEP of human TAC and the associations between the training-induced changes of the VEP and physical performance.
It is well known that muscle strength and size decrease under inactivity or microgravity condition . The TAC-VEP is also changed by inactivity; stiffness decreases and its hysteresis increases after bed-rest . These findings imply that inactivity induces a decline in TAC stiffness as an inverse effect of resistance training.
CONCLUSION: The VEP of human TAC can be a determinant factor for the performances of exercises involving SSC, and it is changeable due to exercise training and/or inactivity. However, it must be remarked that the behavior of TAC during sports and exercise has been mainly examined under the prescribed experimental conditions. In future, further examinations should be conducted to clarify the role of the human TAC-VEP for the performances of practical sport scenes such as maximum acceleration sprinting.

STRUCTURAL REMODELING OF HUMAN SKELETAL MUSCLE WITH CHRONIC LOADING AND UNLOADING

NARICI, M., FRANCHI, M.V., FLÜCK, M.

UNIVERSITY OF PADOVA

Skeletal muscle shows remarkable plasticity in response to chronic loading and unloading. Unloading conditions such as bed rest (BR) and unilateral lower limb suspension (ULLS) have been shown to cause an extremely rapid decrease in muscle size, detectable, both microscopically and macroscopically, after just three days of unloading. This remarkably fast decrease in muscle size is accompanied by substantial remodelling of muscle architecture represented by a decrease in muscle fascicle length and pennation angle1 which, togeth-

er with a decrease in single fibre specific tension and unloaded shortening velocity, account for the loss of muscle force and power. Muscle remodeling seems regulated by mechano-sensitive proteins such as FAK2,3 whose content and activity decrease within 8-10 days of unloading reducing protein synthesis through p70S6K. Muscle remodeling with overloading seems instead regulated by contraction mode. While concentric (CON) loading leads to an increase in pennation angle with little change in fascicle length, eccentric (ECC) training causes diametrically opposite changes. In rodents, longitudinal muscle growth (addition of sarcomeres in series) occurs after downhill (ECC) but not with uphill running (CON). These findings support the contention that the direction of muscle growth is dictated by the contraction mode. Interestingly, in humans, the same mechano-sensitive proteins (FAK, meta-vinculin) have been recently shown to be more activated after ECC and closer to the myotendineous junction. This modulation in FAK-related proteins was also correlated with changes in muscle architectural parameters over training3, reinforcing the interrelation between such myogenic mechanisms and structural adaptations. Furthermore, greater phosphorylation of mitogen-activated protein kinases (ERK1/2, p38) has been reported with ECC vs. CON contractions in mice, humans and cardiac myocytes, in which direction of muscle growth is regulated by different activation of ERK1/2. While there is evidence for lengthening contractions resulting in enhanced extra-cellular matrix remodeling the specific molecular signalling pathways and gene expression regulating the direction of muscle growth with CON and ECC exercise are subject of current investigations by our and other groups.

References: 1. De Boer MD et al.. Time course of muscular, neural and tendinous adaptations to 23 day unilateral lower-limb suspension in young men. J Physiol. 2007;583:1079-91.
2. de Boer MD et al.. The temporal responses of protein synthesis, gene expression and cell signalling in human quadriceps muscle and patellar tendon to disuse. J Physiol. 200;585:241-51.
3. Flück Met al.. Focal adhesion proteins FAK and paxillin increase in hypertrophied skeletal muscle. Am J Physiol. 1999;277:C152-62.
4. Franchi MV et al. Regional regulation of focal adhesion kinase after concentric and eccentric loading is related to remodeling of human skeletal muscle. Acta Physiol. 2018.

ULTRASONOGRAPHY FOR MULTI-SITE ANATOMICAL MEASUREMENT: ITS USE IN UNDERSTANDING FUNCTIONAL PERFORMANCE AND TRAINING ADAPTATIONS

BLAZEVICH, A.J.

EDITH COWAN UNIVERSITY

INTRODUCTION: With practice, B-mode ultrasonography can be used for the relatively rapid and accurate measurement of numerous anatomical variables, including muscle size and fascicle architecture . Two main aims of research have been to <1> determine the relationship between muscle architecture and muscle function in vivo in humans, and <2> describe the changes that result from interventions such as physical training, detraining/disuse, ageing and illness or disease. However, one issue limiting the interpretation of data is the substantial intra- and inter-muscular variability in muscle architecture and its region-specific adaptive change in response to interventions.
METHODS: To better understand the functional importance and plasticity of muscle architecture it seems obligatory to take measurements from multiple muscles or muscle regions. It is also essential that issues surrounding error in ultrasound recordings are taken into account, and new technologies are embraced that enhance image quality and measurement accuracy.
RESULTS: Recent data indicate that the conclusions drawn a study differ depending on which regions or sites are examined, and we have recently observed that models used to predict functional effects of muscle architecture are particularly sensitive to the sites at which measurements are made. Using extended field-of-view ultrasonography, a greater image detail and accuracy has been provided in some muscles, and this may influence conclusions drawn when compared to images taken with a small imaging window. Future advances may improve our accuracy further, and allow imaging of complex, long muscles more completely.
CONCLUSION: Methods used for accurate sonographic muscle architectural measurements will be described, evidence for the significant variability of muscle architecture and its adaptation will be provided, and the importance of testing site location for input into mathematical models will be revealed. These factors significantly influence the conclusions drawn from muscle architecture data collected using ultrasonography.

Oral presentations

OP-PM13 HIGH INTENSITY TRAINING MODALITIES

VARYING LOAD-DISTRIBUTION DURING HIGH-INTENSITY INTERVAL TRAINING (HIIT) IN CYCLING AND RUNNING: EFFECTS ON CARDIORESPIRATORY PARAMETERS.

BELTRAMI, F.G., ROOS, E., VON OW, M., SPENGLER, C.M.

ETH ZURICH

INTRODUCTION: A popular HIIT session to improve cardiorespiratory fitness of already well-trained individuals is the so-called 4x4, consisting of four 4-min bouts at near-maximal intensity interspersed by 3 min of active recovery. As the magnitude of training-related adaptations are believed to depend on the relative intensity of exercise and thus the associated level of physiological responses, manipulating the session in order to elicit higher physiological perturbations at the same exercise intensity could therefore optimize the training stimulus. Thus, this study aimed to test whether the cardiorespiratory strain of a traditional session of HIIT (4x4-TRA) compared with a session of similar duration and average load, but with decreasing power within each intense bout (4x4-DEC; previously shown to elicit higher oxygen uptake [VO2]) was similarly different between protocols in cyclists and runners.
METHODS: 15 cyclists (1 female, age 29 ± 5 years, VO2max 62 ± 6 ml.kg-1.min-1) and 15 runners (4 females, age 30 ± 4 years, VO2max 58 ± 4 ml.kg-1.min-1) performed – following familiarization sessions – a 4x4-TRA and 4x4-DEC session in randomized, counter-balanced order, while gas exchange and heart rate were monitored. Load was initially set at 85% of peak power output of an incremental test and was constant during 4x4-TRA whereas it started at 40 W (2 km/h) higher than average and finished at 40 W (2 km/h) lower than average within each bout of the 4x4-DEC session. The duration of the initial stage of 4x4-DEC was 60 s, and subsequent stages were 30 s long. The average load was adjusted during familiarization to ensure it was the highest tolerated.
RESULTS: Average VO2 during the four bouts, expressed as a percentage of VO2max, was higher in 4x4-DEC compared with 4x4-TRA in cycling (89 ± 4% vs. 86 ± 5%, p=0.002) but not in running (91 ± 4% vs. 90 ± 4 %, p=0.38). The ratio of average VO2 for 4x4-DEC over 4x4-

TRA was significantly higher for cycling (1.03 ± 0.03 vs. 1.01 ± 0.02 for running, p=0.04), and participants stayed for a 27 ± 30 % longer time above 90% VO2max during 4x4-DEC compared to 4x4-TRA in cycling (p=0.007), but not in running. Average heart rate was higher during 4x4-DEC compared with 4x4-TRA for both cycling and running (+3 ± 3 and +2 ± 3 beats.min-1, both p<0.05), and a similar response was seen for pulmonary ventilation (+10 ± 5 and +5 ± 4 L.min-1 higher for 4x4-DEC vs. 4x4-TRA for cycling and running respectively, both p<0.001) and average blood lactate concentration (+0.6 ± 0.7 and +0.7 ± 1.0 mmol.L-1 higher for 4x4-DEC vs. 4x4-TRA for cycling and running respectively, both p<0.05). No differences were seen for perception of breathlessness, leg and respiratory effort.
CONCLUSION: Higher levels of physiological perturbations were achieved during 4x4-DEC sessions in both cycling and running, however, these differences were more prominent in cycling, thus making it a more attractive modality for a future training intervention.

ASSOCIATION OF SKELETAL MUSCLE AND SERUM METABOLITE PROFILE WITH MAXIMUM POWER OUTPUT GAINS IN RESPONSE TO CONTINUOUS ENDURANCE OR HIGH INTENSITY INTERVAL TRAINING PROGRAMS: THE TIMES STUDY

CASTRO, A.1, DUFT, R.G.1, FERREIRA, M.L.V.1, ANDRADE, A.L.L.1, GÁSPARI, A.F.1, MARCHI-SILVA, L.1, OLIVEIRA-NUNES, S.G.1, CAVAGLIERI, C.R.1, GHOSH, S.2, BOUCHARD, C.3, CHACON-MIKAHIL, M.P.T.1

1: UNICAMP, 2: DUKE-NUS-MS, 3: PBRC.

INTRODUCTION: Recent studies have begun to identify the molecular determinants of variability of cardiorespiratory fitness in response to exercise training programs. However, the picture of molecular mechanisms underlying trainability is very incomplete. The aim of this study was to investigate baseline serum and skeletal muscle metabolomics profile and their associations with the gains in maximal power output (MPO) in response to 8-week of continuous endurance training (ET) or high intensity interval training (HIIT) programs matched for total units of exercise (TIMES study).
METHODS: Eighty healthy, young sedentary adult males (18 to 31 years) were randomized to one of three groups and 70 were defined as completers (>90% of sessions): ET (n=30), HIIT (n=30) and control (CO, n=10). Serum and skeletal muscle samples were analyzed by 1H-NMR spectroscopy. The targeted screens yielded 43 serum and 70 muscle reproducible metabolites (intraclass correlation coefficient >0.75; coefficient of variation <25%). Associations of baseline metabolite levels with MPO trainability were explored within each training program via three analytical strategies: (1) correlations with gains in MPO; (2) differences between high and low gainers (HRE and LRE); and (3) metabolite contributions to the most significant pathways related to gains in MPO. The significance level was set at p<0.01 or false discovery rate of 0.1.
RESULTS: MPO improved equally with ET and HIIT (21% and 24% gains, respectively, P < 0.001; range from 8% to 45%). MPO associated baseline metabolites supported by all three levels of evidence were: serum glycerol, skeletal muscle alanine, proline, threonine, creatinine, AMP and pyruvate for ET, and serum lysine, phenylalanine, creatine, and skeletal muscle glycolate for HIIT. Five of 21 significant pathways from metabolites identified in serum or muscle were similar between ET and HIIT: aminoacyl-tRNA biosynthesis, arginine and proline metabolism, glycine, serine and threonine metabolism, glyoxylate and dicarboxylate metabolism, and nitrogen metabolism.
CONCLUSION: For young sedentary men, ET programs performed at moderate to high intensities have the potential to induce similar improvements in MPO compared to HIIT-based programs. We conclude that MPO gains are potentially associated with metabolites indicative of baseline amino acid and translation processes in both programs and with carbohydrate metabolism in ET.
CONTACT: ax.castro@yahoo.com.br

EFFECTS OF HYPEROXIC-SUPPLEMENTED HIGH INTENSITY INTERVAL TRAINING ON ENDURANCE PERFORMANCE, MAXIMAL OXYGEN CONSUMPTION AND MITOCHONDRIAL FUNCTION IN TRAINED CYCLISTS

CARDINALE, D., LARSEN, F.J., LINDHOLM, P., EKBLOM, B., BOUSHEL, R.

THE SWEDISH SCHOOL OF SPORT AND HEALTH SCIENCES

INTRODUCTION: Hyperoxia increases the amount of O2 dissolved in the blood, elevates arterial O2 saturation, and increases arterial O2 concentration, resulting in a higher O2 delivery to the working muscles (Ekblom et al., 1975). Several lines of evidence indicate that breathing hyperoxia (HYPER) lactate metabolism, power output and endurance are improved compared to normoxia (NORM) (Cardinale & Ekblom, 2017). Since acute HYPER enable a higher exercise work rate compared to NORM and considering the O2 delivery limitation at exercise intensities near to maximum, we hypothesized that muscle mitochondrial oxidative phosphorylation (OXPHOS) capacity would be upregulated along with a higher endurance performance following endurance interval training with supplemental oxygen compared to normoxia.
METHODS: 23 trained cyclists (19 men and 4 women) age 35.3±6.4 years (mean ± standard deviation (SD)) body mass 75.2±9.6 kg, height 179.8± 7.9 m, and VO2max 4.5±0.7 L·min-1 performed 6 weeks polarized and periodized endurance training on a cycle ergometer consisting of supervised HIIT sessions 3 days/week (3·8 min or 4·4 min) and additional low-intensity training 2 days/week (120 and 240 min long duration). Subjects were randomly assigned to either HYPER (FiO2 0.30) or NORM (FiO2 0.21) breathing condition during training in a double-blind study design. VO2max, OXPHOS capacity in permeabilized fibers and 20 min cycle performance were tested pre and post training intervention.
RESULTS: Over the intervention change in VO2max (HYPER 1.1±3.8%, NORM 0.0±3.7%; p value = 0.55, ES= 0.08, trivial), OXPHOS capacity (HYPER 27.3±46.0 %, NORM 16.5±49.1%; p value = 0.21, ES= -0.06, trivial) and mean power output during 20 min trial (HYPER 6.0±3.7%, NORM 2.4±5.0%; p value = 0.073, ES= 0.32 small) did not statistically significantly differ between the groups.
CONCLUSION: In line with previous published data (Kilding et al., 2012), these data showed that 6 weeks hyperoxic-supplemented high-intensity interval-training on a cycle ergometer was not superior to conventional training at sea level in improving VO2max, OXPHOS and cycle performance in already trained cyclists. Therefore, despite the small meaningful positive effect in cycling performance that might be relevant in sport, considering the cost/benefit and ethical issues of performing hyperoxic-supplemented HIIT, it is controvertable whether this strategy is worthwhile in maximizing endurance performance in already trained cyclists.

HIGH-INTENSITY INTERVAL TRAINING OPTIMISATION IN CYCLING: THE EFFECT OF POWER OUTPUT DISTRIBUTION

BOSSI, A.H.1, MESQUIDA, C.2, HOPKER, J.G.1, RØNNESTAD, B.R.

UNIVERSITY OF KENT

INTRODUCTION: The scientific optimisation of high-intensity interval training (HIT) is a necessary step to warrant performance improvements of elite cyclists. Theoretically, HIT protocols with large proportions of time spent at a high fraction of the maximal oxygen uptake (VO2max) might be more effective for improving VO2max and performance due to the greater training stimulus (Buchheit & Laursen,

2013). This study investigated whether HIT work intervals with varied power output (vHIT) yields higher fractions of VO2max than work intervals with constant power output (cHIT).
METHODS: Fourteen male cyclists (age: 24 ± 6 years, VO2max: 69.2 ± 6.6 ml·kg-1·min-1, maximal aerobic power (MAP): 387 ± 33 W) performed submaximal exercise bouts to determine MAP, an incremental VO2max test and a 10-min familiarisation of vHIT (visit 1), as well as cHIT and vHIT in randomised order (visits 2 and 3). Both HIT sessions were based on 6 x 5 min at a mean intensity of 84% MAP, with 2.5-min recovery intervals at 30% MAP. However, the work intervals in vHIT consisted of 3 x 30 s at MAP interspersed with two 1-min blocks and a final 1.5 min at 77% MAP. Time >90% VO2max, time >90% HRmax and session ratings of perceived exertion (sRPE) were compared between HIT sessions. Mean VO2 as a percentage of max (%VO2max), total VO2, mean breathing frequency as a percentage of max (%BFmax), blood lactate concentration [La] and acute RPE (following each work interval) were compared between HIT sessions and between work intervals. Data were analysed using paired t-tests and two-way repeated-measures ANOVAs with Bonferroni post-hoc comparisons. Significance level was set at $P \leq 0.05$.
RESULTS: We found a higher time >90% VO2max for vHIT than cHIT (410 ± 207 vs 286 ± 162 s; $t = 2.63$; $P = 0.021$) and no differences in time >90% HRmax ($t = -0.10$; $P = 0.922$) and sRPE ($t = -1.62$; $P = 0.129$). We found a main effect of HIT mode on %VO2max ($F = 11.26$; $P = 0.005$; $\eta p2 = 0.46$) and total VO2 ($F = 10.78$; $P = 0.006$; $\eta p2 = 0.45$), but not on [La] ($F = 1.54$; $P = 0.236$; $\eta p2 = 0.11$) and acute RPE ($F = 1.72$; $P = 0.213$; $\eta p2 = 0.12$). There was a trend of higher %BFmax ($F = 3.61$; $P = 0.080$; $\eta p2 = 0.22$) in vHIT. A main effect of the work intervals was found for all variables (all $F > 30.50$; $P < 0.001$; $\eta p2 > 0.70$), with no interaction (all $F < 1.03$; $P > 0.392$; $\eta p2 < 0.07$).
CONCLUSION: vHIT yields a higher time >90% VO2max, %VO2max and total VO2 than cHIT when the mean HIT intensity is matched, suggesting a higher training stimulus. Moreover, sRPE, %BFmax, [La] and acute RPE are not affected, indicating vHIT can be recommended as an effective HIT session.
Reference
Buchheit, M., & Laursen, P. B. (2013). High-intensity interval training, solutions to the programming puzzle. Sports Medicine, 43(5), 313-338.
Contact: asnb3@kent.ac.uk

ACUTE PHYSIOLOGICAL AND PERCEPTUAL RESPONSES TO THREE MODES OF HIGH-INTENSITY INTERVAL EXERCISE: DEVELOPMENT OF THE BE@WORK (BRIEF EXERCISE AT WORK) INTERVENTION

BURN, N., WESTON, M., ATKINSON, G., WESTON, K.L.

TEESSIDE UNIVERSITY

INTRODUCTION: BE@Work (Brief Exercise at Work) is a controlled trial examining the effects of workplace-based high-intensity interval training (HIIT) on health and fitness outcomes. Despite accumulating evidence that HIIT can improve aspects of cardiometabolic health (Gibala et al. 2012), the feasibility of conducting HIIT beyond laboratory settings is unclear. In preliminary focus groups conducted within BE@Work, employees reported a preference for a choice of activities, with stair climbing, stepping and boxing the preferred exercise modes. As such, we aimed to assess heart rate (HR) and ratings of perceived exertion (RPE) responses to prototype HIIT protocols based on these exercises and explore whether HR and RPE substantially differed across modes.
METHODS: Using a randomised cross-over design, nine employees (five male; aged 38.8 ± 12.3 years; mean ± SD) took part in three exercise sessions (stair climbing, stepping, boxing). Participants completed four 60 s bouts, each interspersed with 75 s rest, and were encouraged to work maximally. Second-to-second HR was recorded via Polar A360 monitors. Peak HR for each bout was expressed as a percentage of participants' age predicted maximal HR (%HRmax), with a high-intensity exercise criterion of ≥85% of age-predicted HRmax (Weston et al. 2014). Session RPE was collected via the Borg CR-10 scale. Using a linear mixed model, mean differences between exercise modes were derived, with magnitude-based inferences subsequently applied. Threshold values for minimal important differences were two percentage points for HR and one Arbitrary Unit for RPE. Given the pilot nature of the study and the small sample size, substantial effects were only declared clear when the probability likelihood for the effect was ≥75% (i.e., likely).
RESULTS: Participants' mean (± SD) peak HR (expressed as % age-predicted HRmax) were 87 ± 9% for stair climbing, 88 ± 6% for stepping and 85 ± 4% for boxing. Mean RPE was 8 ± 3 for stair climbing, 8 ± 3 for stepping and 6 ± 2 for boxing. There were no substantial between-mode differences in HR or RPE.
CONCLUSION: All three exercise modes elicited physiological and perceptual responses indicative of high-intensity exercise, thus presenting viable options for workplace HIIT programmes. The lack of substantial differences between stair climbing, stepping and boxing protocols suggests these could be used interchangeably in a HIIT intervention, without potentially compromising the intensity of the exercise. These findings inform the design and implementation of BE@Work; an 8-week HIIT intervention for workplaces in Northeast England.
References: Gibala MJ et al (2012) Journal Physiol, 590,1077-1084.
Weston KS et al (2014). Br J Sports Med, 48,1227-34.

Oral presentations

OP-PM14 BONE

SEX HORMONES AND BONE MINERAL DENSITY IN FEMALES ATHLETES WITH DIFFERENT HORMONAL PROFILES

RAEL, B.1, CUPEIRO, R.1, PEINADO, A.B.1, ROMERO-PARRA, N.1, ALFARO-MAGALLANES, V.M.1, BUTRAGUEÑO, J.1, COUCEIRO-CANALEJO, J.1, GARCÍA-DE-ALCARAZ, A.1,2, POZAS-KERSTJENS, G.1, PRIETO, M.1

TECHNICAL UNIVERSITY OF MADRID

INTRODUCTION: Although the association between sex hormones and bone mineral density (BMD) in healthy sedentary women has been widely studied (Huitrõn-Bravo et al., 2016), just few studies have evaluated this relation in trained females (Jürimäe, Vaiksaar, Mäestu, Purge, & Jürimäe, 2011). Therefore, the aim of this study was to assess the influence of sex hormones on BMD in females athletes with different hormonal profiles (eumenorrheic females, oral contraceptive users and postmenopausal females).
METHODS: Seven eumenorrheic females (BMI 20,9±1,26 kg/m2; 27,67±5,11 years), seven oral contraceptive users (OCP) (BMI 21,15±1,67 kg/m2; 33,27±4,48 years) and seven postmenopausal females (BMI 20,73±1,7 kg/m2; 50,71±3,20 years), participated in this study. All of them were well trained in endurance and strength training. BMD was assessed by dual-energy X-ray absorptiometry scan (Version

6.10.029GE Encore 2002, GE Lunar Prodigy; GE Healthcare, Madison, WI, USA). One-way ANOVA for independent samples was used to analyse BMD among different groups (p<0,05).
RESULTS: Eumenorrheic group presented a BMD of 1.16±0.06 g/cm2, oral contraceptive users 1.18±0.03 g/cm2 and postmenopausal females 1.13±0.09 g/cm2. No significant differences were observed for BMD among different hormonal profiles (F2,18= 1.2; p = 0.324; η2 = 0.118).
CONCLUSION: The results manifested no difference in BMD among women in different hormonal status, whereas most studies have revealed a BMD decreased in postmenopausal females, because of the estradiol reduction (Huitrón-Bravo et al., 2016). This result may be explained by the fact that our volunteers are well trained, and some researches showed an increase in BMD with impact exercise (Grove & Londeree, 1992). Therefore, exercise could attenuate the possible BMD decrease with the age. With regard to eumenorrheic and oral contraceptive groups, any differences has been reported. On the one hand, these data agree with other findings in healthy non-athletes females (Di Carlo et al., 2013). On the other hand, our outcomes do not agree with a study made with rowers which presented higher levels of bone formation markers in eumenorrheic females (Jürimäe, Vaiksaar, Mäestu, Purge, & Jürimäe, 2011). Future studies are needed in order to elucidate the specific interaction between sex hormones and BMD when studying athletes.

VITAMIN D PROFILE, SEX HORMONE STATUS AND BIOCHEMICAL MARKERS OF BONE TURNOVER IN FEMALE DANCERS: A 12 WEEK HIIT INTERVENTION STUDY

SCOTT, S., KNAPP, K., BRODRICK, A., FULFORD, J., KRUSTRUP, K., TANG, J., FRASER, W., BOWTELL, J.L.
UNIVERSITY OF EXETER

INTRODUCTION: The physiological demands of classical dance alongside aesthetic requirements to maintain a lean physique may impact on bone and reproductive health in females, as a result of relative energy deficiency and perturbation of the hypothalamic-pituitary-gonadal (HPG) axis. As indoor athletes, dancers may also be at risk of vitamin D insufficiency, with further consequences for bone health. This study examined the relationship between gonadal steroid hormones (GSH), vitamin D (25OHD), biochemical markers of bone turnover and calcaneal bone stiffness in response to a 12 week High-Intensity Interval Training (HIIT) intervention in a population of young female dancers.
METHODS: 30 full-time female classical dance students were recruited, of whom 11 second years (17.6±0.7 y) trained as usual (TAU) and 19 third years (18.6±1.2 y) received 15 minutes twice weekly Diverse Movement HIIT in addition to TAU. At baseline (September) and after 12 weeks (December), overnight fasted venipuncture serum samples were collected and a quantitative ultrasound scan (GE Lunar Insight) of the calcaneus performed. Serum was analysed to determine GSH (estradiol, FSH, LH) and 25OHD status, and assayed for P1NP and β-CTX to assess dynamic bone turnover. Two-way mixed model ANOVAs were used to compare between groups (HIIT vs TAU) for all measures pre-and post-12 weeks; data for estradiol (E2) and 25OHD pre- and post-intervention were pooled to examine their relationship with bone outcome measures (P1NP, β-CTX, calcaneal stiffness). Significance was set at p<0.05.
RESULTS: There was no effect of training group on GSHs pre- or post-intervention. At baseline, median E2 in HIIT (191pmol/L) and TAU (191 pmol/L) were below reference values for ovulatory phase E2 (235-1309 pmol/L) and was lower at 12 weeks in TAU (165 pmol/L) but not HIIT (246 pmol/L). Serum 25OHD was lower after 12 weeks in both groups (p<0.001) towards insufficiency in TAU (32-48 nmol/L, 25%-75% IQ) remaining adequate in HIIT (55-130 nmol/L, 25%-75% IQ). There was a significant reduction of β-CTX in HIIT but not TAU (p=0.043 vs p= 0.823; post hoc) no other significant interaction or main effects were observed. P1NP and E2 were positively correlated at baseline (p=0.101, r=0.303) and 12 weeks (p=0.017, r=0.441), and 25OHD and β-CTX at baseline (p=0.047, r=0.364).
CONCLUSION: A diverse movement HIIT protocol superimposed on regular dance training for 12 weeks did not result in increased calcaneal stiffness in young female dancers. However low estradiol status, indicating potential disturbance of the HPG axis in accordance with Triad associated dysfunction, may have exerted a moderating effect on the osteogenic response to exercise, as supported by evidence of a positive relationship between estradiol and bone formation marker P1NP. In contrast bone resorption as measured by β-CTX was suppressed in HIIT but not in TAU, which suggests that in this population a pro-bone HIIT exercise stimulus influenced bone resorption but not formation marker dynamics.

TEN-WEEK TRAINING LOAD HAS AN EFFECT ON ARM BONE MINERAL DENSITY AND BODY FAT FREE MASS IN ADOLESCENCE SWIMMERS

PIND, R., LÄTT, E., PURGE, P., MÄESTU, J.
UNIVERSITY OF TARTU

INTRODUCTION: Swimmers have been characterized as lean athletes, with relatively high proportion of muscle mass and they accumulate relatively high training load from relatively young ages. Despite that, recent review (Gomez-Bruton et al., 2018) has indicated that swimmers bone mineral density might be compromised due to its non-weight bearing nature. The aim of this study was to investigate the effect of different training load intensities to changes in body composition parameters.
METHODS: 7 (2 women, 5 men) national level swimmers (16.1±2.1 years; BMI 19.99±2.75 kg*m-2; VO2max 50.1±4.4 ml*min-1*kg-1) participated in a 10 week study. Their 100 m freestyle swimming time was 57.62±5.92 s prior the study. Before and after the 10 week study period the metabolic parameters together with DXA parameters were measured. 30-minutes after each training session planned by coaches, athletes reported their RPE (Foster et al., 2001). sRPE was then calculated by multiplying training session duration with RPE. Training load was expressed as total load during 10 weeks and also divided into 3 intensity levels as light (RPE<=4), moderate (RPE 5-6) and intensive (RPE>=7) (Seiler and Kjerland, 2006).
RESULTS: Training load from intensive trainings during 10 weeks had the significant effect to changes in fat free mass (p<0.05). Light, moderate and cumulative training load indicated significant effect to changes in arm bone mineral density (p<0.05). Both calculations were controlled for age and sex of the subjects. There was no significant effect of different training load types to changes in other body composition parameters.
CONCLUSION: The most important finding was that there was a significant association between total, light and moderate training load to changes in arm bone mineral density. Although it has been indicated that the effect of swimming might be low to different bone mineral sites, our data show that training load effect might be different for different parts of the body. About 16% of trainings were reported as being intensive by the athletes, which can be considered pretty high. Intensive trainings in contrast were associated to changes in body fat free mass.
REFERENCES:
Foster C et al. (2001). J Strength Cond Res, 15: 109-115.

Gomez-Bruton A et al. (2018), J Sports Sci, 36:4, 365-377.
Seiler KS, Kjerland GØ (2006). Scand J Med Sci Sports, 16: 49-56.
CONTACT:
Rasmus Pind, MSc
Institute of Sport Sciences and Physiotherapy
University of Tartu
5 Jakobi Street, 51014 Tartu, Estonia
E-mail: Rasmus.Pind@ut.ee

DOES BONE GRAFTING INCREASE THE STATIC STRENGTH OF HIGH TIBIAL OSTEOTOMY?

BELSEY, J., DIFFO KAZE, A., JOBSON, S., FAULKNER, J., MAAS, S., KHAKHA, R., WILSON, A., PAPE, D.

UNIVERSITY OF WINCHESTER

INTRODUCTION: Medial opening-wedge high tibial osteotomy (HTO) is a form of knee surgery used to treat tibial deformity and medial osteoarthritis of the knee. It is often indicated in young or active patients who wish to return to physical activity post-operatively. Despite research investigating the clinical benefits and disadvantages of using graft materials during HTO, further research is needed to analyse the mechanical stability of HTO with multiple graft materials. Accordingly, the purpose of this study was to investigate the use of different graft materials during HTO, and their effects on construct strength and stability. It was hypothesised that 1) HTO with a graft, regardless of type, would provide greater static strength when compared to controls without a graft; and 2) that there would be a difference between the graft materials, regarding the stability that they provide the HTO.
METHODS: A 10 mm biplanar HTO was performed on 15 artificial tibiae. In the resultant osteotomy gap, an allograft wedge (n=5), or pairs of synthetic β-tricalciumphosphate wedges (n=5) were inserted prior to plate fixation. An additional control group (n=5) with no inserted wedge was also included in the study. All osteotomies were secured using an internal fixator plate with a monoaxial locking system. Static compression was applied, following a ramp protocol (0.1 mm/s), perpendicular to the tibial plateau of each specimen, until failure of the osteotomy construct. Failure was the point at which there was a fracture of the lateral cortex. Maximum force, horizontal and vertical displacements, valgus malrotation of the tibial head, and specimen stiffness were calculated. Due to the small sample size of each group, statistical analyses were not relevant. The results that are reported in the present study are based on the means from each test group.
RESULTS: The synthetic group failed at 6.25 kN, the allograft group at 6.04 kN, and the control group at 4.46 kN. The most valgus malrotation of the tibial head was observed in the allograft group (2.6˚). The synthetic group showed the highest stiffness at the medial side of the tibial head, but the lowest stiffness at the lateral side. The allograft group showed high stiffness on the medial side of the tibial head as well as the highest stiffness on the lateral side.
CONCLUSION: Allograft and synthetic implants similarly increase the static strength of an HTO compared to no graft. Synthetic grafts provide the highest mechanical strength, however the high increased stiffness that they provide to the medial side of the bone-implant construct may reduce the range of interfragmentary movements of the open wedge, which may affect time-to-union. Allograft implants increase the stiffness of the osteotomy medially and laterally, which may result greater protection of the lateral cortex. These results may have implications for patients returning to physical activities post-surgery that cause high forces to be exerted through their knee.

LONGITUDINAL EFFECTS OF SWIMMING AND VIBRATION TRAINING ON BONE TURNOVER MARKERS IN ADOLESCENTS

MARIN-PUYALTO, J., GÓMEZ-BRUTON, A., MATUTE-LLORENTE, A., LOZANO-BERGES, G., MUÑIZ-PARDOS, B., GÓMEZ-CABELLO, A., GONZÁLEZ-AGÜERO, A., CASAJÚS, J.A., VICENTE-RODRÍGUEZ, G.

UNIVERSITY OF ZARAGOZA

INTRODUCTION: The levels of bone turnover markers in adolescent swimmers are similar to inactive controls and lower than adolescents practising osteogenic sports (i.e. football) (Vlachopoulos et al., 2017). Acute increases in bone turnover markers after performing whole-body vibration training (WBV) have been described in pre-pubertal boys (Harrison et al., 2015); however, the long-term effects of this type of training on bone metabolism in adolescent swimmers are still unknown. Therefore, the main goal of this study was to compare the longitudinal effects of swimming and vibration training on bone formation and resorption markers in adolescents.
METHODS: Sixty-nine swimmers and 41 inactive controls (CG, 14.0 (2.6) years, 14 females) took part in this 24-week controlled trial. Swimmers were randomly assigned to two groups, with one group following an incremental WBV protocol in addition to their regular swimming training (VIB, n=37, 14.4 (1.8) years, 16 females) and the other group practising swimming only (SWI, n=32, 14.1 (1.8) years, 13 females). Baseline and follow-up evaluations included height, weight, Tanner stage and fasting levels of osteocalcin (OC) and C-terminal telopeptide (CTX). Statistical analyses included paired t-tests to evaluate longitudinal changes and repeated measures ANOVA to check group interactions. Statistical significance was set at $p<0.05$.
RESULTS: Groups showed no differences in age, height, weight and maturation status at both baseline and follow-up assessments. After the training period, VIB showed a significant decrease in OC and CTX (both $p<0.05$), CG experienced a decrease in CTX ($p<0.05$) and no change in bone markers were found on SWI. No differences among groups were found at baseline for any bone marker. At follow-up, however, VIB presented lower OC levels than SWI and CG (78.8 (43.0), 118.6 (49.4) and 105.3 (50.7) ng/ml respectively, $p<0.05$) and lower CTX levels than SWI (VIB: 1.45 (0.67), SWI: 1.90 (0.67) ng/ml; $p<0.05$). A group by time interaction was found for OC (partial eta square=0.161, $p<0.05$) but not for CTX (partial eta square=0.036, $p=0.141$). Further analyses stratifying the sample by sex or pubertal stage yielded similar results (data not shown).
CONCLUSION: The main result of the study is that adolescents complementing their habitual swimming training with WBV showed a decrease in both formation and resorption markers, resulting in OC levels lower than those of inactive controls. These results are surprising, especially taking into account the acute increment in bone turnover markers following one week of WBV (Harrison et al., 2015). On the other hand, no decrease of bone metabolism was observed in SWI. Further research could help confirming these results.
References: Harrison R, Ward K, Lee E, Razaghi H, Horne C, Bishop NJ (2015). J Musculoskelet Neuronal Interact, 15(2), 112–122.
Vlachopoulos D, Barker AR, Ubago-Guisado E, Fatouros IG, Knapp KM, Williams CA, Gracia-Marco L (2017). J Bone Miner Res, 32(11), 2269–2277.
Contact: jmarinp@unizar.es

A 9-MONTH JUMPING INTERVENTION TO IMPROVE BONE ACQUISITION IN ADOLESCENT MALE ATHLETES: THE PRO-BONE RANDOMIZED CONTROLLED TRIAL

VLACHOPOULOS, D., BARKER, A.R., UBAGO-GUISADO, E., WILLIAMS, C.A., GRACIA-MARCO, L.
UNIVERSITY OF EXETER

INTRODUCTION: Participation in different loading sports during growth can have different effects on bone status and development. However, there is no evidence how to improve bone acquisition in adolescent athletes involved in weight-bearing and non-weight bearing sports. The purpose of the present study is to investigate for first time the effect of a 9-month progressive jumping intervention programme on bone mass, geometry and microarchitecture in adolescent males participating in weight-bearing (football, FOO) and non-weight bearing (swimming, SWI and cycling, CYC) sports.
METHODS: A total of 93 adolescent males (13-15 years) were included. Sport groups were randomized to intervention and sport (INT-SWI=19, INT-FOO=15, INT-CYC=14) or sport only (CON-SWI=18, CON-FOO =15, CON-CYC=12). The intervention comprised a progressive jumping programme of 3 levels (3 months each) using weighted vests (Level 1= 20 jumps, 0 kg, 3 sets/day, 3 times/week; Level 2= 20 jumps, 2 kg, 4 sets/day, 3 times/week; Level 3= 20 jumps, 5 kg, 4 sets/day, 4 times/week). Dual-energy x-ray absorptiometry (DXA) assessed bone mineral content (BMC), hip structural analysis (HSA) assessed cross-sectional area (CSA), cross-sectional moment of inertia (CSMI) and section modulus, trabecular bone score (TBS) assessed bone microarchitecture and quantitative ultrasound assessed bone stiffness before and after the intervention. One-way analysis of covariance (ANCOVA) was used to compare the bone gains after controlling for pre-intervention bone, change in lean mass and post maturity status. Percentages of difference were used to quantify the magnitude of the differences in adjusted bone gains. Significance was set at $p<0.05$.
RESULTS: INT-CYC gained significantly ($p<0.05$) higher total body less head BMC (5.0%), lumbar spine BMC (4.6%), femoral neck BMC (9.8%) and bone stiffness (12.3%) than CON-CYC. INT-CYC gained significantly higher CSA (11.0%), CSMI (10.1%) and TBS (4.4%) outcomes than CON-CYC. INT-SWI gained significantly ($p<0.05$) higher femoral neck BMC (6.0%), legs BMC (4.2%) and bone stiffness (12.7%) than CON-SWI. INT-SWI gained significantly ($p<0.05$) higher CSMI outcomes (10.9%) than CON-SWI. There were no significant ($p>0.05$) differences between INT-FOO and CON-FOO for any bone outcomes (0.9-3.9%).
CONCLUSION: This is the first randomized control trial to investigate the effects of a 9-month progressive jumping intervention programme on bone outcomes in adolescent male athletes. The findings indicate that the jumping intervention programme can significantly improve bone quantity, geometry, stiffness and microarchitecture outcomes in adolescent male athletes involved in non-weight-bearing sports, such as swimming and cycling, but not in weight-bearing sports, such as football. The present jumping intervention programme may indicate a window of opportunity to counteract the lack of osteogenic stimulus of non-weight-bearing sports and can be implemented by non-weight-bearing sports clubs and athletes to improve bone health.

Oral presentations

OP-PM15 PROTEIN SYNTHESIS

THE EFFECTS OF INGESTING DIFFERENT DAIRY PROTEINS ON SKELETAL MUSCLE PROTEIN SYNTHESIS RATES DURING RECOVERY FROM CONCURRENT EXERCISE

PINCKAERS, P.J.M.1, CHURCHWARD-VENNE, T.A.1, SMEETS, J.S.J.1, PEETERS, W.M.1, ROLLO, I.2, VAN LOON, L.J.C.1
1: NUTRIM, MAASTRICHT UNIVERSITY, THE NETHERLANDS, 2: GATORADE SPORTS SCIENCE INSTITUTE, UNITED KINGDOM

INTRODUCTION: Protein ingestion during recovery from exercise increases muscle protein synthesis rates and supports muscle reconditioning. The type of protein ingested may modulate muscle protein synthesis rates after exercise. Whey and casein are milk-derived proteins that have been reported to possess different anabolic properties. How whey and casein compare to total milk protein (20% whey and 80% casein) in their capacity to support postprandial muscle protein synthesis rates during recovery from exercise remains to be established. Therefore, this study compared muscle protein synthesis rates following co-ingestion of milk protein, whey, and micellar casein with carbohydrate during recovery from a single bout of concurrent exercise.
METHODS: In a randomized, double-blind, parallel-group design, 48 healthy young recreationally active males (aged 23±0.3 y) received a primed continuous infusion of L-[ring-13C6]-phenylalanine and ingested 45 g of carbohydrate with 0 g protein (CHO), 20 g (total) milk protein (MILK), 20 g whey (WHEY), or 20 g micellar casein (CASEIN) following a single bout of concurrent resistance- and endurance-type exercise (n=12 per group). Blood and muscle biopsy samples were collected over a 6 h postprandial period during recovery from exercise to evaluate muscle protein synthesis rates and molecular signaling through targets of the mTORC1 pathway. One-way repeated measures ANOVA with treatment as between-subjects factor was used to evaluate between group differences in muscle protein synthesis rates over the 0-6 h postprandial period.
RESULTS: Muscle protein synthesis rates were not different between treatments (P=0.12) over the 6 h of post-exercise recovery (CHO:0.051±0.003; MILK:0.061±0.003; WHEY:0.056±0.002; CASEIN:0.062±0.005 %/h). In line, no differences in mTORC1 signaling were observed between groups. All protein treatments increased plasma leucine concentrations (µmol/L) more than CHO. When all protein treatments were collapsed into a single group (PROTEIN), protein co-ingestion was shown to result in greater muscle protein synthesis rates (PROTEIN=0.060±0.002 %/h) when compared to carbohydrate ingestion only (CHO=0.051±0.003 %/h; P=0.042).
CONCLUSION: Total milk protein, whey, and micellar casein do not differ in their capacity to support postprandial muscle protein synthesis rates when co-ingested with carbohydrate following concurrent exercise in young recreationally active males.
This study was externally funded by GSSI, a division of PepsiCo Inc. Any opinions or scientific interpretations expressed in this manuscript are those of the author and do not necessarily reflect the position or policy of PepsiCo Inc.

LEUCINE-ENRICHED PROTEIN SUPPLEMENTATION DOES NOT AUGMENT MUSCLE MASS AND STRENGTH GAINS FOLLOWING RESISTANCE-TYPE EXERCISE TRAINING IN HEALTHY OLDER MALES

HOLWERDA, A.M., OVERKAMP, M., PAULUSSEN, K.J.M., SMEETS, J.S.J., GIJSEN, A.P., GOESSENS, J.P.B., VERDIJK, L.B., VAN LOON, L.J.C.

MAASTRICHT UNIVERSITY MEDICAL CENTRE+

INTRODUCTION: The proposed benefits of protein supplementation on the skeletal muscle adaptive response to resistance-type exercise training remain unclear. Protein ingestion after exercise and prior to sleep have been shown to augment muscle protein synthesis during recovery from exercise. However, it remains to be established whether dietary protein ingestion after exercise and before sleep augments muscle mass and strength gains during prolonged resistance-type exercise training in older individuals.
METHODS: Forty-one healthy older males (70±1 y) completed 12 weeks of resistance-type exercise training (3 times.week-1) and were randomly assigned to ingest either protein (20 g whey plus 1 g leucine; n= 21) or an energy-matched placebo (n= 20) after exercise and each night prior to sleep. Maximal strength was assessed by one-repetition maximum (1RM) testing before and after training. Muscle hypertrophy was assessed at the whole-body (dual-energy X-ray absorptiometry), upper leg (computed tomography scan), and muscle fiber (biopsy) level. Muscle protein synthesis rates during week 12 of training were assessed by providing deuterated water (2H2O) and collecting muscle biopsies. A two-factor repeated measures ANOVA (time * treatment) was used to compare muscle strength, appendicular lean mass and quadriceps and muscle fiber cross sectional area. Myofibrillar protein synthesis rates were compared using an unpaired t-test.
RESULTS: Leg extension 1RM increased in both groups (placebo: 88±3 to 104±4 kg, protein: 85±3 to 102±4 kg; P<0.001), with no differences between groups (P>0.05). Appendicular lean mass (placebo: 26.7±0.7 to 27.7±0.7 kg, protein: 26.0±0.5 to 26.6±0.5 kg; P<0.001) and quadriceps cross sectional area (placebo: 67.8±1.7 to 73.5±2.0 cm2, protein: 68.3±1.4 to 72.3±1.4 cm2; P<0.001) increased in both groups, with no differences between groups (P>0.05). Muscle fiber hypertrophy occurred in type II (placebo: 5486±418 to 6492±429 µm2, protein: 5367±301 to 6259±391 µm2; P<0.001), but not in type I fibers (placebo: 6059±364 to 6600±269 µm2, protein: 5935±246 to 6171±305 µm2; P>0.05), with no differences between groups (P>0.05). Muscle protein synthesis rates were 1.62±0.06 and 1.57±0.05 %·d-1 in the placebo and protein groups, respectively, with no differences between groups (P>0.05).
CONCLUSION: Leucine-enriched protein supplementation after exercise and before sleep does not further augment skeletal muscle mass or strength gains following resistance-type exercise training in healthy older males.

INVESTIGATING THE ROLE OF VPS34 AS AN AMINO ACID SENSOR IN HUMAN SKELETAL MUSCLE

HODSON, N., DENT, J., SONG, Z., O'LEARY, M.F., NICHOLSON, T.A., JONES, S.W., MURRAY, J.T., HAMILTON, D.L., BREEN, L., PHILP, A.

UNIVERSITY OF BIRMINGHAM

INTRODUCTION: It is well established that the ingestion of amino acids (AAs) activates the mechanistic target of rapamycin complex 1 (mTORC1) and elevates muscle protein synthesis in skeletal muscle. However, the mechanisms by which AAs are sensed in skeletal muscle are as yet unknown. Recent in vitro studies have implicated the class III PI3Kinase Vps34 in this process, demonstrating that deletion of Vps34 abolishes AA-stimulated mTORC1 signalling (1). The primary aim of this study was to determine the effects of protein-carbohydrate (PRO-CHO) feeding on Vps34 kinase activity, cellular location and protein-protein interactions in human skeletal muscle. A secondary aim was to test the importance of Vps34 kinase activity for mTORC1 signalling in vitro using primary human myotubes with the specific Vps34 inhibitor SAR405 (2).
METHODS: Skeletal muscle biopsies were obtained from the v.lateralis of young healthy males (n=8, 23.1±0.5yrs) at baseline and 1 and 3 h following the ingestion of a PRO-CHO (20/44/1g PRO/CHO/FAT) beverage. Muscle samples were used for Vps34 and S6K1 kinase activity assays and immunohistochemistry. In vitro analysis was completed on myoblasts isolated from 2 middle-aged orthopaedic patients (1 female, 1 male, 57.5±7.5). Here, cells were collected pre- and post-nutrient reintroduction (30mins DMEM+2%HorseSerum), after overnight EBSS incubation, either in the presence of absence of SAR405 and anabolic signalling assessed.
RESULTS: S6K1 kinase activity was elevated 1h post-feeding (p<.01), coinciding with mTOR translocation toward the cell periphery (time effect, p=.026). Vps34 kinase activity was unaltered at any time point. In contrast, Vps34 was observed to translocate toward the cell periphery (1h > Pre, p=.043) where it co-localised with mTOR (time effect, p=.046). Preliminary results from human myotubes reveal a reduction in mTORC1 activation after nutrient reintroduction, when SAR405 was administered, compared to control conditions.
CONCLUSION: Overall, these data suggest that Vps34 kinase activity is required for optimal nutrient-stimulated activation of mTORC1 in vitro, however, Vps34 activity is not altered by PRO-CHO feeding in human skeletal muscle. Alternatively, our data suggests that alterations in the cellular localisation of Vps34, and its interaction with mTOR may contribute to its potential role in AA sensing.
1. M. P. Byfield, et al., The Journal of biological chemistry 280, 33076-33082 (2005).
2. B. Ronan et al., Nature chemical biology 10, 1013-1019 (2014).

MEASUREMENT OF MUSCLE, TENDON, LIGAMENT, CARTILAGE, AND BONE PROTEIN SYNTHESIS RATES IN VIVO IN HUMANS

SMEETS, J.S.J., HORSTMAN, A.M.H., VLES, G.F., EMANS, P.J., GOESSENS, J.P.B., GIJSEN, A.P., VAN KRANENBURG, J.M.X., VAN LOON, L.J.C.

MAASTRICHT UNIVERSITY MEDICAL CENTRE+

INTRODUCTION: Skeletal muscle plasticity is reflected by a dynamic balance between protein synthesis and breakdown, with basal muscle protein synthesis rates typically ranging between 0.04 and 0.06 %/h. Though it is evident that other musculoskeletal tissues should also express some level of plasticity, protein synthesis rates of most of these tissues have never been assessed. The present study applies contemporary stable isotope methodology to assess basal muscle, tendon, ligament, bone, as well as cartilage protein synthesis rates in vivo in humans.
METHODS: Six otherwise healthy patients (62±3 y), scheduled to undergo unilateral total knee arthroplasty, were included in this study. Primed continuous intravenous infusions with L-[ring-13C6]-Phenylalanine were initiated 2.5 h prior to surgery and continued during surgery. Throughout the surgical procedure the following tissue samples were obtained: muscle, tendon, cruciate ligaments, cartilage, bone, menisci, fat and synovium. Tissue-specific fractional protein synthesis rates (%/h) were assessed by measuring the incorporation of

labelled L-[ring-13C6]-Phenylalanine in tissue protein and were compared with muscle tissue protein synthesis rates using a paired t-test. Data are expressed as means ± SEM.
RESULTS: Protein bound L-[ring-13C6]-Phenylalanine enrichments did not differ substantially between the different musculoskeletal tissues and skeletal muscle, except for notch bone tissue (P<0.01). Highest enrichment levels were observed in synovium derived protein (0.029±0.008 MPE) and lowest enrichment levels in patellar bone tissue protein (0.005±0.002 MPE). Tendon, bone, cartilage, fat, anterior cruciate ligament, posterior cruciate ligament, and menisci tissue protein synthesis rates averaged 0.06±0.01, 0.03±0.01, 0.04±0.01, 0.11±0.03, 0.07±0.02, 0.04±0.01, and 0.04±0.01 %/h, respectively, and did not significantly differ from skeletal muscle protein synthesis rates (0.04±0.01 %/h; P>0.05). Synovium derived protein and notch bone tissue protein synthesis rates were respectively higher and lower compared to skeletal muscle protein synthesis rates (P<0.05 and P<0.01, respectively).
CONCLUSION: Basal protein synthesis rates in various musculoskeletal tissues are within the same range of skeletal muscle protein synthesis rates, with fractional muscle, tendon, bone, cartilage, ligament, and menisci tissue protein synthesis rates ranging between 0.02 and 0.13 % per hour.

BASAL AND POSTPRANDIAL MYOFIBRILLAR PROTEIN SYNTHESIS RATES DO NOT DIFFER BETWEEN LEAN AND OBESE MALES

KOUW, I.W.K., VAN DIJK, J.W., HORSTMAN, A.M.H., KRAMER, I.F., GOESSENS, J.P.B., VAN DIELEN, F.M.H., VERDIJK, L.B., VAN LOON, L.J.C.

MAASTRICHT UNIVERSITY MEDICAL CENTRE+

INTRODUCTION: Excess lipid availability has been associated with the development of anabolic resistance. As such, obesity may be accompanied by impairments in basal and/or postprandial muscle protein synthesis. We hypothesized that basal and/or postprandial muscle protein synthesis rates are lower in middle-aged obese when compared to lean men.
METHODS: Twelve normoglycemic, obese men (age: 48±2 y, BMI: 37±1 kg·m-2, body fat: 32±2%) and twelve age-matched, lean controls (age: 43±3 y, BMI: 23±1 kg·m-2, body fat: 21±1%) received primed continuous L-[ring-2H5]-phenylalanine and L-[1-13C]-leucine infusions and ingested 25 g intrinsically L-[1-13C]-phenylalanine and L-[1-13C]-leucine labeled whey protein. Blood and muscle samples were taken frequently to assess protein digestion and amino acid absorption kinetics, and basal and postprandial myofibrillar protein synthesis (MPS) rates. Unpaired t-tests were used to compare basal MPS rates between groups. Repeated measures ANOVA were applied to determine differences in postprandial MPS rates between groups over time (time as within, and group as between-subjects factor).
RESULTS: Exogenous phenylalanine appearance rates increased following protein ingestion in both groups (P<0.001), with 58±1 and 58±2% of the dietary protein-derived amino acids appearing in the circulation over the 5h postprandial period in the lean and obese subjects (P=0.82), respectively. Myofibrillar protein synthesis rates increased from 0.030±0.002 vs 0.028±0.003 %·h-1 in the basal period (between groups P=0.60) to 0.034±0.002 vs 0.035±0.003 %.h-1 in the postprandial period (time P=0.03), with no differences between lean and obese subjects (time x group interaction P=0.58), respectively.
CONCLUSION: Basal, post-absorptive myofibrillar protein synthesis rates do not differ between lean and obese males. Postprandial protein handling, including protein digestion and amino acid absorption and the muscle protein synthetic response to protein ingestion, are not impaired in obese males.

Oral presentations

OP-BN28 Biomechanics of muscle contraction

NEUROMUSCULAR CHARACTERISTICS AND MUSCLE GEOMETRY IN POWER ATHLETES AND UNTRAINED INDIVIDUALS

MONTE, A., GIURIATO, G., ZAMPARO, P.

UNIVERSITY OF VERONA

INTRODUCTION: Electromechanical delay and rate of force development are important determinants of "explosive" neuromuscular performance. The aim of this study was to investigate the influence of muscular characteristics on EMD, RFD, as well as the effects of gender and training level on the possible correlation between neuromuscular parameters and muscle characteristics.
METHODS: Muscle thickness, pennation angle and fascicle length of the quadriceps extensor muscles of 40 subjects <10 M and 10 F power athletes; 10 M and 10 F untrained> were measured with an ultrasound apparatus. Muscle force and EMG were synchronized and measured continuously in time <1500 Hz>; they were normalized to maximal strength and maximal muscle activity, respectively. EMD and RFD were assessed during a series of explosive and maximal voluntary isometric contractions . RFD was measured in 3 time intervals: 0-50, 50-100 and 100-150 ms.
RESULTS: Muscle characteristics, maximal force and maximal RFD showed significant differences according to gender and training level. Athletes had greater normalised RFD <5.7±0.6 and 3.24±0.6 MVC·s-1> and EMG values during the first 50 ms <69.7±10 and 57.9±8 %EMGMVC> of "explosive" contraction. No differences were observed between athletes and untrained individuals in the other time intervals. Male and female had similar EMD values but athletes showed lower values of EMD <16±1.7 and 19.3±1.7 ms> compared to untrained individuals. Muscle characteristics were found to influence "explosive" contraction: pennation angle showed a significant positive correlation with RFD0-50 and RFD50-100 in all groups, whereas no correlation was observed with RFD100-150. A significant negative correlation was also found between pennation and EMD .
CONCLUSION: This is the first study that analysed the role of muscle characteristics on EMD and RDF in "explosive" contractions. In accordance with Tillin et al. <2010> and Hannah et al. <2012> RFD was greater in athletes during the initial phases of contraction <0-50 mz> and no differences was observed between gender. Our data furthermore indicate an important interaction between muscle properties and "explosive" force production suggesting that a greater pennation angle could increase RFD at contraction onset <0-100 ms> and reduce EMD.
Tillin NA, Jimenez-Reyes P, Pain MTG, Folland JP. <2010>. Med. Sci. Sports Exerc., 42, 781-790
Hannah R, Minshull C, Buckthorpe MW, Folland JP. <2012>. Exp. Physiol., 97, 618-629
Contact: Email address: andrea.monte@univr.it

EFFECTS OF MOTOR UNIT PROPERTIES ON ACTIVATION REDUCTION IN THE TIBIALIS ANTERIOR

KUZYK, S.L.1, DALTON, B.H.1, MCNEIL, C.J.1, POWER, G.A.2, JAKOBI, J.M.1

1.UNIVERSITY OF BRITISH COLUMBIA OKANAGAN, KELOWNA, BC 2.UNIVERSITY OF GUELPH, GUELPH, ON

INTRODUCTION: Following an active lengthening contraction, electromyographic (EMG) amplitude of a steady-state isometric (ISO) submaximal contraction is decreased in comparison to a purely ISO contraction, which is known as activation reduction (AR), a phenomenon of residual force enhancement. Alterations in motor unit (MU) activity are thought to contribute to AR as well as torque steadiness (TS) (1,2). However, little is known about the underlying cause of AR, and its functional implication on TS. Our study evaluated the underlying contribution of MU properties in the tibialis anterior (TA) to AR and its effect on TS during an ISO contraction following active lengthening. It was hypothesized that the MU discharge rate (DR) would be lower during AR compared to the torque-matched ISO contraction, which would contribute to less steady contractions in the AR state.
METHODS: Ten healthy males (26±4years) performed torque-matched ISO contractions at 10% maximal voluntary contraction (MVC) at 30° plantar flexion. This was followed by an active lengthening contraction performed from 0° to 30° ankle excursion, ending at the same muscle length as the purely ISO contraction. Indwelling EMG sampled TA MU action potential trains to determine MUDR and DR variability (DRV). Coactivation and AR was assessed using surface EMG of the TA and triceps surae. Torque steadiness was evaluated as the coefficient of variation of torque during the purely steady-state ISO and AR contractions.
RESULTS: In the ISO steady-state after active lengthening, there was a 44% AR ($p<0.05$) compared to ISO, with no difference in antagonist coactivation ($p>0.05$). Following active lengthening, CV of TS was 29% higher during AR than ISO contraction ($p\leq0.01$). There were 51 discrete MUs identified, but only 27 of these were tracked during both the purely ISO and AR contraction. Fewer MUs were recorded during AR and MUDR decreased by 19% ($p<0.05$) compared to ISO. MUDRV did not differ between the two conditions ($p>0.05$).
CONCLUSION: These results indicate that a reduction in MUDR and number of detectable active MUs likely contribute to AR, which in turn leads to reduced TS following active lengthening.
(Supported by NSERC)
1. Altenburg et al. Appl Physiol Nutr Metab, 2008;33(6):1086-1095
2. Enoka et al. J Electro and Kines 2003;13(1):1-12

PRELIMINARY INVESTIGATION OF ULTRASOUND IMAGING OF THE GLUTEAL MUSCLES DURING THE Y-BALANCE TEST IN INDIVIDUALS WITH CHRONIC ANKLE INSTABILITY.

DEJONG, A.F., MANGUM, L.C., HERTEL, J.

UNIVERSITY OF VIRGINIA

INTRODUCTION: Altered dynamic balance has been linked with the development and persistent nature of Chronic Ankle Instability (CAI) (Doherty, 2016). However, the interplay between proximal muscle activity and joint mechanics during such tasks in this population is unknown. Ultrasound imaging (USI) is a reliable means to explore muscle activity without issues of muscle cross-talk seen with electromyography (Dieterich, 2015). Thus, the objective of this study is to determine the relationship between gluteus maximus and medius USI muscle activity, lower extremity kinematics, and Y-Balance test (YBT) performance in individuals with and without CAI.
METHODS: An a priori sample size estimate with a beta level of 0.80 and alpha level of 0.05 estimated the need for 25 subjects per group. In this preliminary analysis there were 8 CAI subjects (21.4±2.2 yrs, 173.5±13.3 cm, 73.1±19.2 kg, 4 males) and 8 healthy matched subjects (20.4±2.3 yrs, 176.7±19.0 cm, 69.3±9.6 kg). Bilateral B-mode USI of the gluteals at stance and the pinnacle of YBT reach directions were taken over 3 trials. Lower extremity sagittal plane kinematics were collected with motion capture software. Gluteal thickness measures were normalized to stance to determine muscle activity ratios. YBT reach distances were normalized to leg length, and peak kinematics were obtained at maximum reach. Independent t-tests were run to compare group demographics. Analyses of variance were run to determine differences between groups and within affected and unaffected limbs for gluteal muscle thickness, kinematics, and reach distances.
RESULTS: For preliminary results, the CAI group had significantly different responses for kinesiophobia and ankle instability questionnaires compared to the healthy group, verifying the target populations. There were no significant differences in reach distance, kinematics, or muscle thickness between groups. The CAI group had significantly decreased anterior reach gluteus maximus thickness of the affected limb compared to the unaffected limb (A: 1.01±0.20cm, U: 1.17±0.16cm; $p=0.02$). No differences were seen within healthy limbs.
CONCLUSION: In this preliminary subset of subjects, there were no significant differences between groups which contrasts current CAI literature. The results suggest gluteus maximus activity differs between CAI group limbs without affecting YBT performance or kinematics. Exploration on CAI gluteal muscle activity during the YBT in a larger representative sample is ongoing.

TORQUE-SHARING STRATEGIES IN HAMSTRING AMONG ELITE SPRINTERS

AVRILLON, S., HUG, F., GUILHEM, G.

FRENCH NATIONAL INSTITUTE OF SPORT

INTRODUCTION: Knee flexion torque has been extensively assessed to indirectly estimate hamstring torque for performance or prevention purposes (Van Dyk et al. 2016). However, due to the redundancy within the musculoskeletal system, a given joint torque can be produced using various torque-sharing strategies. Thus, the estimation of knee flexion torque may conceal individual differences or alterations in the relative contribution of each hamstring head. Interestingly, using an indirect index of muscle activity [functional Magnetic Resonance Imaging (fMRI)], Schuermans et al. (2014) showed that altered coordination between muscle heads may contribute to the risk of injury. This study aimed i) to describe torque-sharing strategies within hamstring heads in elite sprinters and ii) to determine whether these strategies are altered by a previous injury.
METHODS: 18 sprinters with a unilateral hamstring strain injury history (< 6 months) were recruited to participate in this study. Muscle volume and moment arm of semitendinosus (ST), semimembranosus (SM) and biceps femoris (BF) were determined from segmented Magnetic Resonance Images (MRI). Fascicle length of BF (short and long heads) and SM were measured using panoramic ultrasound images. Because ST is fusiform, muscle-tendon length from MRI was considered as fascicle length. Participants performed three 10-s isometric contraction at 20% of MVC on an isokinetic dynamometer. During these tasks, electromyographic (EMG) activity was recorded through surface electrodes placed over the ST, SM and BF. The torque produced by each muscle head was estimated using physiological cross-sectional area, moment arm and activation amplitude, as follow:
"Torque index =" "Muscle volume" /"Fascicle length" " × Moment arm x % EMGmax"

The ratio of torque between the hamstring muscles was calculated as the torque of one muscle divided by the sum of all three muscles (Hug et al. 2015).
RESULTS: Note that results from 5 participants are presented here. When considering the dominant leg, torque produced by BF (7.1 ± 2.6) was larger than SM (5.7 ± 3.7) and ST (2.3 ± 0.7). The torque ratio reached 48.8 ± 11.8%, 35.1 ± 14.3% and 16.1 ± 5.7% for BF/Hams, SM/Hams and ST/Hams, respectively. A large variability between sprinters is noteworthy (range: 33.3-60.6%, 28.7-52.5% and 10.7-22.2% for BF/Hams, SM/Hams and ST/Hams).
When considering the torque ratio of the injured and the non-injured, no differences were observed for these 5 participants (39.0 ± 16.6% vs. 43.2 ± 19.1% for the injured and the non-injured muscle, respectively).
CONCLUSION: Our preliminary results suggest that the torque-sharing strategies of the hamstring vary greatly between sprinters. Moreover, previous injuries do not seem to alter torque ratio within hamstring muscles.

MUSCLE HETEROGENEITY ASSOCIATED FUNCIONAL AND METABOLIC ASYMMETRY

SEMIATZH, M.2, ALCANTARA, P.1, PINHATA OTOCH, J.1, SERRÃO, J.3, SEELAENDER, M.1,2

1: FMUSP, 2: ICB-USP, 3: EEFE-USP

INTRODUCTION: Most people present asymmetric lower limbs , one dominant while the other is non-dominant .? This heterogeneity of LL is due to stimuli such as walking, posture maintenance and exercise. The aim of this study was to evaluate metabolic and biomechanical aspects of lower limbs comparing active and very active individuals.
METHODS: Sixteen volunteers, aged between 18 and 65, were divided in AC and VA according to IPAQ Laterality was determined by Waterloo questionnaire. Biopsies were performed in both gastrocnemius medial limbs. Ground reaction force was obtained through force platforms. For Electromyography was obtained through Noraxon Desk Receiver. Gene expression RT-PCR was performed. Two-way ANOVA, Studants T tests and Sperman?s correlates were used for statistics p? 0.05.
RESULTS: Significant interaction effect was detected between laterality and effort in gene expression of Citrate Synthase , fatty acid binding protein , Lactate dehydrogenase, lipoprotein lipase, and the Homer 2. FABP showed a significant difference only in ND limb with higher expression in the AC group, while CS showed differences in DM limb with higher expression in VA group.? In VA group FABP and CS were more expressed in DM limbs. In horizontal impulse braking, difference occurred in ND limbs with the AC group braking more. In AC group the ND limb braking more than the DM. In horizontal propulsion, impulse difference occurred in DM limb with VA propelling more than AC. In vertical propulsion impulse comparing AC and VA groups, DM limbs have lower VIP than the ND. In the AC, we observed there is a methabolic balance between the lower limbs. In VA DM limb is more methaboic adapted to lipolytic profile.As the lipolityc protein expressions increase, the storage machinery decreases, specially when GM muscle contration increases in the breaking phase of the race.
In ND limb, the important correlations also related to the braking phase of the race point to an increase of the fat storage as the aerobic activity increases.
CONCLUSION: The results confirm the hypothesis that there is a functional asymmetry in the gait between AC and VA groups. There are also assimetry and metabolic heterogeneity between AC and VA, with different responses of the DM and ND limbs to endurance training pointing that endurance training exacerbates limb asymmetry.

Oral presentations

OP-PM37 Health and Fitness mixed

ASSOCIATIONS OF VO2PEAK WITH ADIPOSITY AND MOTOR COMPETENCE IN CHILDREN ARE CONFOUNDED BY BODY SIZE

HAAPALA, E.A., YING, G., LAUKKANEN, A., SÄÄKSLAHTI, A., FINNI, T.

UNIVERSITY OF JYVÄSKYLÄ

INTRODUCTION: Cardiorespiratory fitness (CRF) has been related to adiposity and motor competence (MC) in children. However, most previous studies assessed fitness by field tests or defined it as a peak oxygen uptake (VO2peak) normalised for kg of body mass (BM(-1)). Such normalisation cannot remove the effect of body size affecting the fitness measures leading to spurious correlations with health and MC outcomes. This study investigated the associations of VO2peak, normalised for BM and lean mass (LM) using ratio standard and allometric procedures, with adiposity and MC.
METHODS: Fifteen children (11 girls) aged 7–11 years (median 9.8y) volunteered to the study and gave their informed consent. VO2peak was measured by maximal cardiopulmonary exercise test on a cycle ergometer. CRF was defined as VO2peak/BM(-1) and VO2peak/LM(-1). Based on the data, we utilised scaling exponent of 0.71 from loglinear allometric modeling (Loftin et al. 2016) and defined CRF as VO2peak/BM(-0.71). BM and body composition was assessed by InBody 770. Fat mass index (FMI, kg/m2) and fat free mass index (FFMI, kg/m2.5) were computed. MC was assessed by KTK test battery including walking backwards on a balance beam, hopping for height, jumping sideways, and moving sideways. Maturity offset was estimated by sex-specific equations (Mirwald et al. 2002).
RESULTS: VO2peak/BM(-1) was inversely associated with FMI (r=-0.550, p=0.036) but not with FFMI. It was also positively correlated to jumping sideways (r=0.529, p=0.043), moving sideways (r=0.522, p=0.046), and balance (r=0.526, p=0.044). Although VO2peak/BM(-0.71) was not associated with FMI or FFMI, it was positively correlated to jumping sideways (r=0.601, p=0.018) and balance (r=0.542, p=0.037). VO2peak/LM(-1) was not associated with FMI, FFMI or MC. Further adjustment for age or maturity offset attenuated the associations of the measures of VO2peak with MC. FMI was inversely associated with moving sideways (r=-0.433, p=0.050) and hopping for height (r=-0.628, p=0.003). Adjustment for age or maturity offset had no effect on these associations.
CONCLUSION: As expected, normalising VO2peak for BM(-0.71) instead of BM(-1) attenuated the effect of adiposity on CRF. However, the positive association between VO2peak and MC was disappeared only after normalising VO2peak for LM. Furthermore, the association between CRF and MC were modified by age and maturity. Because of the confounding influence of children's body size and composition on CRF, it is suggested that the measures of CRF should be expressed relative to LM or allometrically modeled BM.
REFERENCES: Loftin M, Sothern M, Abe T, Bonis M. (2016). Sports Med, 46, 1451–1460.
Mirwald RL, Baxter-Jones ADG, Bailey DA, Beunen GP. (2002). Med Sci Sports Exerc, 34, 689–694.

RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND MUSCULOSKELETAL DISORDERS IN MEN AND WOMEN 19-64 YEARS OLD

MOKHLESABADI FARAHANI, A., JADIDIAN AKBAR, A.

PAYAM-E-NOOR UNIVERSITY

INTRODUCTION: Research on health and physical activity has focused on physiological problems and diseases, such as cardiovascular disease. Focusing on these diseases can lead to loss of common musculoskeletal disorders (Bergman, S., 2007). Musculoskeletal disorders can affect the movement system, which reduces performance, pain, injuries and consequently life quality reduction over time(Barrett et al., 2016).
The aim of this study was to investigate the relationship between physical activity levels in different domains (occupation, domestic, leisure time and transportation) and musculoskeletal disorders among men and women aged between 19 and 64 years in Tehran.
METHODS: Data from a cross-sectional survey were analysed. From a statistical population of 6234, a sample of 540 was selected by cluster random sampling. Physical activity levels data in the domains of occupation, domestic, transportation and leisure time with International Physical Activity Questionnaire (IPAQ) and musculoskeletal disorders (MSDs) data were collected by Nordic Musculoskeletal Disorders Questionnaire. Chi-square and Pearson tests were used to determine the relationship between variables in SPSS software version 22.
RESULTS: There is a significant difference (P=0.003) between the physical activity of men 1571 (SD ±2640) MET-min/week and women 792 (SD ±1415) MET-min/week.Total physical activity in men (occupation, leisure time, transportation) 3582 MET-min/Week was higher in men than women 910 Met-min/week. But the physical activity at domestic in women 2973 Met-min/week was more than men. There was a significant relationship between physical activity of leisure time at all levels and reduction of musculoskeletal disorders (P = 0.009). There was also a reverse relationship between total physical activity at domestic and hip disorders (r = -0.238).
CONCLUSION: Results showed that physical activity in leisure time can significantly reduce musculoskeletal disorders. Physical activity in other areas does not seem to be sufficient to result in positive physical and physiological adaptations. Physical activity at leisure time may increase the musculoskeletal health of the individuals and may reduce the damage caused by sedentary behaviors.
References: Bergman, S. (2007). Public health perspective–how to improve the musculoskeletal health of the population. Best Practice & Research Clinical Rheumatology, 21(1), 191-204.
Barrett, E., OKeeffe, M., OSullivan, K., Lewis, J., & McCreesh, K. (2016). Is thoracic spine posture associated with shoulder pain, range of motion and function? A systematic review. Manual therapy, 26, 38-46.
Contact: A.sisily@gmail.com

PREVALENCE OF SARCOPENIA AND DIETARY PROTEIN INTAKE IN COMMUNITY-DWELLING OLDER ADULTS IN IRELAND

MURPHY, C.H.1, MCMORROW, A.M.1, FLANAGAN, E.M.1, CUMMINS, H.2, MCCARTHY, S.N.2, MCGOWAN, M.J.3, RAFFERTY, S.4, EGAN, B.5, DE VITO, G.1, CORISH, C.A.1, ROCHE, H.M.1

1: UCD , TEAGASC FOOD RESEARCH CENTRE , 3:HSE CHO 6 , 4: HSE CHO 9 , 5: DCU

INTRODUCTION: Sarcopenia, the age-related loss of skeletal muscle mass and function, is an independent risk factor for numerous adverse health outcomes in older adults. When obesity is superimposed on sarcopenia, termed sarcopenic obesity (SO), there is an even greater risk of physical disability than is seen with either condition in isolation. The aim of this study was to identify the prevalence of sarcopenia and SO among community-dwelling older adults in Ireland for the first time, and to examine dietary intake in this cohort.
METHODS: In a cross-sectional analysis, 394 community-dwelling adults (age 77.9 ± 7.9 y, range 65-97 y; body mass index (BMI) 27.4 ± 5.1 kg/m2, range 14.0-49.9 kg/m2) were assessed. Skeletal muscle mass was measured using bioelectrical impedance analysis, muscle strength via handgrip dynamometry and physical performance via the Short Physical Performance Battery. A 24 h dietary recall performed by a Registered Dietitian was used to assess dietary intake. Sarcopenia was defined according to the European Working Group on Sarcopenia in Older People criteria (i.e. low muscle mass combined with low handgrip strength and/or low physical performance)1. SO was defined as the presence of sarcopenia in combination with a BMI ≥30 kg/m2.
RESULTS: The overall prevalence of sarcopenia was 32.8% with 20.6% of participants meeting the criteria for severe sarcopenia. Although 26.3% of the cohort were obese, only 4.1% met the criteria for SO. Of those that did not meet the definition for sarcopenia 27.6% were pre-sarcopenic (low muscle mass without a decrement in strength or physical performance) and 49% had low strength and/or physical performance in the absence of low muscle mass. Participants reported consuming 17% of energy from dietary protein, 47% from carbohydrate, 34% from fat and 2% from alcohol. Mean dietary protein intake was 1.05 ± 0.44 g/kg body mass/d, however 29.4% of the cohort reported consuming less than the Recommended Daily Allowance for protein (0.80 g/kg/d) and only 49.3% reported consuming ≥1g protein/kg/d. Dietary protein intake was similar in the participants with normal muscle mass, strength and function (0.98 ± 0.43 g/kg/d) and those with severe sarcopenia (1.13 ± 0.47 g/kg/d, p=0.115).
CONCLUSION: Sarcopenia is prevalent in community-dwelling older adults living in Ireland and, even among those who do not meet the definition for sarcopenia, decrements in muscle mass, strength and physical function are common. Less than half of the older adults reported meeting the minimum dietary protein intake recommendations to support the preservation of muscle mass and function in healthy older adults (1.0 – 1.2 g/kg/d)2,3.
REFERENCES: 1 Cruz-Jentoft, A. et al. Age and ageing 39, 412-423 (2010).
2 Bauer, J. et al. J. Am. Med. Dir. Assoc. 14, 542-559 (2013).
3 Deutz, N. E. et al. Clin. Nutr. 33, 929-936 (2014).

PREVALENCE OF SARCOPENIA BASED ON EWGSOP CRITERIA AND POPULATION SPECIFIC CUTPOINTS IN ADULTS AGED 60 AND ABOVE IN KOSOVO

BOSHNJAKU, A.1,2, BAHTIRI, A.3, FEKA, K.4, KRASNIQI, E.5, TSCHAN, H.1, WESSNER, B.1

1: UNIVERSITY OF VIENNA , 2: UGJFA , 3: UNIVERSI , 4: UNIPA , 5: UMT

INTRODUCTION: Sarcopenia is a condition characterized by the age-related loss of skeletal muscle mass and function [1]. The overall estimates of prevalence are 10%, although population-based differences have been observed [2]. Given the fact that life expectancy and health status in developing countries such as Kosovo are lower as compared to the European average, the prevalence of sarcopenia could differ from other European countries. Therefore, the aim of the current study was (1) to assess the prevalence of sarcopenia in Kosovo, and (2) to evaluate the impact of various covariates on sarcopenia status.

METHODS: 238 adults (f: 47.5%, 68.4±5.3 y; m: 52.5%, 72.1±5.7 y) participated in this study. Sarcopenia was diagnosed using the EWGSOP algorithm using either published or population-derived (Kosovan, KS) gender-specific cut-points for handgrip strength (Jamar), gait speed (6m) and skeletal muscle index (SMI) [1]. IBM SPSS statistics was used to determine differences between continuous variables (independent t-test) and frequencies (Chi-square) as well as to ascertain the effects of age, gender, BMI, nutritional status, health status and educational level on sarcopenia status by binary logistic regression.
RESULTS: Our study population was characterized by a BMI of 29.8±4.7 kg/m² (f: 32.0±4.3 kg/m², m: 27.8±4.1 kg/m², p<0.001), a gait speed of 1.08±0.24 m/s (f: 1.03±0.26 m/s, m: 1.13±0.22 m/s, p<0.001), a handgrip strength of 30.1±8.8 kg (f :24.1±5.1 kg, m:35.4±8.0 kg, p<0.001), and a SMI of 9.9±1.4 kg/m² (f: 9.4±1.0 kg/m², m: 10.3±1.6 kg/m², p<0.001). The frequencies of low handgrip strength (EWGSOP: 21.0%, KS: 25.2%), low gait speed (EWGSOP: 36.1%, KS: 56.7%, p<0.001, and low SMI (EWGSOP: 5.9%, KS: 6.3%) were significantly higher when using KS-specific cut-points (p<0.001). Overall, the prevalence of sarcopenia was only 3.36% (EWGSOP) or 5.46% (KS). The logistic regression model was statistically significant, $\chi 2(8)=15.74$, p=0.046 explaining 46.3% of the variance in sarcopenia status. Increasing BMI and higher educational status were associated with a reduction in the likelihood of being sarcopenic.
CONCLUSION: We have shown that the prevalence of sarcopenia in Kosovo is lower as compared to other European and Non-European countries independent of the underlying calculation method [2]. Interestingly, age and gender did not contribute significantly to the development of sarcopenia, but higher BMI and educational status seem to be associated with a lower risk of developing sarcopenia. Although being "protective" against sarcopenia the high prevalence of obesity, especially in females, should be a matter of concern for general health status Kosovo [3,4].
References: [1] Cruz-Jentoft AJ, et al. (2010). Age Ageing, 39(4), 412-23.
[2] Shafiee G, et al. (2017). J Diabetes Metab Disord, 16, 21.
[3] Tucker KL & Buranapin. (2001). J Nutr, 131, 2417S-23S.
[4] Rexhepi S, et al. (2015). Mater Sociomed, 27(4), 259-262.

Oral presentations

OP-BN04 GAIT

WHAT IS UNIQUE IN INDIVIDUAL GAIT PATTERNS? UNDERSTANDING AND INTERPRETING DEEP LEARNING IN MOVEMENT ANALYSIS

HORST, F.1, LAPUSCHKIN, S.R.2, SAMEK, W.2, MÜLLER, K.R.3,4,5, SCHÖLLHORN, W.I.1

1: JOHANNES GUTENBERG-UNIVERSITY 2: FRAUNHOFER HEINRICH HERTZ INSTITUTE 3: TECHNICAL UNIVERSITY BERLIN 4: KOREA UNIVERSITY 5: MAX PLANCK INSTITUTE FOR INFORMATICS

INTRODUCTION: Although machine learning techniques such as (deep) neural networks are solving very successfully a plethora of tasks and provide new insights from complex physical, chemical or biological systems [1], in most cases they go along with the disadvantage of acting as a black box, rarely providing information about what made them arrive at a particular prediction. This black box manner is crucial especially in medical applications like gait analysis and strongly hamper their clinical acceptance [2]. In the context of personalised movement analysis, the aim of the study was to examine individual gait patterns by: (1) demonstrating the uniqueness of individual gait patterns using artificial neural networks; (2) decomposing the contribution of each input variable using Layer-Wise Relevance Propagation (LRP) [3]; and (3) explaining which variables at what time of the gait cycle are most relevant for the characterisation of gait patterns from a certain individual.
METHODS: A sample of 57 healthy participants (29 female, 28 male; 23.1 ± 2.7 years; 1.74 ± 0.10 m; 67.9 ± 11.3 kg) walked 20 times a distance of 10 m. Two force plates (Kistler, 1000 Hz) and ten infrared cameras (Qualisys, 250 Hz) recorded the three-dimensional ground reaction forces (GRF) and 12 segment full-body joint angles (JA) during a double step at a self-selected walking speed under barefoot conditions. The subject-classification was conducted by means of deep (convolutional) neural networks and the prediction accuracy was obtained as an average over a ten-fold cross-validation. In order to explain the prediction of an individual based on the participant's gait patterns, the input relevance of each input variable was decomposed using LRP.
RESULTS: Deep neural networks were able to predict the correct individual by average accuracies of 99.6% (GRF) and 100.0% (JA) and verified unique characteristics for individual gait patterns. By attributing portions of the prediction of artificial neural networks back to the input variables (time-continuous GRF and JA), LRP demonstrated which variables at what time of the gait cycle were most relevant for the characterisation of individual gait patterns.
CONCLUSION: The determination of characteristics that are specific for the movement patterns of a certain individual facilitates to support coaches and therapists during the individualisation of their treatments. By measuring the contribution of each input variable to the prediction of artificial neural networks, LRP presents a framework that enables to understand and interpret machine learning in (biomechanical) movement analysis.
REFERENCES:
[1] Schöllhorn WI. Clin Biomech. 2004;19(9):876-898.
[2] Wolf S et al. Gait Posture. 2006;23(3):331-338.
[3] Bach S et al. PloS ONE. 2015;10(7):e0130140.
CONTACT:
horst@uni-mainz.de

RETENTION OF FALL RESISTING SKILLS OVER 1.5 YEARS IN OLDER ADULTS: EFFECTS OF PERTURBATION EXPOSURE AND PLANTAR FLEXORS NEUROMUSCULAR EXERCISE

EPRO, G.1, MIERAU, A.2,3, MCCRUM, C.4, LEYENDECKER, M.3, BRÜGGEMANN, G.P.3, KARAMANIDIS, K.1

1: LONDON SOUTH BANK UNIVERSITY, UK; 2: LUNEX INTERNATIONAL UNIVERSITY OF HEALTH, EXERCISE AND SPORTS, LUX; 3: GERMAN SPORT UNIVERSITY COLOGNE, GER; 4: MAASTRICHT UNIVERSITY, NL

INTRODUCTION: The plantar flexors play a crucial role in recovery from sudden disturbances to gait [1]. In a recent study [2] we demonstrated that older adults are able to increase their triceps surae (TS) muscle strength and Achilles tendon stiffness in response to 1.5 years

TS neuromuscular exercise intervention. The current work assessed whether such exercise-induced changes in the TS affects older adults' ability to retain improvements in reactive gait stability during perturbed walking acquired from single perturbation training sessions.
METHODS: Thirty-four older adults (65±7 years) participated in the study and experienced eight separate unexpected trip perturbations while walking on a treadmill. A motion capture system was used to analyse the margin of stability (MoS; state of the centre of mass in relation to the base of support) at touchdown of the perturbed step and six following recovery steps. In an additional session, dynamometry and ultrasonography were used to assess TS muscle-tendon unit mechanical properties and motor skill performance. The participants were enrolled either to a gait perturbation only training group (GAIT; n=13) experiencing eight trip perturbations during treadmill walking in two separate sessions (once at baseline and once after 14 weeks) or to a group completing the same as GAIT and in addition completing 1.5 years of combined TS neuromuscular exercise 2-3 times a week (GAIT+TS; over 14 weeks n=21; over 1.5 years n=12).
RESULTS: GAIT+TS group showed significantly ($p<0.05$) improved motor skill performance and higher maximal plantarflexion moments along with higher Achilles tendon stiffness after 14 weeks of exercise with no further adaptive changes after 1.5 years. No changes in TS neuromechancial properties were observed in the GAIT group between analysed time points. Regarding the tripping task, both groups were able to improve their recovery response (increased MoS at touchdown of the perturbed leg) in each perturbation training session ($p<0.05$). The GAIT group displayed a partial retention of the improvements in recovery response over both 14 weeks and 1.5 years ($p<0.05$). Despite the changes in TS neuromechanical properties in the GAIT+TS group, no further benefits for fall resisting skills were detected post 1.5 years of exercise.
CONCLUSION: The aged neuromotor system demonstrates a rapid plasticity to repeated exposure to unexpected perturbations and can retain these acquisitions in fall resting skills over a long time period (1.5 years), but an additional exercise-induced enhancement of TS neuromuscular capacities seems not to further augment the effects of perturbation training. Thus, in order to improve the ability to cope with gait disturbances, older adults may benefit more from exposure to unexpected gait perturbations than from interventions targeting to enhance lower limb neuromuscular capacities.
REFERENCES:
1. Pijnappels et al. 2005 Gait Posture 21: 388–394.
2. Epro et al. 2017 J Exp Biol 220: 1008–1018.

LIMITS OF AGREEMENT BETWEEN A MAGNETOMETER-INDEPENDENT INERTIAL SENSOR SYSTEM AND A MARKER BASED OPTICAL MOTION CAPTURE SYSTEM FOR 3D JOINT KINEMATICS IN GAIT ANALYSIS

TEUFL, W., MIEZAL, M., TAETZ, B., FRÖHLICH, M., BLESER, G.

TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

INTRODUCTION: Inertial Measurement Unit systems (IMUS) provide a mobile alternative for gait analysis [1]. However, there are still drawbacks when considering IMUs. They are prone to magnetic distortions and the measurement of 3D joint kinematics lacks accuracy and validation against optical motion capture systems (OMCS). Hence, the aim of this study was to evaluate the agreement between a magnetometer-free IMU system and an OMCS regarding 3D joint kinematics of the lower extremity.
METHODS: 28 volunteers (15 females, 13 males) participated in the study. The subjects performed one trial of a 6 minute walking test. Global pelvis flexion and obliquity and left (LT) and right (RT) lower extremity 3D kinematics were simultaneously captured by means of seven IMUs and 32 retroreflective markers. Additionally, marker clusters were fixed to the IMUs to eliminate deviations due to soft tissue artefacts. Thus, the mere technical error between the systems was considered. IMU data was processed with an extended Kalman Filter approach [2] omitting magnetometer information. Limits of Agreement (LoA) were calculated per subject and gait cycle for all joint angles to evaluate the comparability of the present systems.
RESULTS: LoA ranged from $-1.3° \pm 0.5°$ to $1.4° \pm 0.7°$ (absolute mean $0.4° \pm 0.6°$). The global pelvis flexion revealed the less biased outcome with mean difference of $0.0° \pm 0.3°$. LT ankle rotation and LT knee rotation showed the biggest mean differences with mean values of $1.4° \pm 0.7°$ and $-1.3° \pm 0.5°$ respectively. Knee and ankle flexion showed the widest range of LoA with limits of $1.1° - 1.3°$.
CONCLUSION: Assessing the LoA analysis between a magnetometer-free IMUS and an OMCS showed mean differences similar to Robert-Lachaine et al. [3]. However, Robert-Lachaine et al. [3] reported limits ranging from $2.8° - 7.0°$. The present results showed limits in bounds of $0.3° - 1.3°$, therefore, indicating acceptable limits of agreement for applications in motion capturing. Ankle and knee rotation showed the highest LoA bias. This could be explained by the missing magnetometer data which can provide additional information in the transversal plane [2]. In summary, despite omitting magnetometer information, the examined IMUS revealed excellent agreement with an OMCS regarding the lower limb kinematics and the global pelvis flexion and obliquity. Therefore, this system provides a highly accurate and mobile alternative for the assessment of 3D joint kinematics of the lower extremity in gait analysis.
[1] P. Picerno, 25 years of lower limb joint kinematics by using inertial and magnetic sensors: A review of methodological approaches, Gait Posture. 51 (2017) 239–246.
[2] M. Miezal, B. Taetz, G. Bleser, On Inertial Body Tracking in the Presence of Model Calibration Errors, Sensors. 16 (2016) 1132.
[3] X. Robert-Lachaine, H. Mecheri, C. Larue, A. Plamondon, Validation of inertial measurement units with an optoelectronic system for whole-body motion analysis, Med. Biol. Eng. Comput. 55 (2017) 609–619.

ADAPTATION AND INTER-LIMB TRANSFER OF GAIT STABILITY FOLLOWING PERTURBATIONS IN YOUNG AND OLDER ADULTS ASSESSED USING STABILITY-NORMALISED WALKING SPEEDS

MCCRUM, C.1,2, WILLEMS, P.1, KARAMANIDIS, K.3, MEIJER, K.1

1: MAASTRICHT UNIVERSITY, THE NETHERLANDS. 2: GERMAN SPORT UNIVERSITY COLOGNE, GERMANY. 3: LONDON SOUTH BANK UNIVERSITY, U.K.

INTRODUCTION: Healthy young and older adults show differences in gait stability recovery following perturbations but a similar capacity to adapt stability following repeated perturbations (McCrum et al. 2017; Bohm et al. 2015). However, it is not clear if walking speed differences seen with age affect stability and adaptation to perturbations. Here, we assessed if age differences are eliminated when walking speed is normalised to stability and if evidence of (age-dependent) inter-limb transfer of locomotor adaptations could be observed.
METHODS: 14 young (25±3y) and 10 older (73±5y) healthy adults participated. Measurements were conducted on a dual-belt treadmill (CAREN; Motekforce Link). 5 reflective markers (C7, trochanters and halluces) were tracked via motion capture (100Hz; 12 cameras; Vicon Motion Systems). To assess dynamic gait stability, the anteroposterior margins of stability (MoS; Hof et al. 2005; Süptitz et al. 2013) were calculated at foot touchdown. The walking speed that would result in MoS of 5cm was calculated for each subject based on MoS during unperturbed gait at various speeds (0.4m-1.8m/s). Subjects walked for four minutes at this speed and then experienced 10 treadmill belt

acceleration perturbations (3m/s^2 to 180% of walking speed), each occurring every 30-90s. The first and last perturbed the right leg, while the second to ninth repeatedly perturbed the left leg.
RESULTS: Two-way repeated measures ANOVAs with step (baseline and first eight recovery steps) and age group (young and older) as factors with Bonferroni corrections revealed that both the young and older adults required five recovery steps to return to baseline MoS following the first two perturbations (recovery step 4 differed to baseline: P<.05; no age group difference at step 5). After repetition with the left leg, both age groups required only three steps to return to baseline MoS (recovery step 2 differed to baseline: P<.05; no age group difference at any step). The final perturbation (right leg) again required five steps of both age groups to return to baseline MoS (recovery step 4 differed to baseline: P<.05; no age group difference at any step).
CONCLUSION: With the stability-normalised walking speed, no age differences were seen in number of steps to return to MoS baseline and adaptation of gait stability following repeated exposure occurred to a similar magnitude. Therefore, previously reported age differences in perturbed gait may be related to the walking speeds used in the studies. Adaptations in gait stability following repeated perturbations were restricted to the exercised limb, suggesting that healthy adults have a limited ability to transfer motor adaptations to gait perturbations between limbs, irrespective of age, which has implications for falls prevention.
REFERENCES:
Bohm et al. (2015) Sports Med 45:1759-1777
Hof et al. (2005) J Biomech 38:1-8
McCrum et al. (2017) Eur Rev Aging Phys A 14:3
Süptitz et al. (2013) Hum Mov Sci 32:1404-1414
CONTACT:
chris.mccrum@maastrichtuniversity.nl

RECOVERY RESPONSES AND ADAPTATIONS IN DYNAMIC STABILITY TO GAIT-TRIP PERTURBATIONS ACROSS THE ADULT LIFESPAN

KÖNIG, M., EPRO, G., SEELEY, J., POTTHAST, W., KARAMANIDIS, K.

LONDON SOUTH BANK UNIVERSITY

INTRODUCTION: Older adults show diminished recovery responses to a novel trip perturbation (Süptitz et al. 2013) and, in comparison to younger adults, tend to show lesser improvements in dynamic stability control in response to repeated unexpected surface compliance perturbations during walking (Bierbaum et al. 2011). However, little is known about adaptability in recovery responses to trip perturbations across the adult lifespan. Therefore the aim of the current work was to examine locomotor stability and its adaptability following repeated trip-inducing gait perturbations in young, middle- and older-aged adults.
METHODS: Ten young, ten middle- and ten older-aged adults (26±3, 50±6 and 72±5 years respectively) walked at 1.4 m/s on a treadmill and experienced eight separate unexpected trip perturbations. A custom-made brake-and-release system was used to apply a resistance to the swing phase of the right leg via an ankle strap. Thirteen reflective markers were tracked by a motion capture system (120 Hz; Vicon Motion Systems, UK). The anteroposterior margins of stability (MoS – the situation of the centre of mass in relation to the base of support; Hof et al. 2005) were calculated at foot touchdown (TD) of the perturbed leg and for six subsequent recovery steps, using accelerometers placed on both tibias. In order to determine potential age-related differences in adaptive changes in dynamic stability, the recovery responses for the first and eighth trip perturbation trial were considered.
RESULTS: Gait-trip perturbations caused a significant ($p<0.05$) reduction in the MoS at TD of the perturbed leg compared to baseline (unperturbed) walking, leading to negative MoS values, with no differences between the age groups. After the first perturbation trial, middle- and older-aged adults required more recovery steps to return to baseline MoS compared to younger adults. After experiencing eight trip perturbations all age groups showed an improved recovery response (increased MoS at TD of the perturbed leg and for the following recovery steps; $p<0.05$) and returned back to baseline MoS with fewer recovery steps when compared to the first perturbation trial.
CONCLUSION: We conclude that the ability to control locomotor stability during perturbed walking is already diminished by middle age, increasing fall risk, but that ageing may not inhibit the neuromotor system from adapting reactive motor responses to trip perturbations. Thus, in order to improve the ability to cope with unexpected gait perturbations and potentially reduce falls risk, middle- and older-aged adults may benefit from repeated exposure to unexpected trip perturbations.
References: Bierbaum et al. (2011). J Biomech, 44, 1921-1926.
Hof et al. (2005). J Biomech, 38, 1-8.
Süptitz et al. (2013). Hum Mov Sci, 32, 1404-1414.
Contact: koenigm@lsbu.ac.uk

IN FIELD MONITORING OF IMPAIRMENTS IN HUMAN GAIT

ROY, S.H., SHIWANI, B., KLINE, J.C., SAINT-HILAIRE, M.H., THOMAS, C.A., DE LUCA, G.

DELSYS INC. AND ALTEC INC.

INTRODUCTION: Advances in motion capture systems and instrumented force plates have enjoyed widespread use and acceptance for assessing gait abnormalities in laboratory settings. However, there remains a need for a portable system that can provide comparable quantitative metrics of gait impairments outside of the laboratory for clinical, athletic, and home environments.
METHODS: Our group is developing a mobile system of body-worn sensors and automated detection algorithms that provide in-field assessment of clinically relevant characteristics of gait that are of minimal encumbrance to the user and operator. The system tested uses a single sensor to record surface electromyographic activity and inertial measurement from the tibialis anterior muscle of the lower leg. With these data, we designed algorithms to autonomously detect and monitor, in real-time, 3 key characteristics of gait: 1> Angular range and speed- to assess and understand the movements of leg in its natural physiological form of angular displacements; 2> Muscle Activity- to analyze the muscle activation patterns during different phases of the gait cycle; and 3> Heel strike and Toe-off mechanics- to analyze coordination in take-off and landing mechanics of the foot. We tested our system in a case study of post medication monitoring among n=6 patients with Parkinson's disease gait symptoms during unscripted activities for a 3-hour period in a simulated home setting.
RESULTS: We successfully detected the instances of gait during these unscripted activities with 99.5% accuracy from all patients tested using our automated detection algorithm. All 3 objective gait metrics were significantly different when comparing data from ON and OFF periods determined by annotation of video recordings by movement disorder experts. The results indicate that a single body-worn sensor system can provide clinically-relevant gait metrics to evaluate therapeutic interventions in Parkinsons disease.

CONCLUSION: A version of this system is under development to enhance its usability in the field by interfacing it with a handheld tablet and accommodating a greater number of wireless sensors. The final system will facilitate point-of-care gait monitoring for clinicians and therapists working with patients with neurological and musculoskeletal disorders to make real-time objective assessments in the clinic or community.
Support: Research reported in this abstract was supported in part by the De Luca Foundation and by a grant from the National Institute of Neurological Disorders and Stroke of the National Institute of Health under award R44NS083098.

Oral presentations

OP-BN29 Physical activity in Parkinsons disease

CONTRIBUTION OF ACHILLES TENDON MECHANICS TO PLANTARFLEXION TORQUE STEADINESS IN PERSONS WITH PARKINSONS DISEASE

SMART, R.R.1, RICHARDSON, C.M.1, WILE, D.2, DALTON, B.H.1, JAKOBI, J.M.1

1: SCHOOL OF HEALTH AND EXERCISE SCIENCES, UNIVERSITY OF BRITISH COLUMBIA OKANAGAN, KELOWNA, BC CANADA; 2: SOUTHERN MEDICAL PROGRAM, UNIVERSITY OF BRITISH COLUMBIA OKANAGAN, KELOWNA, BC CANADA

INTRODUCTION: Parkinsons disease (PD) is associated with increased muscle rigidity (1) and reduced torque steadiness (TS) (2). As TS depends on a smooth transfer of force from muscle to bone via tendons, it is important to understand how tendon mechanics are influenced by PD and determine whether these properties influence TS. Our purpose was to determine how Achilles tendon (AT) mechanics contribute to plantar flexion (PF) TS in persons with PD compared to age- and sex-matched controls. We hypothesized that maximal torque, AT strain, and stress would be lower in persons with PD contributing to reduced TS relative to controls.
METHODS: Nine persons with PD (6 female; 70±5 yrs) tested in the "ON" phase of their dopaminergic medication cycle, and 9 age- and sex-matched controls (70±7 yrs) performed isometric PF maximal voluntary contractions (MVCs) and 5-s submaximal torque-matching contractions of 5, 10, 25, 50 and 75% MVC. Coefficient of variation (CV) was used to evaluate TS. The AT cross-sectional area at rest and elongation during contraction were recorded via ultrasound to determine tendon stress and strain. The influence of MVC and tendon mechanics on CV of torque was evaluated at low (5, 10% MVC) and high (25, 50, 75% MVC) torques using forward multiple regressions.
RESULTS: The PD group was weaker (84.6±26.3Nm) and less steady (4.3±2.2%) than controls (113.8±28.0Nm; 2.14±1.0%; $p<0.05$). Tendon strain was less in persons with PD (4.9±1.1%) than controls (7.2±1.5%) from 50% to MVC ($p<0.05$). Tendon stress did not differ between persons with PD (1.17±0.42MPa) and controls (1.22±0.36MPa; $p>0.05$). At low torques, MVC (r2: 0.39-0.57) and strain (r2: 0.16-0.17) predicted reduced CV of torque in PD and control groups ($p<0.05$). At high torques, MVC (r2: 0.26) and stress (r2: 0.26) predicted reduced CV of torque in controls.
CONCLUSION: Our findings indicate that persons with PD during the "ON" phase of dopaminergic cycle are less steady than age- and sex-matched controls, and this is associated with muscle weakness. At low torques greater strain improved the buffering of torque fluctuations in controls and thereby led to steadier contractions compared to PD group. The contribution of strength was further evident in controls, as stress and MVC predicted enhanced steadiness at high torques, yet not in persons with PD. Thus, muscle strength is the strongest factor in producing steady isometric contractions in those with PD.
1. Marusiak J, Kisiel-Sajewicz K, Jaskólska A, Jakólski A. (2010). Arch Phys Med Rehabil 91(5):800-802.
2. Rose MH, Løkkegaard A, Sonne-Holm S, Jensen BR. (2013). Motor Control 17: 203-216
Contact: rowan.smart@ubc.ca

GAIT ADAPTATIONS TO TREADMILL TRAINING IN PARKINSON'S PATIENTS: EFFECTS OF PERTURBATION, SUSTAINABILITY, AND MODERATORS

STEIB, S.1, KLAMROTH, S.1, GAßNER, H.2, PASLUOSTA, C.3, ESKOFIER, B.3, WINKLER, J.2, KLUCKEN, J.2, PFEIFER, K.1

FAU ERLANGEN-NÜRNBERG

INTRODUCTION: Gait impairment is a major symptom in Parkinson's disease (PD), and treadmill training is an effective non-pharmacological treatment option (Mehrholz et al., 2015). This secondary analysis of an eight-week interventional trial aims at investigating i) the time course and sustainability of gait adaptations, ii) the effects of additional perturbations during treadmill walking, as well as iii) potential moderators of training effects.
METHODS: 38 PD patients (Hoehn &Yahr 1 – 3.5) were randomly allocated to eight weeks of treadmill training, performed twice-weekly for 40 minutes either with (PTT, n=18) or without (CTT, n=20) additional perturbations to the treadmill surface (Steib et al., 2017). Spatiotemporal gait parameters related to pace, rhythm, symmetry, and variability of gait were assessed during treadmill walking on a weekly basis (T0 – T8), and after three months follow-up (T9). Linear mixed models (random intercept and slope) were specified for each dependent variable (gait parameters) to evaluate within- and between-group changes over time. Moderators were successively included as covariates: age, gender, UPDRS motor score, cognitive function (MOCA), balance (MiniBESTest), and gait speed. Effect sizes are reported as Cohen's d.
RESULTS: Both groups significantly improved gait variability, with positive effects already observed after three weeks of training. The strongest effects were seen in stride time CV in the PTT group ($p<.001$; $d=0.81$), and stride length CV in the CTT group ($p<.001$; $d=0.84$). Gait parameters related to pace and rhythm (stride length, stride time, stance phase, swing phase) improved in the PTT group only, with a significant between-group interaction effect for stride time ($p=.05$; $d=0.33$). Improvements in the PTT group were sustained until T9, while rhythm and variability of gait significantly worsened in the CTT group. Age (stride time CV: $p=.04$; $d=-0.35$) and balance performance significantly moderated improvements in gait variability (stance time CV: $p=.03$; $d=-0.36$).
CONCLUSION: Treadmill therapy substantially improved gait variability in PD, with first positive effects observed after six sessions. Adding postural perturbations during training improved pace and rhythm of gait, and appeared to produce more sustainable effects. Older patients and those with lower balance performance demonstrated larger improvements in stride-to-stride variability.
REFERENCES:
Mehrholz J, Kugler J, Storch A, et al. (2015). Cochrane Database Syst Rev, 8, CD007830.
Steib S, Klamroth K, Gaßner H, et al. (2017). Neurorehabil Neural Repair, 31(8), 758-768.

WALKING BIOMECHANICAL IMPROVEMENTS AFTER 6 WEEKS OF NORDIC WALKING TRAINING IN PATIENTS WITH PARKINSONS DISEASE

FAGUNDES, A.O.1, MONTEIRO, E.P.2, FRANZONI, L.T.3, PANTOJA, P.D.1, OLIVEIRA, H.B.1, CUBILLOS, D.M.1, GOMEÑUKA, N.A.1, MARTINEZ, F.G.1, PAGNUSSAT, A.S.2, PEYRÉ-TARTARUGA, L.A.1

UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL

INTRODUCTION: Gait disorders are cardinal clinical symptoms of Parkinsons disease (PD). Walking training has been indicated in the literature as a therapeutic tool for gait rehabilitation. In this way, our purpose was to compare the effects of a training program, of Nordic walking (NW) and free walking (FW), on biomechanical parameters, in patients with PD.
METHODS: The sample comprised 33 participants, aged above 50 years, of both sexes, with a clinical diagnosis of idiopathic PD, with the staging of 1-4 in the Hoehn and Yahr scale (H&Y). The participants received two types of intervention: Nordic walking training program (n = 16) and free walking training program (n = 17), during six weeks. Aiming to evaluate the effects of the training program, the participants underwent the tests in the following period: pre-training and post-training. The biomechanical parameters studied were the spatiotemporal parameters during walking and amplitude of the EMG signal of the Vasto Lateralis (VL), Tibialis Anterior (TA), Biceps Femoris (BF) and Gastrocnemius (GM) muscles, initial activation threshold (onset), final activation threshold (offset) and activation time. Outcomes were analyzed using the Generalized Estimates Equations (GEE), to compare groups (NW and FW) and moments (T1 and T2). The Bonferroni post-hoc was used to identify differences between effects and interactions. A significance level of 0.05, was adopted.
RESULTS: There was a reduction in contact time (CT), swing time (ST), stride length (SL) and stride frequency (FP), for NW when compared to FW ($p < 0.05$). Regarding the neuromuscular parameters, an increase in the amplitude of the VL and BF EMG signal, reduction of the final activation threshold (offset) of the VL and GM ($p < 0.05$), reduction in the activation of the VL and BF ($p < 0.05$) and reduction in the co-contraction index of the TA and GM ($p < 0.05$), were found for the NW group, whereas the FW group showed statistically significant improvements only in the amplitude of GM when compared to the NW group.
CONCLUSION: The NW improved the sensory afferents due to the upper limb use, and this enabled the increase of the cortical sensorimotor integration. Therefore, this cortical integration contributed to the gain of motor skills of patients undergoing NW training (Reuter et al., 2011; Fritz et al., 2011). There were greater positive effects after a period of training of NW, indicating that the effects of the NW training were more efficient than the FW.
REFERENCES:
Reuter I, Mehnert S, Leone P, Kaps M, Oechsner M, Engelhardt M. (2011). J Aging Res, 18-770-778.
Fritz B, Rombach S, Godau J, Berg D, Horstmann T, Grau S. (2011). Gait Posture, 34, 234–238.
CONTACT:
Alex de Oliveira Fagundes, e-mail : alexfagundes1@gmail.com
Address : R. Felizardo,750, Jd Botanico
CEP 90690-200 Porto Alegre RS - BRAZIL

THE EFFECTS OF NORDIC WALKING ON ASYMMETRY IN MUSCLE'S STRENGTH OF THE LOWER LIMBS AND ON OXIDATIVE STRESS IN PARKINSONS DISEASE

FRACCA, I.1, FONSECA, G.2, LANZA, M.3, VOLPE, D.4

1: STUDIO PREVENZIONE E SALUTE ; 2,3: DEPARTMENT OF NEUROSCIENCES, BIOMEDICINE AND MOVEMENT SCIENCE, UNIVERSITY OF VERONA ; 4FRESCO INSTITUTE FOR ITALY VILLA MARGHERITA

INTRODUCTION: We have analyzed the effects of Nordic Walking (NW) on asymmetry in muscle's strength of lower limbs and on oxidative stress mechanisms in Parkinson's disease.
METHODS: Twenty-nine patients with PD (1-3 Stage Hoehn & Yahr in ON medication) agreed to participated to a multidisciplinary intensive rehabilitative program for 4 weeks. They were randomly assigned in two groups: a Control group (Ctrl) composed by 12 patients and an experimental group (Exp) composed by 17 patients that practiced additional NW 60 minutes, twice a week. As instrumental outcomes we used Peak Torque right and left leg and markers of oxidative stress (AU/CR markers, 8OHdG, 2dG, 8-OH/2dG, HCY, 3NT). As clinical outcomes, we used UPDRS III, PDQ-39, BBS, FES, FOG-Q, TUG, 6MWT. Measures were taken at the beginning (T0) and at end of training (T1). Chi-squared Test, Test-T and two-way ANOVA for repeated measures were used.
RESULTS: In Exp there was a trend towards the symmetry of lower limbs strength. Moreover, Exp showed a reduction in HCY compared with Ctrl where it increased. The 8-OHdG / 2dG ratio seems to have a higher trend in Exp with 2dG increased.
Significant improvement was found for all subject in: UPDRS III ($P < 0.001$), BBS ($P=0.002$), 6MWT ($P<0.001$), TUG ($P<0.05$), PDQ-39 ($P=0.006$), FoGQ ($P=0.001$). PDQ-39 and FoGQ improve ($P < 0.05$) in Exp but not in Ctrl. FES do not shows variation.
CONCLUSION: This pilot study confirms that NW, as well as a good workout, is a valid rehabilitation strategy, contributes to correct the asymmetry in muscle's strength and improves REDOX status, increasing markers of DNA repair and decreasing markers of oxidative stress.
References: Monteiro E.P., L.T. Franzoni, D.M. Cubillos, A. de Oliveira Fagundes, A.R. Carvalho, H.B. Oliveira, P.D. Pantoja, F.B. Schuch, C.R. Rieder, F.G. Martinez, L.A. Peyr_e-Tartaruga; Effects of Nordic Walking Training on functional parameters in Parkinson's Disease: a randomized controlled clinical trial; Scand J Med Sci Sports. 2017 Mar;27(3):351-358. doi: 10.1111/sms.12652
Frazzitta G, Ferrazzoli D, Maestri R, Rovescala R, Guaglio G, Bera R, et al. (2015) Differences in Muscle Strength in Parkinsonian Patients Affected on the Right and Left Side. PLoS ONE 10(3): e0121251. doi:10.1371/journal. Pone.0121251
Contact: ilenia@studioprevenzioneesalute.it

SPRINT EXERCISE IN PARKINSON'S DISEASE PATIENTS: A PILOT STUDY

MONTEIRO, E.1,2, PEYRÉ-TARTARUGA, L.A.2, SOARES, E.2, ZANARDI, A.P.2, MORIN, J.B.3, PAGNUSSAT, A.S.1

FEDERAL UNIVERSITY OF SCIENCE OF HEALTH OF PORTO ALEGRE

INTRODUCTION: Parkinson's Disease (PD) is the second most prevalent neurological disorder in the world, with progressive loss of muscle control and power output. Exercise is recommended in PD for its neuroprotective effect (Alberts et al., 2011). Training programs transitioning from walking to running with pole may induce positive outcomes in neural function and functional mobility (Monteiro et al., 2017). Furthermore, since a single bout of high-intensity exercise promotes changes in the motor cortex neuroplasticity of healthy subjects, it is reasonable to expect that sprint exercise (i.e. short bouts of maximal intensity running) performed after an adapted, progressive training

program, would be beneficial for PD patients. The aim of this pilot study is to test a protocol for describing sprint performance and mechanics in PD patients.
METHODS: 14 male PD patients (1 to 3 on Hoehn and Yahr Scale), followed a transition training program from speed walking to running with poles and then performed two maximal 30-m sprint accelerations (5-min rest). Sprint performance (20 and 30m time) and the main mechanical outputs (theoretical maximal velocity V0, maximal horizontal force F0, and power Pmax) were obtained from high-speed video recording (240 frames/s) and the iPhone 6 App "MySprint" (Samozino et al., 2016). Descriptive data are mean and standard deviation.
RESULTS: The patients studied had the following characteristics: age: 65.1(7.4) yrs, body mass: 77.8(7.0) kg, stature: 1.69(0.04) m, time with PD: 5.5(3.2) yrs, and clinical UPDRS III: 16.8(7.1). The between-trial coefficient of variation for all variables was 6.4(0.05)%. Their 30- and 20-m time were 7.67(1.2) s, and 5.36(0.8) s, respectively. Mechanical outputs were 4.64(0.9) m/s for V0, 5.16(0.8) N/kg for F0, and 6.02(1.2) W/kg for Pmax.
CONCLUSION: This pilot descriptive study showed the feasibility of sprint exercise in PD patients. The performance and mechanical responses observed were consistently lower or within the range of values found in trained master athletes (Pantoja et al., 2016). Furthermore, field observations revealed that during sprinting, patients needed to focus their attention on finalizing the task and did not experience freezing. This study brings encouraging insights into the feasibility and potential benefits of using the sprint exercise in functional training for PD patients.
References: Alberts J, Linder S, Penko A, et al. (2011). Exerc Sport Sci Rev,1(39):177-186.
Monteiro E, Franzoni L, et al. (2017). Scand J Med Sci Sports, 27(3):351-358.
Samozino P, Rabita G, et al. (2016) Scand J Med Sci Sports, 26(6):648–58.
Pantoja P, Villarreal E, Brisswalter J, et al. (2016). Med Sci Sports Exerc, 48(12):2469-2476.
Contact: elren.monteiro@gmail.com

A FEASIBILITY STUDY FOR A UNIVERSITY-BASED COMMUNITY EXERCISE PROGRAMME FOR PEOPLE WITH PARKINSONS DISEASE

MCGRATH, D., MCMAHON, L., WALSH, A., CUNNINGHAM, C., LENNON, O.

UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: This study investigated the feasibility of a university-based community exercise programme for people with Parkinson's disease (PwP). It is well known that exercise can improve symptoms and quality of life in PwP. However, many barriers to exercise have been documented for PwP, including lack of information and referral to physiotherapy services, disease-specific issues such as fatigue and depression, setting-related issues such as walking distances, low expectations from exercise, lack of time to exercise, cost and fear of falling. Given the complexity of these issues, any potential exercise service or research undertaking with PwP requires an initial feasibility study to ensure that the intervention is: safe and acceptable to the target population, addressing a real demand, integrated into users' lives, practical for intervention providers, implementable in other settings and shows some level of efficacy1. This study sought to address these issues.
METHODS: Twenty-three PwP were recruited to a 12 week exercise programme taking place at the University College Dublin sports centre. Participants were asked to attend 3 exercise sessions/week, if possible: circuit training, spinning and Tai Chi, and one health coaching session every 2 weeks. Exercise classes were delivered or supervised by an occupational therapist or physiotherapist. Participants were screened by a physiotherapist prior to being enrolled in the programme at which point a timed-up-and-go test (TUG) and 6 minute walk test (6MWT) were recorded. These measures were also recorded at 6 weeks and at 12 weeks. Qualitative interviews were conducted with all participants in weeks 10-12 with resultant data analysed using thematic analysis.
RESULTS: Preliminary data analysis demonstrates a statistically significant reduction in TUG time ($p=0.025$) and a strong trend towards increased 6MWT (23.7 m) at the 6-week mark. There were no drop-outs from the intervention with attendance at classes greater than 90%. Prevalent themes from the qualitative data were enjoyment, support, sense of community, increased motivation for exercise, sense of well-being and concern around termination of the programme. Once or twice a week was seen to be the optimal class frequency, given the challenge of travelling to UCD. Participants enjoyed being part of the fabric of the university and accessible café facilities enhanced the psycho-social benefits of the programme, which were critical to its success.
CONCLUSION: A university sports facility is an ideal setting for a community-based exercise programme from the perspective of PwP, while also providing learning opportunities to students. Universities' health promoting capacity can be developed through engaging their local communities in health promoting activities, particularly in underserved populations. PwP would need supported navigation to and within campus and parking in close proximity to exercise studios.
1. Bowen et al (2009) Am J Prev Med. 36(5): 452–457

Oral presentations

OP-PM42 Training adaptation

MICROPAUSE RUNNING: A VIABLE ALTERNATIVE TO MODERATE INTENSITY CONTINUOUS RUNNING

WALSH, A., DELAHUNT, E., MATTHEWS, J., BOREHAM, C.

UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: Although the health benefits of regular exercise, such as running, are well known, a lack of time and the unpalatable nature of vigorous effort hinder large sections of the population from participation in routine physical activity. Currently unpublished findings suggest running that incorporates short breaks (micropauses) of either 15 seconds (MP15) or 30 seconds (MP30) is more palatable than moderate intensity continuous running (MIC) in recreationally active young males. As there is a need for exercise interventions suitable to broad populations, this study was conducted to compare the subjective response of recreationally active young females to these protocols.
METHODS: Following institutional ethics approval, 15 recreationally active females (age = 21.2 ± 1.3 years, body mass= 62.9 ± 2.6kg, height= 166.3 ± 4.1cm) were tested on three separate occasions under controlled laboratory conditions with one week between sessions. One week following a preliminary VO2max assessment, participants performed MIC at 65% of their VO2max, running until they expend-

ed 400kcal of energy. Participants' Rate of Perceived Exertion (RPE) was measured at regular intervals throughout the run. Blood lactate concentration (BLa) was assessed immediately post exercise, following which, participants completed the Physical Activity Enjoyment Scale (PACES) and Physical Activity Affect Scale (PAAS). On the two subsequent testing days, participants completed the micropause protocols, running at 80% of VO2max with passive rest of either 15 or 30 seconds interspersed at 3-minute intervals throughout their respective runs. Energy expenditure was isocaloric across protocols and all other methodology was standardised across testing sessions.
RESULTS: The PACES score was significantly higher (P<0.05) in MP15 (84.3 ± 7.9) and MP30 (89 ± 6.8) than MIC (77.7 ± 5.9) while there was no significant difference between MP15 and MP30. There were no significant differences on the positive, negative or fatigue subscales of the PAAS across the three protocols. RPE was significantly higher (p<0.05) in MP15 (16 ± 1) and MP30 (16 ± 1.2) compared to MIC (13 ± 1.6). BLa was significantly higher (P<0.05) in both MP15 (4.8 ± .5mmol/L) and MP30 (4.5 ± .5 mmol/L) than MIC (2.1 ± 0.4 mmol/L).
CONCLUSION: Micropauses resulted in higher levels of enjoyment than MIC, with no difference found between micropause protocols. Micropause running was conducted at a higher intensity than MIC resulting in higher BLa accumulation and RPE scores. Although metabolic strain, and perceived exertion were higher in the micropause protocols, they were perceived as more enjoyable and no more fatiguing than the lower intensity MIC post-exercise. These results are reflective of a male population, and support the use of micropause running as a viable alternative to MIC.

IMPROVEMENTS IN 12-MINUTE RUN PERFORMANCE, PEAK OXYGEN UPTAKE AND MUSCULAR OXIDATIVE ENZYMATIC POTENTIAL ARE RELATED TO INITIAL LEVEL

KILEN, A., NORDSBORG, N.

DANISH ARMED FORCES HEALTH SERVICES

INTRODUCTION: It is evident that humans respond differently to exercise training. It was hypothesized that improvements in both a 12-minute run test, peak oxygen uptake and muscular oxidative enzymatic potential would be dependent on the initial level. Moreover, it was hypothesized that changes in the 12-minute running test would correlate to peak maximal oxygen uptake as well as muscular oxidative potential.
METHODS: A total of 287 conscripts volunteered to participate in a training study for the first 9 weeks of their Basic Army Training program. Weekly cardiovascular training included 30 minutes of running and 30 minutes of muscle endurance training with increasing intensity over the 9 weeks. Besides the scheduled physical training, the army basic training program consisted of low intensity aerobic activity for an average of 20 hours per week, such as closed order drills, loaded marching and low intensity running. Pre and Post testing included a 12-minute run test, a peak oxygen uptake test on a treadmill and muscle biopsies. The conscripts were divided into three equal sized groups, low (LO), medium (ME) and high (HI), according to their initial level of the 12 minute run test, peak oxygen uptake and enzyme activity of citrate synthase (CS) and beta-hydroxyacyl-CoA dehydrogenase (HAD) respectively.
RESULTS: All three groups improved the distance covered in the 12-minute run test and peak oxygen consumption from pre to post. LO significantly increased both more than ME and HI (Lo: 346±206; Me: 156±166; Hi: 81±152 meters, n=209 and Lo: 845±654; Me: 156±512; Hi: -103±565 ml O2*min-1, n=63 respectively, P<0,01). ME improved significantly more in the 12-minute run test than HI (P<0.05) but not peak oxygen uptake. CS (n=65) and HAD (n=63) enzyme activity increased in LO (9,5% and 2,3% respectively) and decreased in ME and HI (ME: 10,1% and 9,7%, HI: 20,1% and 18,8% respectively). There were a weak non-significant correlation (r2<0.10) between adaptations in the 12-minute running test and altered maximal oxygen uptake as well as muscular oxidative potential.
CONCLUSION: The present results support the hypothesis that improvements in both run performance, peak oxygen uptake and muscular oxidative enzymatic potential are dependent on the initial level. A higher initial level within each parameter resulted in a lower adaptation. However, the results do not support the hypothesis that the change in the 12-minute run test would correlate to the change in peak oxygen uptake or muscular oxidative potential.

BLOOD PRESSURE CHANGES DURING SELF-PACED OUTDOOR WALKING IN MIDDLE-AND OLDER INDIVIDUALS AND EVIDENCE-BASED EXERCISE PRESCRIPTION TO EFFICIENTLY DECREASE ARTERIAL STIFFNESS

OTSUKI, T., ISHII, N., NAKAMURA, F., ZEMPO-MIYAKI, A.

FACULTY OF SPORT AND HEALTH SCIENCES, RYUTSU KEIZAI UNIVERSITY

INTRODUCTION: Exaggerated elevation of systolic blood pressure (SBP) during exercise is a risk factor for future cardiovascular disease. We also demonstrated that product of SBP and heart rate during aerobic exercise is correlated with arterial stiffness (Otsuki T et al. Hypertens Res 29: 65-73, 2006), an independent risk factor for cardiovascular disease. Identification of factors affecting on SBP changes during exercise might be of significance for attenuating excessive SBP elevation, leading to an efficient improvement in arterial stiffness by aerobic exercise training. However, there is little information regarding SBP changes during practical outdoor exercise.
METHODS: To explore factors relating to SBP changes during practical outdoor walking, 109 subjects (47–83 years of age) walked outdoors at their own pace wearing a blood pressure monitor on their wrist. In addition, a 6-week intervention study (walking, 3-5 d/wk, 30-60 min/d, 65-75% of maximal heart rate) was performed to investigate effects of exercise prescription based on our findings; subjects were asked to walk at a normal pace for first 10 minutes of walking and at a subjectively assessed fairly hard pace, somewhat faster than their normal walking pace, or both after the lapse of 10 minutes. Arterial pulse wave velocity (PWV), an index of arterial stiffness, was measured before and after the intervention period.
RESULTS: SBP increased during walking compared to rest, but was higher at the 1 km mark than both the 2 and 3 km marks (rest, 124±14 mmHg; 1 km, 140±16 mmHg; 2 km, 136±18 mmHg; 3 km, 135±18 mmHg). SBP at rest, air temperature, body mass index (BMI), and walking intensity during the first 1 km were identified as predictors of SBP at the 1 km mark in the stepwise regression analysis, independent of other confounders (R2=0.606). SBP at the 1 km mark was independently higher in the lower temperature group (11.6–14.3 °C, 145±14 mmHg) than in the intermediate (15.1–16.7 °C, 140±18 mmHg) and higher (17.0–19.6 °C, 136±16 mmHg) temperature groups. In the intervention study, PWV in the training group decreased after the intervention. In the control group, there were no differences in PWV.
CONCLUSION: These results may imply that measures should be taken against the cold on cooler days and an appropriate walking pace would be preferable to attenuate the SBP response during the onset of walking. A lower walking pace during the onset of walking followed by a faster pace may be preferable to efficiently decrease arterial stiffness.

THE ADVANTAGES OF ENERGY TENNIS PROGRAM IN TEACHING TECHNIQUE TO CHILDREN

HEGAZY, K.1,2, SCHMIDT, S.1, WOLL, A.1

1: KIT , 2: UA

INTRODUCTION: Tennis playing necessitates a high complexity of movements. The formation and training in sport must be considered as a unity of coordination, conditioning, technique, tactics, mentality, and social environment (Schönborn, 2000). Moreover, an important aspect that the trainer should keep in mind is that the players are having fun and experiencing early success (Minihan, 2008). Progressive tennis programs aim to combine all aspects. Therefore, the present study aims to investigate the effectiveness of the Energy tennis program (NRGTennis) in teaching tennis to children.
METHODS: A total of 30 children from Tennis Club Singen in Germany, aged between 7 and 11 years old participated in the study. The training unit started with warming up (10 min.) which included running games, then the children were divided into groups of maximum 5. The groups practiced different coordination exercises in stations (30 min.) using tennis balls, rackets, jumping rope, basket balls, split steps, keeping the tempo between all. Further they were divided into groups according to their performance level and practiced tennis skills (forehand, backhand, volley and serve) gradually from easy to difficult (45 min.), with increasing ball contact and keeping the tempo. Last part included stretching exercises (5 min.). The physical fitness test included speed evaluation, rope jumping, basketball dribble, ball throw, dynamic balance and flexibility.
RESULTS: The results of ANOVA with repeated measurements showed a highly significant interaction effect between time and group in tennis technical skills ($F_{1,55}=22.5$; ETA2=.29) and physical fitness exercises ($F_{1,41}=19.8$; ETA2=.33).
CONCLUSION: The improvement of tennis skills performance and physical fitness level indicated that the NRGTennis program has a good impact on learning tennis for children. The advantages of the program are that the lesson aim is very clear, the training is continuous and the lesson is done progressively from easy to difficult, from small to big distance, from slow to fast, from big to medium and small targets, first getting used to the ball and racket, then playing without partner and lastly playing with partner.
References:
Schönborn, R. (2000). Advanced Techniques for Competitive Tennis, 2nd edition, Meyer & Meyer Sport.
Minihan, D. (2008). Coaching your tennis champion. The progressive plan for success, Mansion Grove House, USA.
Contact: khaled.hegazy@kit.edu

Oral presentations

OP-PM76 Injury

MOUNTAIN BIKE RELATED INJURIES - FREQUENCIES AND CORRELATIONS AMONG AMATEUR AND PROFESSIONAL MALE ATHLETES.

STOOP, R.1, HOHENAUER, E.1,2,3, VETSCH, T.1, CLIJSEN, R.1,2,3

1: SUPSI , 2: THIM , 3: VUB

INTRODUCTION: Mountain biking has developed into a popular sport performed by both amateurs and professionals. Physical activity is often related to an increasing risk of injury which may lead to high socioeconomic costs. To avoid accident-related injuries, each racing discipline demands its own set of specific skills and training regimens. The aim of this study was to perform a descriptive analysis of the causes and effects of mountain biking related injuries in amateur and professional male athletes.
METHODS: A survey of mountain biking related injuries was conducted on the participants of the Swiss Epic mountain bike event in 2017. The survey included 25 questions and was translated into English, French, Italian, Spanish and German. The questions focused on correlating racing experience, training hours and usage of protection, the possible reasons for accidents, the injury mechanisms, the severity of and recovery from injuries. Exclusion criteria were set a priori. Incomplete data reporting and participants without injuries were excluded from this analysis.
Descriptive statistics were used to analyze the data. Spearmans correlation rank tests were applied. A significance level of alpha = 0.05 was accepted.
RESULTS: After data screening, n = 99 from returned n = 139 questionnaires were assessed for eligibility, from which n = 29 athletes reported never being injured. Thus, n = 70 questionnaires were analyzed. For amateurs, significantly positive correlations were found between the number of injuries and the injured body location , bone fractures and the trunk region , joint injuries and the foot/ankle region , soft tissue injuries and lower extremity body sites , head injuries and concussions . For professionals, a significantly positive relationship between soft tissue injury and hip/thigh region was detected . There was a negative correlation between injury frequency and the use of protective gear . A significantly positive correlation between the amount of protective gear worn and return to sport in days was found .
CONCLUSION: Our results demonstrate that skill level, experience and training hours positively affect the incidence of mountain bike related injuries. No correlation was found for the wearing of protective gear and the occurrence of musculoskeletal injuries. Furthermore, the usage and amount of protective gear does not alter injury frequency, indicating that this cannot replace training load and experience. Therefore, the use of protective equipment might create a false sense of security especially for amateur mountain bikers.

TRACKING SEASON CONTINUITY TO ESTIMATE INJURY INCIDENCE IN DISTANCE RUNNERS AMONG COLLEGIATE PROGRAMS USING PUBLICLY AVAILABLE DATA

BURNS, G.T., LEE, M.J., ZERNICKE, R.F.

UNIVERSITY OF MICHIGAN

INTRODUCTION: Over 30,000 collegiate distance runners compete each year in the NCAA, yet there are no publicly available records of injury incidence across universities. Thus identification of institution-level factors related to injury risk (e.g., athletic expenditure, geographic location, or coaching tenure) are difficult to systematically investigate. Many distance runners compete in both an indoor and outdoor track and field season, and the results of all competitions are available publicly. Individual athlete continuity across seasons may provide an of estimate injury incidence within and across institutions. We hypothesized that season continuity rates could be calculated from

publicly available track and field competition results, and that institution-level season continuity would be predicted by their conference and the amount of annual athletic expenditure.
METHODS: Competition results from 60 NCAA Division I indoor and outdoor track and field conference championship meetings were scraped from the Track & Field Results Reporting Service (TFRRS). Season continuity rates (SCR) were calculated based on the presence of individuals in distance races (1500m–10,000m) in each of the indoor and outdoor seasons for each institution. Total athletic expenditure (TAE), athletic expenditure per athlete (AEpA), and average institutional coaching salary per athlete (CSpA) were mined for each institution. A linear model was used to determine contributions of these factors to the SCRs.
RESULTS: SCR was calculated for 96 teams from 57 institutions (39 male; 57 female) across 5 conferences. Average SCR was 0.73±0.16 across teams. Mean TAE was $49,756,689±31,872,120, mean AEpA was $92,789±42,446, and mean CSpA was $16,805±7,011. From 2010 to 2015, SCR varied significantly between institutions ($p < 0.001$) and between conferences ($p < 0.001$), but not between sexes. The conference with the highest SCR was the Western Athletic Conference (0.81), while the conference with the lowest SCR was the Mid-American Conference (0.68). No financial measures were significant predictors of a team's SCR.
CONCLUSION: This investigation created a new measure to track and compare season continuity in collegiate-level distance runners using publicly available data. A key reason for an individual's lack of participation across seasons is injury, so the SCR can be an indirect indicator of a team's injury incidence. The SCR varied across institutions and conferences, but it was not related to the institution's athletic expenditures. This suggested that season continuity and injury in collegiate distance runners was related to cultural factors and pressures unique to teams and geographic regions, rather than their monetary resources. Additional factors, such as coaching tenure, roster size, and season performance can be mined, in the future, to expand this preliminary investigation. Furthermore, the data mining methods developed, here, can be replicated in other sports to track various metrics using web-based public data.

OVERUSE AND TRAUMATIC INJURIES IN YOUTH ELITE SOCCER: GROWTH AND MATURATION MATTER!

ROMMERS, N.1,2, RÖSSLER, R.3,4, WITVROUW, E.2, GOOSSENS, L.2, VAEYENS, R.2, LENOIR, M.2, D'HONDT, E.1,2
1: VRIJE UNIVERSITEIT BRUSSEL , 2: GHENT UNIVERSITY , 3: VU UNIVERSITY AMSTERDAM , 4: UNIVERSITY OF BASEL

INTRODUCTION: Elite-level youth soccer involves a significant injury risk. Moreover, this risk is known to increase during periods of growth. Previous research identified age and anthropometric variables as risk factors for injuries but these risk factors have not been investigated together, nor regarding specific types of injuries. Therefore, the aim of this study was to assess the role of age, growth rate, weight change, maturational timing and training exposure in all injuries as well as in overuse and traumatic injuries in elite-level youth soccer players.
METHODS: 318 elite-level male soccer players between 9 and 15 years of age (mean age: 11.64 ± 16.69 years) were followed during one competitive season (2016-2017). At the start and the end of the season, body height, body weight and sitting height were measured. These anthropometric variables were then used to determine the standardised growth rate, standardised weight change and the age-specifically standardised age at peak height velocity. Injuries were registered by the medical staff of each participating Belgian youth academy (N = 4) using a standardised injury report form. Average weekly training exposure was calculated per team over the season. Incidence risk ratios (IRR) of potential risk factors were investigated using multivariable Poisson or negative binomial regression models (according to best fit) for all injuries as well as for overuse and traumatic injuries separately.
RESULTS: A total of 297 injuries (134 overuse and 163 traumatic injuries) were registered in 156 players during the competitive season. Only a higher age was a risk factor for all injuries (IRR = 1.30 per year). For overuse injuries, a higher age and weight gain were significant risk factors (IRR = 1.29 per year and IRR = 1.36 per kg, respectively). For traumatic injuries, a higher age and an earlier maturational timing were identified as significant risk factors (IRR = 1.30 per year and IRR = 0.80, respectively). In contrast, the risk for traumatic injuries was lower in players with a higher growth rate (IRR = 0.63 per cm of growth). Average weekly training exposure did not influence the risk for any type of injury.
CONCLUSION: In accordance with previous studies, we can conclude that increasing age is an important risk factor for all injuries in 9- to 15-year-old elite-level soccer players. Adjusted for age, however, weight gain was a significant risk factor for overuse injuries, whereas for traumatic injuries, injury risk was higher in players with an earlier maturational timing and a lower growth rate. These differences between overuse and traumatic injuries should be taken into consideration when assessing injury risk and applying injury prevention strategies.

INJURY RISK IN ACADEMY LEVEL RUGBY LEAGUE MATCH PLAY: A SINGLE SEASON PROSPECTIVE COHORT STUDY

TEE, J., TILL, K., JONES, B.
LEEDS BECKETT UNIVERSITY

INTRODUCTION: Rugby League is an invasion sport characterized by frequent accelerations, decelerations, changes of direction and collisions between players. The game is played world wide at junior and senior age groups and across competitive levels ranging from amateur to elite. Rugby league academy competition is an important step along the pathway to professional player status. Despite the importance of this pathway, to date no research has examined injury risk at senior academy level in England.
METHODS: Three professional rugby league academies were recruited to this observational prospective cohort investigation. Eighty-one players were included in the investigation. Physiotherapists from each academy were recruited and remunerated to act as injury surveillance officers throughout the season. Match injuries were recorded using a time-loss definition consistent with the consensus adopted within rugby union. Injury incidence , injury severity and injury burden were all calculated.
RESULTS: Injury incidence of 85 <95%CI 67 to 103> injuries/1000 h was observed during the 59 matches played. This equates to 1.5 <95%CI 1.2 to 1.8> time-loss injuries per match. The mean severity of injury was 22 ± 19 days resulting in an overall injury burden of 1870 <95%CI 1785 to 1955 days/1000h>. The tackle event was the most common cause of injury <69% of injuries>, with the tackled player injured more frequently than the tackler . Forwards sustained a greater proportion of injuries than backs and ankle sprains <11, 95%CI 4 to 17 per 1000 h> were the most commonly diagnosed injuries, but the shoulder joint was the most commonly injured site <17, 95%CI 9 to 25 per 1000 h>.
CONCLUSION: Overall, the incidence of injury for academy rugby league was similar to that reported in senior professional rugby league <78 injuries / 1000 h> , but the mean severity and overall burden of injury was lower . Injury patterns indicate that academy players are at a higher risk of concussion and shoulder joint injuries than senior professional players. This suggests that the specific focus for injury risk management in academy rugby league should be on players' tackle technique and prevention strategies for concussion and shoulder injuries.
REFERENCES:

Fitzpatrick, A. C., Naylor, A. S., Myler, P., & Robertson, C. <2018>. A three-year epidemiological prospective cohort study of rugby league match injuries from the European Super League. Journal of science and medicine in sport, 21<2>, 160-165.

Oral presentations

OP-PM77 Training load

DETERMINATION OF THE INTERRELATIONSHIPS AMONG MEASURES OF TRAINING LOAD IN ELITE SOCCER

RUF, L.

CARDIFF METROPOLITAN UNIVERSITY CARDIFF

INTRODUCTION: Numerous training load measures can be derived from wearable microtechnology such as heart rate, GPS devices and accelerometers. Practitioners are faced with the challenge to decide which measures to compute and select for daily monitoring purposes. Therefore, the aim of this study was to outline a systematic process of data reduction and variable selection of a variety of commonly used training load measures in professional soccer.
METHODS: Data were collected in 32 professional soccer players (25.2 ± 4.8 years, 180 ± 5 cm, 75.7 ± 5.4 kg) over the course of 32 consecutive weeks (14-week pre-season and 18-week in-season period). Training load was quantified via heart rate, GPS, tri-axial accelerometers and subjective RPE for all training session. A total of 25 absolute (n = 1639 data points) and 22 relative training load measures (n = 1846 data points) from speed-, acceleration-, accelerometry-, metabolic power-, heart rate- and subjective-related parameters were computed and subsequently subjected to two separate Principal Component Analyses. This statistical technique was used to reduce the dimensionality of a given data set while retaining as much information in the remaining components as possible. The optimal number of components to retain was established by examining the eigenvalues, scree plot and percentage of variance explained by each component.
RESULTS: When analysing absolute measures of training load, five principal components were extracted explaining in total 82% of the variance. Training load measures that were highly loaded on component 1 were associated with measures of total volume, while component 2, 3, 4 and 5 represented measures of high-speed, acceleration, mechanical work and internal load. Results suggest that PlayerLoadTM and total distance can be used interchangeable and explained with ~26% the largest proportion of the total variance. Positional analysis revealed moderate similarities in the structure of the identified components. When analysing relative measures of training load, five components have been identified explaining in total 72% of the variance. Components 1, 2, 3, 4 and 5 were considered to represent relative high-speed, relative total volume, relative internal load, relative acceleration load and relative deceleration load. Large similarities were evident between positions.
CONCLUSION: Multiple training load measures are needed to thoroughly monitor the imposed demands on elite soccer players. Practitioners can select the following absolute variables to capture the largest variance in training load when monitoring the entire squad: PlayerLoadTM, distance covered at high-speed (>19.8 m.s-1), number of accelerations >1.5 m.s-2, PlayerLoadTM >3 m.s-2 and RPE. Similarly, the following relative variables account for the largest proportion of training load: relative high-speed, relative PlayerLoadTM, relative RPE, relative number of accelerations >1.5 m.s-2 and relative number of decelerations >1.5 m.s-2.

QUANTIFICATION OF PRESEASON TRAINING LOAD IN ELITE GREEK SOCCER PLAYERS

KALAPOTHARAKOS, V.I., BASDEKIS, G., TOKMAKIDIS, S.P.

DEMOCRITUS UNIVERSITY OF THRACE, KOMOTINI, GREECE

INTRODUCTION: Quantifying training load is an important part in the training monitoring process of soccer player (Borresen & Lambert, 2009). However, there are few information about the periodization practices of training load across a preseason period in elite soccer players, and how this periodization affects the aerobic performance (Malone et al., 2015; Manzi et al., 2013). The main aim of the present study was to quantify the internal training load of a 6-week preseason period completed by professional soccer players of Greek Super League. Also, this study examined the effects of a 6-week preseason in aerobic performance.
METHODS: Fifteen professional soccer players (mean + SD: age 26.5 + 3.8 years; height 177 + 5 cm; weight 77 + 7.2 kg) from a Greek Super league team participated in the present study. Initially, VO2max and running velocity at VO2max (v-VO2max) before and after the preseason period were determined during a laboratory incremental treadmill for all players. Also, the Interval Shuttle Run Test (ISRT) was performed before and after the preseason period to determine interval endurance capacity. The stage and the velocity (v-ISRT) completed during the ISRT by each player were recorded. The internal training loads completed during the training sessions of six training weeks were determined multiplying the session RPE (CR10-scale) by session duration in minutes. Pre-season period of 6 weeks were analyzed across 6 x 1 week microcycles.
RESULTS: VO2max (57.9+3.4 vs 59.6+2.9 ml/kg/min), v-VO2max (16.6+1.4 vs 19+1 km/h), stage (98.1+18 vs 121+12) and v-ISRT increased significantly ($p<0.001$) after the preseason period. Internal training loads and duration of week 2 (2592+295 AU) week 3 (2519+514 AU) were significantly higher ($p<0.05$) in comparison to week 1 (1736+383 AU), week 4 (1857+517 AU), week 5 (1586+322 AU) and week 6 (1800+306 AU). No significant differences were observed in weekly internal training load and weekly duration among week 1, 4, 5 and 6 of preseason period.
CONCLUSION: VO2max, vVO2max, the stage and the running velocity completed during the ISRT are useful and practical predictors to monitor endurance performance changes during a soccer preseason. The findings of the present study suggest that a variation on weekly internal training load and duration occurred during a 6 week preseason period in a Greek Super League Team. Previous studies have shown conflicting results, with higher or less s-RPE values of elite soccer players from different championships compared to our study. It seems that the variation in internal training load in preseason between the present and previous studies (Malone et al., 2015; Manzi et al., 2013) may be due to their different external loads.
References: Borresen J, Lambert MI. (2009). Sports Med, 39 (9), 779-795.
Malone JJ et al. (2015). Int J Sports Physiol Perform, 10, 489-97.
Manzi V et al. (2013). J Strength Cond Res, 27(3), 631-6.
Contact: Dr Vasilios I. Kalapotharakos: vasikal@yahoo.com

EXAMINATION OF THE EFFICACY OF GPS GENERATED METABOLIC LOAD MEASURES FOR MONITORING INTENSIVE INTERMITTENT RUNNING LOAD IN RUGBY UNION.

SMITH, T.B.1,2, TARRANT, O.P.3, MCINTOSH, N.1

UNIVERSITY OF WAIKATO

INTRODUCTION: Various global positioning system (GPS) metrics are regularly employed to measure locomotion workload in team sports. Common GPS metrics include distance in specific high-speed zones (e.g. > 5.5 m/s) and counts of acceleration/deceleration events occurring beyond a specific intensity threshold (e.g. > 3 m/s/s). During a super rugby match a player sprints approximately 20 meters each minute, which isnt often far enough for all the distance sprinted to fall in the high-speed zone. Some intensive rugby sprints start whilst the player is already moving or acceleration decays during an intensive prolonged sprint, resulting in a low average acceleration. Both scenarios can result in a single count in a low acceleration zone, which limits the ability of the acceleration metric to accurately measure intense workloads. To overcome these limitations, some GPS companies include the high metabolic workload distance (HMLD) metric, despite various studies claiming its unsuitability for this task. HMLD is power output derived from the estimated energy cost calculated from velocity, acceleration and deceleration measurements. We observed a strong relationship between HMLD and player finish order in various on-field rugby union fitness drills and set out to investigate this relationship in more depth.
METHODS: We sought to explore the relationship between (HMLD) measured by a Viper Pod GPS (STATSports Technology Ltd, Courtney Hill, NI) and the time to complete a repeated sprinting task for 27 participants. Two different intensive rugby tests were investigated. The first test involved a maximal 10 m & 20 m out and back shuttle run (SHORT), repeated each minute for ten repetitions. The second test involved a maximal 20 m, 40 m & 60 m out and back shuttle run (LONG), repeated every two minutes for six repetitions. Correlations between the individual HMLD and associated time for all participants various shuttle runs, were determined for each test (SINGLE). For each participant the shuttle times were also combined, as was HMLD, for both the SHORT and LONG tests. This participant data was used to calculate the correlation between the combined HMLD and combined time for each test (COMB). HMLD was set at ≥ 25 watts/kg and all statistics were conducted in SPSS with correlations calculated with Pearsons correlation coefficient (r).
RESULTS: The analysis showed the relationships to be linear and variables to be normally distributed. Correlations were: SINGLE SHORT r = 0.85, SINGLE LONG r = 0.87, COMB SHORT r = 0.88 and COMB LONG r = 0.96.
CONCLUSION: Despite studies questioning the accuracy of HMLD, we found strong correlations between it and the time taken to complete rugby specific intermittent maximal shuttle tasks and this relationship strengthened with longer running distances. We believe these results provide some evidence for the efficacy of HMLD for monitoring locomotion workload in sports such as rugby union that involve intensive intermittent acceleration, deceleration and velocity activities.

CURRENT TRENDS IN BIOLOGICAL MATURATION AND TRAINING LOAD MONITORING IN ELITE ENGLISH ADOLESCENT SOCCER

SALTER, J., TOWLSON, C.

YORK ST JOHN UNIVERSITY AND THE UNIVERSITY OF HULL

INTRODUCTION: Evidence has outlined the enhanced risk of injury during periods of accelerated biological maturation (BM) and the subsequent importance of training load (TL) monitoring. Given the competitive nature of professional soccer, the differences in approach taken by soccer academies to monitor BM and TL is somewhat unknown, with only minimum general legislative guidelines presented by governing bodies. Therefore, this study aimed to explore and quantify the current approaches and attitudes of UK elite youth soccer academy practitioners for monitoring plyer BM and TL in male and female adolescent soccer players.
METHODS: Having ethical approval, 49 respondents completed an online survey who represented male Premier League (n = 38), soccer academies and female Regional Talent Clubs (n = 11) spanning U9-U23 age groups, of which 78% were Sport Science support (SSS) staff. The survey consisted of 16 questions covering two constructs: 1) monitoring of BM (8 questions) and 2) TL monitoring TL (8 questions). Questions were either multiple choice or unipolar scaled (0 = not important; 100 = highly important) and took <10 minutes to complete.
RESULTS: Respondents ranked injury prevention (83 ± 5.3) as the most important reason for BM and TL monitoring with overall development (80 ± 5) second and load management (78 ± 2.6) third. Practitioners ranked resource limitations (71 ± 14) and time constraints (65 ± 6.7) as the primary barriers to implementing monitoring strategies but support from key stakeholders (parents, senior management and players) was not deemed a barrier. The primary methods of BM monitoring conducted by SSS staff (83%) were maturation offset (47%) and predicted adult height (42%). Such data is typically reported to coaches (31%), SSS (18%) and medical staff (17%) via visual presentations (59%) on a quarterly basis (57%). The most common approach taken to TL monitoring was rating of perceived exertion (49%) and global positioning satellite (23%) collated in customised spreadsheets (58%) by SSS (74%) and reported to age group coaches (58%) and medical staff (8%) via presentations (48%) daily (39%).
CONCLUSION: The main findings suggest that although there is some unity around BM and TL monitoring between elite soccer academies, there is still a large discrepancy between approaches. It appears that a club-level approach is employed rather than a standardised approach despite legislative guidelines, which is primarily impacted by time and resource constraints at elite levels. Therefore, although evidence of good practice exists, a more widespread and consistent approach to BM and TL is needed to further understand the complexities between BM and TL on player physical development.
j.salter@yorksj.ac.uk

WORKLOAD INFLUENCE ON BIOCHEMICAL AND PSYCHOLOGICAL MARKERS THROUGHOUT PROFESSIONAL RUGBY UNION SEASON.

DUBOIS, R.1, PAILLARD, T.1, PRIOUX, J.2

1: LAPPS , 2: M2S

INTRODUCTION: Roe et al., (2016) showed that physiological stress during rugby union competition induced an acute fatigue characterized by several biochemical and psychological disturbances. Moreover, Slattery et al. (2012) showed that the physical workload also influences these characteristics in team sports players (muscle damages, inflammation, …). Therefore, the aim of this study was to analyse the influence of weekly workload (WWL) (training & competitive stress) on biochemical and psychological responses throughout elite rugby union season (TOP14).
METHODS: This study was carried out throughout a season [48 Weeks (W) - Preseason: 8W & 3 competitive blocks (CB ~ 12 to 14W each)]. 3 blood samplings (W16, 30 & 45) together with 10 recovery-stress questionnaires (RESTq; weeks: 1, 3, 5, 8, 12, 16, 22, 30, 38, 46) were

performed by 14 professional players. The blood samplings were carried out more than 72h after the last game in fasted condition. The RESTq was informed after a full day of recovery about 48h before the next game. Endocrine parameters [Testosterone (T), Cortisol (C), Insulin Growth Factor (IGF-1)] & muscle damages [Creatine Kinase (CK)] were studied.
WWL was assessed through S-RPE methods and GPS/accelerometer monitoring (GPSport, SPI-HPU, 5Hz). These 2 methods were used during training and competitive practices. The GPS units allowed to assess the distance covered and the number of heavy impacts (>8G) suffered. ANOVA for repeated measures showed the evolutions of biochemical and psychological characteristics over the season. Pearson's coefficient of correlation (r) was used to analyzed the influence of WWL on these characteristics. The influence was studied with a certain time lag. The short-term (acute) effects corresponds to the weekly values of the previous and current week, while the moderate-term (chronic) effects corresponds to the average of the 4 last weeks. The global influence over the season were analysed thank to rolling average of these variables.
RESULTS: The WWL and number of impacts were greater during the preseason, and during the 1st CB compared to the 2nd and the 3rd CB ($p<0.05$). [CK], [ASAT] et [ALAT] were higher during the 1st CB ($p<0.05$) whereas T/C & IGF-1/C ratios were lower in 2nd CB compared to 1st CB ($p<0.05$). The acute number of impacts was correlated to [CK] ($r=0.46$, $p<0.01$). [CK] showed correlation with acute competitive load & acute S-RPE ($r=0.56$ et 0.59, $p<0.001$). Specific stress index was correlated to [CK] ($r=0.63$, $p<0.001$), while the general score of recovery was in relationship with T/C & IGF-1/C ratios ($r=0.50$ & 0.45, $p<0.01$).
CONCLUSION: WWL influence changes in biochemical and psychological characteristics of rugby players. Number of impacts and competitive load were the factors that most influence the changes in these parameters

Oral presentations

OP-PM51 Nutritional physiology: Energy metabolism/body composition

VALIDITY OF A COMMERCIAL BIOELECTRICAL IMPEDANCE ANALYSIS AGAINST THE DUAL ENERGY X-RAY ABSORPTIOMETRY IN ASSESSING BODY COMPOSITION OF ADULT MALES.

ALJALOUD, K.
KING SAUD UNIVERSITY

INTRODUCTION: Bioelectrical impedance analysis (BIA) is widely used to assess body composition. However, there is lack of studies that evaluated the validity of BIA especially the commercial models such as Omron BF-511. Aim: The main aim of the present study was to examine the accuracy of Omron BF-511 model in assessing body composition in male adults.
METHODS: Apparently healthy men (n=302, mean age=31.7±10.3 years) participated in this cross-sectional study. Anthropometry measurements including body mass, height, and waist circumference (WC) were taking on the same time of the day. Body mass index (BMI) was calculated for all participants.
Body composition (%fat and %SMM) has been assessed for all participants under the same conditions using Omron BF-511 and DXA as a criterion measure. Since DXA do not provide direct measurement for skeletal muscle mass, prediction formula was applied in order to obtain a predicted skeletal muscle mass (SMM). The validity of the prediction formula was evaluated in previous study. skeletal muscle mass (SMM) (Kg)= 1.19* appendicular lean soft tissue (ALST) – 1.65, where ALST measured by DXA. Then, SMM percentage was calculated and presented as mean and standard deviation. Participants who had radiation exposure such as X-rays in the prior two weeks, or had frequent exposure to radiation in the prior year have been excluded for their health safety. Data set were checked for normality using the Kolmogorov-Smirnov test. Independent t tests (two-tail), which examined mean differences in both %BF and %SMM between the two devices (DXA and Omron). Wilcoxon signed ranks tests were used as appropriate. The Limits of Agreement (LoA) was examined for both devices (DXA and Omron) using the Bland-Altman plots method (Bland and Altman, 1986). Pearson's correlation coefficients were applied to assess the association between the two devices in measuring %BF and %SMM. Acceptable percent error limit (±3.5) was calculated for the examined device (Omron BF-511) using a developed equation %error = [(Omron – DXA)/DXA x 100]. Statistical significance was set at $P<0.05$ for all the analyses.
The current study protocol has been approved by the Internal Review Board (IRB) at King Saud University (IRB No. E-16-1785
RESULTS: Although the results showed relatively close values (%fat &%SMM) between the examined instruments (Omron BF-511 & DXA), and the correlation between Omron BF-511 and DXA were high in both %fat and %SMM, the differences existed in both measures were significant (%Fat, Omron=29.02+7.68 vs. DXA=31.93+8.01, P=0.000; %SMM, Omron=34.42+4.83 vs. DXA=35.70+4.66, P=0.002).
CONCLUSION: The current study concluded that Omron BF-511 could provide close estimation of %fat and %SMM. However, caution should be taken when an accurate estimate of %fat and %SMM is crucial. Therefore, more investigations are recommended to develop the accuracy of the commercial BIA (e.g. Omron BF-511) in order to provide accurate body composition assessment.

PREDICTION EQUATIONS UNDERESTIMATE DIRECT MEASUREMENTS OF RESTING METABOLIC RATE IN ELITE YOUTH SOCCER PLAYERS

HANNON, M.P., CARNEY, D., FLOYD, S., PARKER, L., UNNITHAN, V., DRUST, B., CLOSE, G.L., MORTON, J.P.
LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: The prescription of nutritional guidelines for elite youth soccer players is currently difficult owing to the lack of data quantifying daily total energy expenditure (TEE). Given the contribution of resting metabolic rate (RMR) towards TEE, an initial step in developing population specific nutritional guidelines is direct assessment of RMR. Therefore, the aims of the present study were 1) to directly assess RMR in elite youth soccer players and 2) to assess the validity of common RMR prediction equations.
METHODS: Seventy eight elite male youth soccer players from a Premier League Academy (n= 14 U12s; 11 U13s; 14 U14s; 13 U15s; 7 U16s; 19 U18s) were assessed for body composition (DXA) and RMR (indirect calorimetry) after an overnight fast. Measured RMR (from pooled data) was compared to predicted RMR values from seven equations via a one-way repeated measures ANOVA (Cunningham, 1980; DeLorenzo et al., 1999; Henry, 2005; Kim et al., 2015; Molnar et al., 1995; Schofield, 1985; Wong et al., 2012).
RESULTS: Height (U12= 154.9±3.7; U13= 161.0±5.3; U14= 171.1±8.5; U15= 175.0±6.3; U16= 182.4±6.2; U18= 181.3±5.4 cm), body mass (U12= 42.4±5.0; U13= 45.0±5.3; U14= 54.5±9.4; U15= 60.6±6.8; U16= 72.3±8.2; U18= 69.8±8.5 kg) and lean mass (U12= 30.0±3.7; U13= 32.7±4.5; U14= 41.5±8.3; U15= 47.7±6.3; U16= 56.5±5.7; U18= 55.3±6.9 kg) was significantly different between U12-U16 age groups in a hierarchal manner ($P<0.05$). There was no difference in height, body mass and lean mass between the U16 and U18 age groups

(P>0.05). Measured RMR (1855±262 kcal.day-1) was greater (P<0.05) than the predicted values of Cunningham (1468±258 kcal.day-1), DeLorenzo (1608±171 kcal.day-1), Henry (1639±241 kcal.day-1), Kim (1390±176 kcal.day-1), Molnar (1561±206 kcal.day-1), Schofield (1675±232 kcal.day-1) and Wong (1608±171 kcal.day-1).
CONCLUSION: Common prediction equations underestimate RMR in elite youth soccer players. Future research should therefore establish a valid predictive equation for this specific population in order to help formulate population specific nutritional guidelines.

HIGH PREVALENCE OF NEGATIVE ENERGY BALANCE AND HEALTH PROBLEMS ASSOCIATED WITH ENERGY DEFICIENCY AMONG PRE-PROFESSIONAL BALLET DANCERS.

CIVIL, R.1, LAMB, A.1, BROWN, M.2, STEVENSON, E.3, WITARD, O.1

1: UNIVERSITY OF STIRLING , 2: UNIVERSITY OF GLOUCESTERSHIRE , 3: NEWCASTLE UNIVERSITY

INTRODUCTION: Elite ballet dancers are considered to be at high risk of energy deficiency. Previous studies have investigated the energy intake (EI) and energy expenditure (EE) patterns of professional ballet dancers, and have monitored problems associated with low energy availability (EA). However, a paucity of equivalent information exists in young ballet dancers who may even be considered at a higher risk. Therefore, the primary aim of this study was to determine dietary intake and EI, EE, and EA of pre-professional ballet dancers. The secondary aim was to investigate the presence of health problems associated with energy deficiency in this at risk population.
METHODS: In a cross-sectional study design, we measured EI (using food diaries and 24h dietary recall) and EE (by tri-axial accelerometry and activity logs) of 20 pre-professional ballet dancers (age: 18.1 ± 1.1 years; body weight: 54.4 ± 5.8 kg; body mass index: 19.0 ± 1.6 kg·m2; body fat %: 22.8 ± 3.4; Z-score: 1.1 ± 0.9) over a 7-day period, including 5 weekdays and 2 weekend days. We then calculated energy balance (EB) and EA (n=18). In addition, measurements of body composition, bone health (including Z-scores), eating behaviours, menstrual function, and blood glucose were collected, and the Low Energy Availability Questionnaire (LEAF-Q) was conducted (n=20) to identify problems associated with energy deficiency.
RESULTS: The EE of dancers was greater than EI over the 7 days (P=0.003), equating to an EB of -308 ± 372 kcal·day-1. EI (weekdays: 1979 ± 470 kcal·day-1; weekend days: 2058 ± 589 kcal·day-1), carbohydrate, protein, and fat intakes were similar during weekdays and weekend days (P>0.050); while EE, fluid and fibre intakes were lower on weekend days when compared with weekdays (P<0.010). The magnitude of negative EB was greater (P=0.015) on weekdays (-425 ± 465 kcal·day-1) compared to weekend days (-6 ± 506 kcal·day-1), and there was a tendency for EA to be lower on weekdays (38 ± 13 kcal·kg FFM-1·day-1) than weekend days (44 ± 13 kcal·kg FFM-1·day-1, P=0.110). Overall, 83% of dancers (n=15) were in negative EB, 61% (n=11) reported an EA <45 kcal·kg FFM-1·day-1, and 22% (n=4) an EA <30 kcal·kg FFM-1·day-1. Primary amenorrhea was reported in 45% (n=9) of dancers and 40% of dancers (n=8) reported current menstrual dysfunctions, with 5 amenorrheic and 3 oligomenorrheic. When compared to the eumenorrheic cohort (n=7), amenorrheic and oligomenorrheic dancers reported greater LEAF-Q scores (P=0.006), reduced EE (P=0.015), and tendencies for lower EI (P=0.141), EA (P=0.116), and expression of emotional eating behaviour (P=0.056). However, measurements of body composition, bone health, and fasting blood glucose concentrations were similar between eumenorrheic group and dancers with menstrual dysfunctions (P>0.05).
CONCLUSION: Consistent with their professional counterparts, a state of energy deficiency was prevalent among pre-professional ballet dancers. In addition, we identified several health problems associated with low EA.

MAKING WEIGHT SAFELY: MANIPULATION OF ENERGY AVAILABILITY WITHOUT SYMPTOMS OF RED-S IN AN ELITE MALE TAEKWONDO ATHLETE

LANGAN-EVANS, C.

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Athletes involved in combat sports may experience transient periods of low energy availability (LEA) when making weight, often manifesting as symptoms of the relative energy deficiency in sport syndrome (RED-S). Additionally, combat athletes may also practice rapid weight loss (RWL) methods (e.g. extreme dehydration) that can also negatively impact health and performance. The aim of this case-study is to outline the impacts of making weight (using a structured nutrition and training intervention) on symptoms of RED-S in a male international level Taekwondo (TKD) athlete making weight for the -63kg bantam weight category.
METHODS: Over an 8 week period, the athlete adhered to a daily energy intake (1,700 kcal.day-1; 2.3 g.kg-1 protein, 3.4 g.kg-1 carbohydrate and 0.9 g.kg-1) equivalent to resting metabolic rate (RMR). Body composition (using Dual X-ray Absorptiometry, DXA), RMR, VO2peak , maximal fat oxidation rates (using indirect calorimetry), strength (1-RM back squat), power (reactive strength index, RSI) and total mood disturbance (TMD) via a profile of mood states (POMS) assessments were made at regular periods. Training consisted of specific TKD, cardiovascular conditioning and strength sessions equating to 12-15 hours.wk-1. Activity Energy Expenditure (AEE) was assessed using a combined actigraphy and HR monitor.
RESULTS: AEE ranged from 407 ± 39 to 1297 ± 71 kcal.day-1 thus equating to estimated EA ranging from 7 ± 1 to 30 ± 1kcal.kg.day-1. Average BM loss was 1.0 ± 0.8 kg.wk-1, equating to a total loss of 9.3kg. This resulted in an overall decrease of fat mass (FM) (11.5kg-7.1kg). LBM remained constant (54.5-55.1kg) and RMR was stable (1698 ± 80-1710 ± 94 kcal.day-1) throughout the period eliciting no adaptive thermogenic responses. The final 3kg of BM loss (4.5%) was achieved in the final 24 hours prior to weigh in via both active and passive dehydration methods. Despite LEA, measures of cardiovascular (VO2peak 52.3ml.kg.min-1/3.7L.min-1 to 62.5ml.kg.min-1/4.3L.min-1), strength (1RM Squat 1.6 x BM to 1.9 x BM) and power (RSI 1.72 to 1.83) based performance all improved with no detrimental effect on bone density (Hip and Lumbar Z-SCORES: 0.9 to 1.0 and 0.8-0.8, respectively) or psychological (TMD ≤2-7) health status. VENOUS BLOODS ARE BEING ANALYSED & WILL BE PRESENTED AT THE CONFERENCE.
CONCLUSION: This nutritional strategy represented a major change in the athletes habitual BM loss practices as he typically employs a number of RWL techniques over an acute period (2 weeks) in order to lose 4 kg for a higher weight category. The intervention demonstrates that a more gradual approach to making weight in TKD athletes can be successfully achieved via a combination of restricted and periodised energy intake (according to the demands of the daily training), increased energy expenditure and limited dehydration techniques, whilst avoiding the negative consequences associated with LEA and RED-S.

THE ACUTE EFFECTS OF COMBINED MONOPHASIC ORAL CONTRACEPTIVES ON BODY COMPOSITION

THOMPSON, B., HILLEBRANDT, H., BARBA, L., SCULLEY, D., KNOX, C., HUNTER, S., JANSE DE JONGE, X.
UNIVERSITY OF NEWCASTLE

INTRODUCTION: Oral contraceptives (OC) are commonly used by both athletes and females in the general population. OC use suppresses the production of endogenous female sex hormones through a combination of synthetic estrogen and progestin. The most common OC is the combined monophasic OC, which usually has a pattern of 7 days of non-active pills followed by 21 days of active hormone pills. Synthetic estrogen is known to influence fluid regulation, however it is not known whether the level of androgenicity of the progestins in OC also influences fluid regulation. As approximately 73% of lean body tissue is comprised of water, variations in fluid regulation throughout the OC cycle may affect body composition measurements. This study aimed to assess whether body composition measurements change throughout the OC cycle and whether the level of androgenicity of the OC has an influence on these measures.
METHODS: Twenty-seven moderately active females aged 18-30 years, BMI 23.5 kg/m2 (SD 3.3), all taking a combined monophasic OC with either high androgenicity (n=14) or low androgenicity (n=13), were tested during the non-active pill phase (days 4-7), the first week of the active OC (days 11-14) and the last week of the active OC (days 25-28). Dual X-ray absorptiometry (DEXA), skinfolds and body weight were measured. Hydration level was assessed using urine specific gravity (USG). Testing occurred at the same time of day and diet for 24 hours prior to testing remained the same for all tests.
RESULTS: There were no differences over the OC cycle for USG, skinfolds or bodyweight in both the high and low androgenicity groups. However repeated measures ANOVA reported a significantly higher body fat percentage for DEXA in the first week of the active OC phase compared with the non-active phase in the high androgenicity group (p=0.023). There were no differences in DEXA body fat percentage over the OC cycle for the low androgenicity group.
CONCLUSION: Our findings suggest that the more sensitive tests of body composition, such as DEXA, may be affected by the different hormones in OC at different time points in the cycle. Therefore DEXA testing should be performed at the same time during the OC cycle, particularly for females taking an OC with high androgenicity. Despite not finding significant differences for the other measures of body composition it is suggested that repeat testing should still be standardised for OC phase and that OC type and androgenicity should be recorded.

Oral presentations

OP-BN52 Neuromechanics of cycling

THE BETWEEN DAY VARIABILITY OF ASYMMETRIES IN CYCLING.

MURRAY, K.A., HETTINGA, F.J.
UNIVERSITY OF ESSEX

INTRODUCTION: A number of previous studies have determined that bilateral asymmetries in force and torque production are prevalent during cycling. Research has investigated the effect of intensity, cadence and seat position on the magnitude of asymmetry during cycling. However, at present little is understood about the day to day variation in cyclists asymmetries when performing standardised cycling trials across multiple visits. The aim of this study was to investigate the variability of asymmetry between cycling trials on multiple days.
METHODS: Five well trained cyclists (mean maximal aerobic power of 362.8±28.3W) visited the laboratory on four occasions, each separated by seven days. The initial visit consisted of a maximal incremental cycle test to volitional exhaustion, to determine the cyclists' maximal aerobic power (MAP). The following three visits were all the same, whereby cyclists performed 4 x 4-minute trials at various relative intensities (40%,60%,75% and90% of MAP). Cycling trials were standardised at 90rpm and performed on a Lode Excalibur ergometer fitted with Garmin Vector pedals (GVP's). GVP's were used to measure the bilateral contribution to total power output during each of the cycling trials. Bilateral data from the GVP's were used to calculate the mean Asymmetry Index (AI%) for each trial, to assess the magnitude of each cyclists asymmetry. AI%=((DOM-NONDOM)/DOM)x100, with dominance (DOM) defined by the limb contributing most greatly to total power output. An asymmetry index of 0% would represent an equal contribution of the lower limbs to total power output.
Coefficient of Variation (CV) was calculated for each cyclist to determine their variation in the magnitude of asymmetry between the three visits. CV was also calculated between the three visits for each intensity, to determine whether the variation of AI% is influenced by intensity.
RESULTS: The mean AI% for all participants and cycling intensities was 10.8±6.5% (AI% range 2.4-31.0%). CV calculations demonstrated that, on average, the cyclists AI% varied 40.0±27.1% (CV range 18.7-68.5%) between the three visits. The mean CV of AI% at 40%MAP was 44.4±23.5 (CV range 18.7-68.5%), at 60%MAP was 37.0±27.5% (CV range 9.1–73.3%), at 75%MAP was 39.4±31.4% (CV range 1.5-82.6%) and at 90%MAP was 26.2±33.6% (CV range 3.5–64.7%).
CONCLUSION: The results of this study substantiate others which conclude that bilateral asymmetries during cycling are prevalent. However, our novel finding is that these asymmetries demonstrate considerable variability between visits. The high variability is evidenced by an average CV of 40.0%, present across the range of cycling intensities. These findings demonstrate that single day analysis is not sufficient to assess asymmetry during cycling. Further research should investigate the cause of these highly variable asymmetries, and their impact on performance.
Lastly, these results are currently based on five cyclists, so they should be interpreted with care. Data collection is ongoing.

A STUDY ON EVALUATION OF MUSCLE COORDINATION PATTERN OF BOTH LOWER EXTREMITIES ON PEDALING SKILLS

SATO, T., TOKUYASU, T.
FUKUOKA INSTITUTE OF TECHNOLOGY

INTRODUCTION: Numerous studies have suggested that the central nervous system controls bodily motion through a combination of muscles, which is called muscle synergy. Recent studies have shown that muscle synergies can be extracted from the variation of EMG patterns in spite of the load and cadence during pedaling (Hug et al., 2011). However, many studies have measured the variation of EMG patterns of highly trained cyclists who pedaled with normal pedals. Generally, most trained cyclists use clipless pedals in their daily

training. Thus, the authors of the present study doubted that the EMG data measured in previous studies can be used to understand the pedaling exercise of a competitive bicycle. In a bicycle competition, a cyclist needs both the appropriate muscle coordination between legs and the appropriate saddle height to increase pedaling efficiency and/or to reduce the risk of injury (Bini and Hume, 2011; Blake and Wakeling, 2015). Yet, few studies have investigated the influence of clipless pedals on muscle coordination pattern. The purpose of this study is therefore to investigate the structure of muscle synergy generated in pedaling exercise using clipless pedals.
METHODS: Seven healthy male subjects pedaled for 30 seconds with different cadences and workloads: 70/90/110 rpm with 50/100/150 W. Three of the seven subjects had over two years experience riding a competitive bicycle with clipless pedals; they were categorized as trained subjects. The remainder of the subjects had never used a competitive bicycle or clipless pedals; they were categorized as untrained subjects. Surface electromyogram (SEMG) signals were wirelessly recorded from the tensor fasciae latae, rectus femoris, biceps femoris, and gastrocnemius medialis of both legs at a sampling frequency of 1 kHz. First, the raw SEMG signals were processed with a band-pass filter from 10 to 500 Hz. Next, the signals were transformed into time-varying frequency components using EMG-specific wavelet analysis (Tscharner., 2000), and these components were then integrated at every 10 degrees of the crank rotation angle. To derive muscle synergy, this study used principal component analysis (PCA), in which a correlation matrix is constructed using the integrated time-varying frequency components of both the untrained and trained subjects. This study assumed that the vectors and coefficients derived from PCA implementation represented the structure of muscle synergy.
RESULTS: The structure of muscle synergy has two main aspects: temporal structure and spatial structure. This study focused on temporal structure. The synergy activation coefficients (SAC), the temporal structure of muscle synergy, indicated that with respect to the significant features of coordination pattern between the legs of trained subjects, the peak SAC value was inverted by an interval of roughly 180 degrees of crank rotation angle in most of the experimental conditions. This could not be found in the results associated with untrained subjects.
CONCLUSION: This study investigated the temporal structure of muscle synergy in both legs during the pedaling of a competitive bicycle with clipless pedals. The experimental results showed that the central nervous system of trained subjects evenly controlled both legs and that the muscles adequately acted according to muscle synergy. In the future, spatial aspects of muscle synergy will also be discussed.

H-REFLEXES IN CYCLISTS VS. UNTRAINED SUBJECTS

BERTSCHINGER, R.

UNIVERSITY OF KONSTANZ

INTRODUCTION: It has been reported that aerobically trained subjects show lower Hmax/Mmax ratios in the Soleus muscle (SOL) than untrained or anaerobically trained subjects (Rochcongar et al., 1979; Maffiuletti et al., 2001; Ogawa et al., 2009). However, it is not clear if the differences reported in these studies can be attributed to the aerobic training per se or to sport specific adaptations, like they occur in runners or swimmers. Therefore, this study investigated the H/M ratios in the SOL muscle between a group of highly trained cyclists and a group of untrained subjects.
METHODS: 11 healthy, well-trained cyclists (61.3±1.8 VO2max) and 8 untrained men (46.8±2.3 VO2max) participated in this study. Recruitment curves of the right SOL muscle were obtained in a recumbent position (90° knee angle) at rest. A rectangular pulse of 1ms duration was delivered by an electrical stimulator with a stimulus intensity ranging from 2mA below H-reflex threshold to 2mA above maximal M-wave amplitude with stimuli given in randomized order in steps of 0.5 mA. Finally, VO2max was measured with a cardiorespiratory exercise test to exhaustion on a cycle ergometer.
RESULTS: Paired samples t-tests revealed no statistical difference ($p = 0.33$) in Hmax/Mmax ratio in SOL (Trained 60.3±4.9 % vs. Untrained 60.6±3.3 %) between both groups that differed significantly in VO2max ($p<0.001$).
CONCLUSION: In the present study we were not able to demonstrate a difference in Hmax/Mmax ratios between well trained cyclists and their untrained counterparts. Thus, we found no indications of specific spinal adaptations as a result of chronic endurance cycling training. Our findings question the universality of lower Hmax/Mmax ratios in endurance trained athletes and rather indicate that the observed differences might at least partly be sport specific.
REFERENCES:
Maffiuletti, N.A., Martin, A., Babault, N., Pensini, M., Lucas, B., and Schieppati, M. (2001). Electrical and mechanical H(max)-to-M(max) ratio in power- and endurance-trained athletes. J Appl Physiol (1985) 90(1), 3-9.
Ogawa, T., Kim, G.H., Sekiguchi, H., Akai, M., Suzuki, S., and Nakazawa, K. (2009). Enhanced stretch reflex excitability of the soleus muscle in experienced swimmers. European Journal of Applied Physiology 105(2), 199-205. doi: 10.1007/s00421-008-0890-8.
Rochcongar, P., Dassonville, J., and Le Bars, R. (1979). [Modification of the Hoffmann reflex in function of athletic training (authors transl)]. Eur J Appl Physiol Occup Physiol 40(3), 165-170.

THE EFFECT OF CADENCE ON THE MUSCLE-TENDON MECHANICS OF THE VASTUS LATERALIS MUSCLE AND ITS RELATIONSHIP WITH THE PREFERRED CADENCE IN CYCLING.

BRENNAN, S., CRESSWELL, A., FARRIS, D., LICHTWARK, G.

UNIVERSITY OF QUEENSLAND

INTRODUCTION: When maintaining a constant power output, cyclists prefer to use higher cadences than those that minimise net metabolic cost or the total muscle activation. The preference for higher cadences could be related to the requirement for net positive mechanical power in cycling compared to other movements like running, which require zero net power per cycle. The aim of this study was to investigate if measures of muscle mechanics could help explain the preference for metabolically sub-optimal cadences in cycling. It was hypothesised that cyclists prefer to use higher cadences because at these cadences, muscle mechanics are more favourable for power production.
METHODS: The force-length and force-velocity properties of vastus lateralis (VL) were determined using maximal voluntary isometric and isokinetic knee extension dynamometer protocols with simultaneous ultrasound imaging of VL. Participants (group mean age = 28 years, mass = 76 kg) cycled on a bicycle ergometer with force instrumented pedals at a constant power output of 2.5 W/kg body mass and cadences of 40, 60, 80 and 100 RPM. A preferred cadence condition was also performed where cadence feedback was hidden from the participant. Motion capture data and pedal forces were used to compute leg joint kinematics and kinetics in OpenSim software. VL fascicle mechanics were determined from ultrasound imaging, and indices of fascicle power and efficiency capacity were estimated during cycling based on the normalised fascicle shortening velocity and force-velocity relationships. Surface EMG data were collected for selected quadriceps, hamstring and ankle plantar flexors to compute the total cumulative muscle activation.

RESULTS: Net metabolic cost was lowest while cycling at 60 RPM. Despite the increased metabolic cost, the group mean preferred cadence was 81 RPM. The distribution of joint work remained constant across cadence, with the majority of positive work being performed at the knee during extension. The preferred cadence coincided with the highest mean VL power capacity, without a significant penalty to efficiency, compared to the most economical cadence. The total cumulative muscle activation showed a similar relationship with cadence as net metabolic cost, requiring lower overall activation at slower cadences.
CONCLUSION: The preference for higher cadences during cycling appears to coincide with favourable shortening velocities of major muscles that contribute to power output. The higher preferred cadence was favourable for the VL power capacity, without a large decrease in efficiency. The most economical cadence appears to be related to favourable conditions to reduce overall activation costs while maintaining favourable shortening velocities for efficiency. These results highlight the importance of shortening velocity in muscle performance, and the role it may play in selection of preferred cadence.

THORACOABDOMINAL MOTION PATTERN AT REST OF MASTER ROAD CYCLISTS: PRELIMINARY RESULTS.

LOPES, A.1, BERNARDINA, G.1, RODRIGUES, I.1, MASSARONI, C.2, SILVESTRI, S.2, CERVERI, P.3, BOSSI, A.4, LEITE, R.5, AMORIM, P.1, SILVATTI, A.1

1: UFV , 2: UCBM , 3: POLIMI , 4: UOK , 5: UFES

INTRODUCTION: Intensive sports training can increase the respiratory muscle function and has been shown to change thoracoabdominal motion pattern at rest (Silvatti et al. 2012). Therefore, this study aimed to describe which differences cycling training can induce on the trunk mechanics during breathing maneuvers at rest in master athletes.
METHODS: Six male cyclists (40 ± 5.5 years) with at least five years of competitive experience in road cycling, performed two breathing maneuvers: thirty seconds of quite breathing (QB) and five cycles of vital capacity (VC). For the tridimensional kinematic analysis, eleven OptiTrack Prime 17W cameras (360Hz) were positioned around the subjects and 32 retro-reflective markers were fixed on their trunk (Ferrigno et al. 1994) that was divided in compartments (superior thorax, ST; inferior thorax, IT and abdomen, AB). From the reconstructed 3D coordinates of the markers, the compartmental volumes were calculated (Visual 3D) as a function of time and divided in breathing cycles of QB and VC. For both breathing maneuvers, we calculated: 1) the mean percentage contribution (%C) of each compartment; 2) the mean correlation coefficient (R) of the (ST,IT), (ST,AB) and (IT,AB) pairs. Friedman test ($p<0.05$) and Bonferroni post-hoc comparison test was applied to verify which compartment was more active and to analyze the coordination between trunk compartments.
RESULTS: Differences were found in the %C for QB and VC ($p<0.05$), with greater contribution of AB compartment (QB=41.9%, VC=42%); than ST (QB=24.3%, VC=26.9%). Since we did not find significant difference between the mean correlation coefficient pairs and they were very high positive values, we could suggest that the cyclists had highly coordinated thoracoabdominal motion patterns in QB and VC.
CONCLUSION: The largest contribution of the AB and a coordinated thoracoabdominal motion could be an outcome of the high demands of cycling training and the associated increases in tidal volume and agree with previous results in intensive swim training (Silvatti et al. 2012). Nevertheless, Layton et al. (2011) found different results that could be related to the training history and the age of the sample under testing. Further studies correlating the trunk mechanics with physiological variables could improve the understanding of the cycling training impact on breathing.
REFERENCES:
Silvatti AP, Sarro KJ, Cerveri P, Baroni G, Barros RM (2012). J Sports Sci, 30(14):1551-60.
Ferrigno G, Carnevali P, Aliverti A, Molteni F, Beulcke G, Pedotti, A (1994). J Appl Physiol, 3:1224-31.
Layton AM, Garbera CE, Byron M, Thomashow BM, Gerardo RE, Emmert-Aronson BO, Armstrong HF, Basnerc RC, Jellen P, Bartels MN (2011). Respir Physiol Neurobiol, 178:223–229.
ACKNOWLEDGMENT: FAPEMIG, CNPQ, CAPES
CONTACT: analuiza.castrolopes@gmail.com

INFLUENCE OF LEG MUSCLE SIZE AND POWER ON MAXIMAL AEROBIC CYCLING PERFORMANCE OF MALE AND FEMALE ATHLETES

YAMAGISHI, T.1, SAITO, A.2, KAWAKAMI, Y.1

1:WASEDA UNIVERSITY , 2:THE UNIVERSITY OF TOKYO

INTRODUCTION: High peak oxygen uptake (VO2peak) is a prerequisite for success in the majority of sporting events since VO2peak sets the upper limit of athletes' aerobic capacity. While cycling is commonly adopted for the determination of VO2peak, cycling-derived VO2peak may not entirely represent aerobic capacity. Indeed, the power produced by leg muscle groups (e.g. knee and hip extensors) has been shown to account for most of work completed during cycling (Ericson et al. 1986). Therefore, leg muscle size and/or power may play a role in maximal aerobic cycling performance. This study sought to determine the influence of leg muscle size and power on VO2peak and maximal power output (Pmax) attained in a ramp cycle exercise in male and female athletes.
METHODS: Thirty-nine Japanese (males: 20, females: 19, aged 18.3 ± 3.9 years) athletes competing in various sporting events (e.g. swimming, badminton) participated in this study. All athletes performed a ramp cycle exercise to exhaustion for the determination of VO2peak and Pmax. Axial scanning of the right leg was performed with MRI, and cross-sectional areas (CSAs) of quadriceps femoris (QF) and hamstring muscles at 50% of thigh length were measured. Moreover, bilateral leg extension power was determined. These variables were entered into a forward stepwise multiple regression model with VO2peak and Pmax being dependent variables.
RESULTS: The male athletes had significantly greater VO2peak (3.92 ± 0.60 l/min or 57.0 ± 6.6 ml/kg/min) and Pmax (327 ± 44 W) than the female athletes (VO2peak: 2.67 ± 0.53 l/min or 47.5 ± 5.9 ml/kg/min, Pmax: 229 ± 49 W, $p < 0.05$). In the males, none of the variables was chosen as a predictor for VO2peak while leg extension power was the best single predictor for Pmax ($r2 = 0.22$). In the females, CSA of QF muscle was the best single predictor for both VO2peak ($r2 = 0.58$) and Pmax ($r2 = 0.70$).
CONCLUSION: The results of this study indicate that the female athletes with smaller QF muscle had difficulty pedalling against increasing work rate during the ramp cycle test thereby limiting VO2peak. Unlike male athletes, leg extension power did not explain any parameters of aerobic performance ($r2 = 0.07$ for both VO2peak and Pmax) in the females, suggesting that they were less able to translate leg power into pedalling performance. Greater VO2peak in the males would reflect their cardio-respiratory capacity that well functioned throughout the test (e.g. no plateau in stroke volume), leading to limited influence of non-aerobic factors on the maximal aerobic cycling performance.
References: Ericson et al. (1986). Eur J Appl Physiol Occup Physiol. 55(3), 229-235.
Warburton and Gledhill (2008). J Appl Physiol. 104(1), 276-278.

Contact: t.yamagishi@aoni.waseda.jp

Oral presentations

OP-SH11 Philosophical, humanities and management perspectives on sport

A CROSS CULTURAL ANALYSIS OF THE MANAGEMENT POLICIES AND THE MOTIVES OF VOLUNTEERS WITHIN SPECIAL OLYMPICS

CARLIN, L., HASSAN, D.

ULSTER UNIVERSITY

Sports organisations have traditionally relied heavily on the work of volunteers, yet research suggests that many organisations struggle to recruit adequate numbers with the sports coaching role being notoriously difficult to recruit and retain. In order to assist the recruitment and retention process, it is important for volunteers to feel connected with the values of the organisation and also that they have an input into the decision-making processes within the organisation. The overarching aim of this paper is to gain an understanding of the volunteers' views on the processes and structures of volunteer management and retention within Special Olympics. Conducting this research in three European countries, with a combination of countries which has and has not hosted an International Special Olympics event: European or World Games, will provide a greater understanding of the different policies adopted by the National Programs as well as outlining any cultural differences in the motives and opinions of the volunteers themselves. An online questionnaire was issued to volunteers within each of the three national programs receiving 403 respondents. Using the Coach Motivation Questionnaire (McLean, Mallett & Newcombe, 2012) volunteers within Special Olympics scored significantly higher on Intrinsic Motivation questions than on questions relating to Amotivation on the Self Determination Theory Continuum (Deci & Ryan, 2002). Additionally, across all countries, Special Olympics volunteers scored higher on all elements of the CMQ than the CMQ average rating except for the amotivation scale which was lower than average. The response rate per country provides significant insight into volunteer engagement with 203 responses (5.05%) from Special Olympics Ireland, 150 responses (3.2%) Special Olympics Hellas and 56 responses (1.2%) Special Olympics Great Britain. Volunteers generally were unaware of the policies and procedures adopted by their National Programs, however there was a general consensus that recruitment is primarily ad hoc and should be more strategic. Special Olympics Ireland volunteers wanted to be more involved in decision making processes within the organisation with Special Olympics Hellas volunteers more likely to state that they did not have the knowledge to do this. Overall, a more co-ordinated response is required from National Programs in relation to the recruitment and retention of volunteers and this response needs to be tailored to the specific demographics of the volunteers within each National Program. Ethical approval for this research was obtained from the Ulster University ethical committee.

References: Deci, E. L., & Ryan, R. M. (2002). Handbook of self-determination research. Rochester, NY: University of Rochester Press.
McLean, K.N., Mallett, C.J., & Newcombe, P., (2012). Assessing Coach Motivation: The development of the Coach Motivation Questionnaire (CMQ). Journal of Sport & Exercise Psychology, 2012, 34, 184-207

THE PHENOMENON OF MOTION

HOGENOVA, A.

CZECH OLYMPIC COMMITTEE

This text deals with the phenomenon of motion, which is still very problematic today in relation to the Olympic Games and their significance for the whole planet

Motion, along with the phenomenon of reality, is one of the greatest mysteries. Both phenomena are used the most, but they are mysterious if we become absorbed in thinking about them. We find that motion is not just the motion of something from one place to another, because the place does not play the most important role here. Every change is a motion, even if we do not see it. Motion is also growth, it is also coming-to-be and ceasing-to-be. It is a matter of fact that in the sub-lunar world everything is a motion, but at the same time we find that motion is also all that is in the supra-lunar world. Motion is therefore understood by the ancient Greeks as something primordial, and peace is just the privation of motion, it is a kind of absence of observable motion, because there must be something protecting against the raids of outside forces that are constant and aggressive. Even peace in our soul is not based on will but on the whole, which is the source of reconciliation with what cannot be changed.

Motion is understood both ontologically and ontically. Ontologically, motion is appearance, phenomenality, it can be "clare et distincte", but it does not have to have margo , and then we are talking only about the phenomenon. If love originates from inside us, then it is a phenomenon that does not have margo, and therefore cannot be defined in a cartesian manner, which is the basis of many misunderstandings today. For example, when a lawyer asks for evidence of a Cartesian character of these phenomena, then it is not possible. Aristotle's ontological and ontic interpretations are linked into one theory. In his "Physics", but also in Metaphysics, we experience motion in this form; he divides motion into coming-to-be and ceasing-to-be, increasing and decreasing, change and local motion. We then talk about substantive motion , quantitative motion , change; we do not understand this as a motion, because we consider "local motion" as the most important physical motion, and that is the most important and often the only motion for us.It is difficult to talk about motion in sport, it is not just physical and mechanical motion , it is also chemical motion , it is also historical motion it is spiritual motion . It is not possible to simplify motion into physical, chemical and social causality in a Cartesian way; it bears life as a basic possibility, and this possibility is motion, which has long been called zoe, bios, i.e. life. Motion remains an obscure phenomenon, despite the fact that we have written so much about it and it is understood by many.

Literature
Patočka, J. Péče o duši I. Praha : Oikumene, 1996.

THE PRESERVATION OF SPORT COMPETITION INTEGRITY IS ESSENTIAL IN ANTI DOPING POLICY.

MCNAMEE, M.

SWANSEA UNIVERSITY

Loland, S. Norwegian University of Sport and Exercise Sciences, Oslo; and McNamee, MJ Swansea University, UK.

Within the philosophy of sport the justification of anti-doping practices has traditionally been based on arguments employing the concepts of health and fairness. By contrast, WADA policy is not explicit in this regard. Rather, it makes general ethical remarks at the beginning of its Code relating to the preservation of the spirit of sport (WADA, 2015) and offers three criteria to support potential inclusion of substances on to its central policy tool, the Prohibited List. Strictly speaking, the Code is one of 7 instruments that comprise WADA policy, and it is the criteria used to consider substances and methods for the Prohibited List that has been the core of academic contention. Several scholars have argued mutatis mutandis for the need of the spirit of sport and its place in anti-doping policy (Loland and Hoppeler, 2011; McNamee, 2012; 2014) while others have argued for its abolition (Kornbeck, 2013).
We argue (i) that it is essential that the justification is based on normative grounds, not merely medical or scientific ones; (ii) for a revised justification for anti doping policy, and the criteria for the Prohibited List, based on a reconsideration of the spirit of sport understood as competition integrity (Cleret et al, 2015). We articulate and justify this interpretation, demonstrating how it is more easily operationalised than WADAs current spirit of sport criterion, enhancing its power in line drawing problems between acceptable and prohibited performance enhancing means and methods.
Kornbeck, J. (2013). The naked spirit of sport: a framework for revisiting the system of bans and justifications in the world anti-doping code. Sport, Ethics and Philosophy, 7(3), 313-330.
Loland, S., & Hoppeler, H. (2012). Justifying anti-doping: The fair opportunity principle and the biology of performance enhancement. European Journal of Sport Science, 12(4), 347-353.
McNamee, M. J. (2012). The spirit of sport and the medicalisation of anti-doping: empirical and normative ethics. Asian Bioethics Review, 4(4), 374-392.
McNamee, M. J., (2014). The spirit of Sport and its place in anti doping policy. Companion to Drugs and Sport, edited by J. Hoberman, V. Moller and I. Waddington Abingdon: Routledge.

Oral presentations

OP-SH17 Anxiety in athletes and overreaching

STUDY OF THE IMPACT OF BIOFEEDBACK TRAINING ON ANXIETY WITH COLLEGIATE LEVEL ATHLETES

SCHOEN, C., LARA, B., STODDART, S.
SALEM STATE UNIVERSITY

Introduction: As college level student athletes (SAs) endure the demands for their sport while balancing academics, reports of debilitating anxiety seem to be on the rise. Statistics published by the NCAA show more than 21% of all college male SAs reported suffering from some form of depression and 31% experienced persistent anxiety within a 12 month period (Kearns, Davoren & Hwang, 2014). For female SAs the numbers are even more troubling (28% and 48%, respectively). Reduced performances as a result of anxiety often spreads to academic work. Ultimately the entire SA experience is diminished.
Biofeedback training (BFBT) has been a technique used by sport psychology practitioners to help athletes improve performance for many years (Collins, 2002). "Biofeedback optimizes the ability to teach athletes cognitive and emotional self-regulation" (Perry, Shaw & Zaichowski, 2011, p.95) by training them to control physiological processes such as muscle tension, blood pressure, or heart rate using computer software and graphic read outs of physiological measures that are captured with sensitive detection devices. Moss and Wilson (2011) have used BFBT to train SAs to recognize and reduce the ruminative thinking and anxiety that often led to reduced performances. The essential impact of BFBT, as hypothesized here, occurs as the athlete learns to regulate physiological functioning, manage their anxiety, and ultimately enhance the collegiate SA experience.
Method
For this project university IRB approval was granted. A total of 11 SAs volunteered to received BFBT as part of a sport psychology class. BFBT was introduced as a method for increasing physiological awareness and for treating anxiety through breathing techniques and emotional regulation strategies. Engaging in BFBT was a course option. Initial measurements using the State-Trait Anxiety Inventory (STAI, Spielberger, 1977) were gathered. The STAI is a self-report measure designed to distinguish (Spielberger, 1977) between in the moment, feelings of anxiety from the more dispositional variety. Baseline heart rate variability (HRV) and coherence measures using emWave™ software were collected. BFBT was conducted with a Wild Divine Iom™ program measuring heart rate variability and respiration. Each unit within the program involved 20-40 minutes of breathing exercises. An entire 10 unit HRVBF program took on average 12 weeks to complete, after which both anxiety and physiology measures were collected.
Results & Conclusions
10 of the 11 SAs completed the protocol. Unanimously they reported that BFBT helped them cope with the demands of their athletics. Most of the SAs scored lower on both state and trait anxiety measures. Eight out of ten experienced improvements in their coherence and HRV measures as a result of the BFBT. These results cannot be considered significant given the small sample size, but the results warrant further study. Implications and future directions will discussed.

A PATH ANALYSIS OF ADOLESCENT ATHLETES' PERCEIVED STRESS REACTIVITY, APPRAISALS, EMOTIONS, COPING, AND PERFORMANCE SATISFACTION

BRITTON, D., KAVANAGH, E., POLMAN, R.
BOURNEMOUTH UNIVERSITY

This study examined the direct and indirect effects of adolescent athletes' perceived stress reactivity on stress appraisals, emotions, coping, and performance satisfaction. The study further aimed to validate the use of the Perceived Stress Reactivity for Adolescent Athletes . 229 Adolescent athletes completed the PSRS-AA followed by a measure of stress appraisals less than one hour before a competitive event. Within an hour after the completion of a competitive event, participants completed a retrospective assessment of their emotions, coping strategies, and subjective performance. Path analysis revealed that perceived stress reactivity had direct effects on the appraisal of higher stress intensity and more negative emotions. Indirect effects were observed on greater levels of threat , more disengagement-orientated coping, , and reduced performance satisfaction. No effects for perceived stress reactivity were observed on positive emotions, task orientated coping, or distraction orientated coping. These findings support the use of the PSRS-AA for assessing individual differences in stress reactivity. Practitioners could use the PSRS-AA to identify young athletes at greatest risk of experiencing negative

emotions and decreased performance as a result of individual differences in stress reactivity, and thus prioritise interventions for these athletes.

INDICATORS OF PSYCHOLOGICAL ADAPTATION IN ELITE SPORTS

RAZUMETS, E., MITIN, I., ZHOLINSKY, A.

FEDERAL MEDICAL BIOLOGICAL AGENCY

INTRODUCTION: Elite sport is associated with potential risk to the athletes' health. Training and competitions are extremely stressful, leading to negative changes in the mental state of athlete. It leads to decrease of psychological adaptation, which causes sport injuries, as well as the development of psychosomatic diseases.
METHODS: To identify indicators of psychological adaptation that affect professional success of athletes we examined 70 Russian national teams male athletes , aged 18-37. First examination was performed before the training part of season. Re-examination was performed after 6 months of the training. After that, the athletes were divided into 2 groups according to the dynamics of change in mental status. Group A included 26 athletes, group B - 44 athletes. The results of both groups were compared with estimates of the athletes success rates from coaches.
We used Yakhin-Mendelevich clinical questionnaire for the identification of neurotic symptoms including anxiety, depression, asthenia, obsessive-phobic symptoms and vegetative disorders.
To study the cognitive processes we used «Landolt rings»; Numerical square test was used for the evaluation of attention; the mental speed was assessed with Intellectual lability test. To assess central nervous system functional state we used a complex of visual-motor reaction. The vegetative-nervous system state was assessed by heart rate variability.
Statistical analysis was carried out using the EXCEL and SPSS 17.0 software and included descriptive statistics, analysis of the normality of the distribution , and the analysis of the reliability of the differences.
RESULTS: In group A before the competition neurotic symptoms, anxiety, depression and asthenia are increased. The motivation to avoid failure began to prevail. The tolerance for stress decreased. There is a significant decrease in the distribution of attention, speed and accuracy of the reaction. There is a tendency to decrease the switching and concentration of attention.
In group B, we see a trend opposite to group A. There is a significant decrease in the neurotic symptoms by the scales of anxiety, depression and asthenia in the group B before the competition. There is a significant increase in switching and concentration of attention with a decrease of the number of wrong actions.
According to the coaches' evaluation after competition, the athletes of group A showed a high performance and result. The athletes of group B did not show a satisfactory result.
CONCLUSION: To identify athletes with the risk of mental adaptation failure, the following indicators should be used:
-Neurotic symptoms, anxiety, depression, asthenia, motivation to avoid failure;
-Increase in the number of wrong tasks in tests of cognitive functions;
-Increase in the number of errors in visual-motor tests.

THE ANALYSIS OF MENTAL STATE FOR COMPETITION IN INDIVIDUAL AND TEAM SPORTS

MLADENOVIC, M.

COLLEGE OF SPORTS AND HEALTH

Introduction: In order to create conditions that would enable athletes to convert their sports potential into a desired outcome at a competition, athlete has to be able to achieve an optimal mental state for competition. The aim of this study was to analyse the relative differences between elite athletes in individual and team sports, using the Color Association method as a diagnostic tool (Mladenovic, 2017).
Methods: The Color Association method (CA) is a projective technique based on Lüscher's color test (Lüscher, 1971). CA measures athlete's self-perception of pain, effort, fear, tiredness, injury, readiness for competition and training, ability to take a risk in competitive situation in sport, and relying on habits in sports context. Result on CA can vary from zero to 100. Sample included 41 elite athlete, members of senior national shooting (N=24) and handball (N=17) team of Serbia. CA method was applied at major international competitions during 2016. or 2017. Descriptive statistics and ANOVA were conducted.
Results: There are significant differences between elite shooters and elite handball players on CA measures of pain ($F=4.514$; $p<0.04$), fear ($F=4.828$; $p<0.034$), training ($F=5.209$; $p<0.028$), competition ($F=3.937$; $p<0.05$) and habit relations ($F=3.935$; $p<0.05$). Shooters showed higher Mean value on CA measures of pain ($M=47.92$; $SD=17.42$), fear ($M=49.1$; $SD=17.74$), habit relations ($M=49.42$; $SD=17.74$) then handball players (pain: $M=36.96$; $SD=14.47$; fear: $M=37.73$; $SD=14.07$; habit relations: $M=39.16$; $SD=14.03$). Handball players showed significantly higher scores on CA measures of training ($M=67.06$; $SD=22.05$) and competition ($M=64.24$; $SD=20.50$) then shooters (training: $M=54.11$; $SD=14.32$; competition: $M=53.61$; $SD=13.85$).
Discussion: Studies usually show individual differences on personality trait-like features in favor of athletes in individual sports (Laborde et al, 2016). This study was investigating state-like features in competitive context and showed more psychological advantage in favor of athletes in team sport (positive readiness for competition and training), while athletes in individual sport showed more intrapersonal sensitivity for potential distractors in competitive situation (self-perception of fear and pain, relying on habits in sports context).
References: Laborde, S., Guillen, F. & Mosley, E. (2016). Positive personality-trait-like individual differences in athletes from individual- and team sports and in non-athletes. Psychology of Sport and Exercise 26, 9-13.
Lüscher, M. (1971). Color test. NY: Simon & Shuster.
Mladenovic, M. (2017). Goal orientation and mental resilience in elite sport. In: Gangyan, S., Cruz, J. and Jaenes, J.C. (Eds). Sport psychology: Linking theory to practice, Proceedings of the XIV ISSP World Congress of Sport Psychology, Seville, Spain. Pp.469.
Contact: marijana.mladenovic@gmail.com

PRACTICAL GUIDELINES TO QUANTIFY THE RISK OF NON-FUNCTIONAL OVERREACHING: EXPLORING PSYCHOLOGICAL QUESTIONNAIRES

DE RYCK, T.1, JANNES, C.2, VAN BRUAENE, N.1, MEEUSEN, R.3

ANACURA

INTRODUCTION: Athletes are all pushing their limits to increase their performance and to reach their personal goals in sport. Nevertheless, it is important to maintain the delicate balance between training and recovery to reduce the risk for non-functional overreaching

(NFO). But when is this balance perfect? For the best guidance of the athletes there is an important need for tools to quantify the risk of non-functional overreaching and to give correct guidelines to athletes.
METHODS: In our field study, 300 endurance athletes were observed during their training towards a sport event such as a marathon or an iron man. All athletes trained at least 4 times a week. To monitor the training load and mental status of the athletes, the SpartaNova monitoring tool was used (including training data, diary and the POMS questionnaire) together with the RESTQ-Sport questionnaire. Different scores were calculated from the questionnaires, all having a slightly other accent within the complex process of NFO. Spearman rank correlation coefficients were calculated to evaluate the correlations between the different scores obtained from the questionnaires.
RESULTS: The differences between the scores were evaluated. Significant correlations ($p<0.01$) were found between scores obtained from the POMS questionnaire and the RESTQ-Sport questionnaire. Nevertheless, some correlations, such as those between the fatigue-scores obtained from the different psychological questionnaires were low (correlation coefficient < 0.5), pointing to important differences between the questionnaires, such as the time period that is reflected when answering the questions. Practical guidelines to use and interpret the questionnaires both on individual as on group level were formulated based on the data obtained from the study. Furthermore the best scoring methods were put forward to interpret the questionnaires in the context of non-functional overreaching.
CONCLUSION: This is the first time that different psychological questionnaires were compared for their usefulness in detecting NFO in a large cohort. Both the advantages and disadvantages of the use of the questionnaires in a practical setting will be discussed. Further research is needed to confirm our results and guidelines in other sports and settings.

18:00 - 19:30

Oral presentations

OP-PM33 Hypoxia 1

EFFECTS OF NORMOBARIC HYPOXIA AND METABOREFLEX ACTIVATION ON HEART RATE VARIABILITY

MULLIRI, G., SAINAS, G., DONEDDU, A., PINNA, V., PALAZZOLO, G., CRISAFULLI, A.
UNIVERSITY OF CAGLIARI

INTRODUCTION: Exposition to hypoxic enviroments induces a series of acute and chronic adaptations in the human cardiovascular system, which are partly mediated by changes in autonomic nervous system. In previous studies, it has been observed an increase in sympathetic nervous system (SNS) and a decrease in parasympathetic nervous system (PNS) activity in response to hypoxia. The aim of our study was to measure changes in PNS by means of heart rate variability (HRV) after exposure to a normobaric hypoxic gas mixture and during metaboreflex activation by using the Post Exercise Muscle Ischemia (PEMI) method.
METHODS: 8 subjects (6 men 2 women) underwent a rectangular 10 min leg-cycling exercise session at two different levels of normobaric hypoxia, level 0,5 (Fraction of Inspired Oxygen – FIO2- 0,21) and level 12 (FIO2 0,135), pedalling at 80% of their second ventilatory threshold previously determined by cardiopulmonary exercise test (CPET). After each session, the subjects performed a metaboreflex activation protocol at normoxic conditions, which consisted in 3 min of leg cycling at 30% of maximal load measured by CPET, followed by 3 min of PEMI induced through an inflatable cuff applied to one thigh. Results were compared to a Control Exercise Recovery (CER) protocol consisting in 3 min of leg cycling at the same load and 3 min of recovery.
Two HRV indices of PNS activity (RMSSD and LF-HF power) were measured analyzing the electrocardiogram recordings at rest and during CER and PEMI. Students T test was performed to verify significant differences between HRV parameters at rest (lvV 0,5 vs lv12) and during metaboreflex activation (CER vs PEMI at lv 0,5, CER vs PEMI at lv 12, Δ of CER-PEMI at lv 0,5 vs Δ of CER-PEMI at lv12) with a P value set at <0,05.
RESULTS: No significant differences were observed on both RMSSD (p=0,35) and LF-HF power (p=0,46) at rest (lv 0,5 vs lv12). RMSSD showed a statistical significant reduction during PEMI at lv 0,5 (p=0,039) and near-significant at lv 12 (p=0,06), while LF-HF power showed a near-significant reduction at lv 12 (p=0,057) but not at lv 0,5 (p=0,30).
Δ of CER-PEMI at lv 0,5 vs Δ of CER-PEMI at lv 12 did not showed any difference in both parameters (RMSSD p=0,15, LF-HF Power p=0,41).
CONCLUSION: Our results showed a decrease in HRV measures during PEMI in both normoxic and hypoxic conditions which is in line with previous studies on metaboreflex activation and PNS activity. However, hypoxia alone did not induce changes in HRV either at rest or combined with metaboreflex activation, a result in contrast with the current literature in this field.
One possibile explanation could be the delay in hypoxia exposure and HRV measurement, indicating that a brief exposure to hypoxia induces acute PNS responses that rapidly fade.

HYPOXIC VENTILATORY RESPONSES IN PREMATURELY AND FULL-TERM BORN ADULTS

DEBEVEC, T., MRAMOR, M., MILLET, G.P., PIALOUX, V., OSREDKAR, D.
JOZEF STEFAN INSTITUTE

INTRODUCTION: Pre-term birth hinders lung development and can result in life-long anatomical and functional sequelae (Duke et al., 2014). Perinatal hyperoxia, often associated with treatment of premature newborns, induces significant alterations in cardiorespiratory control which can affect ventilatory responses. Hyperoxia-related carotid chemoreceptor dysfunction seems to be among the key factors underlying the abnormal ventilatory responses of prematurely born individuals (Bates et al., 2014). While blunted hypoxic ventilatory response (HVR) is consistently reported in pre-term infants, recent evidence indicates that it can persist with ageing (Bates et al., 2014).
METHODS: Twenty-one prematurely born adult males (gestational age=29±4 weeks (mean±SD)), and 14 age and aerobic capacity matched controls born at full term (gestational age=39±2 weeks) underwent the following three tests: 1) the Richalet hypoxia sensitivity test (Richalet et al., 2012) to determine the resting and exercise HVR responses and a graded exercise test to volitional exhaustion in 2) normoxia (FiO2=0.21) and 3) normobaric hypoxia (FiO2=0.13) to compare hypoxia-related effects on maximal aerobic power (MAP).
RESULTS: The resting HVR was lower in the pre-term (0.21±0.21 L·min-1·kg-1) compared to full-term born individuals (0.47±0.23 L·min-1·kg-1; p 0.05). Surprisingly, no differences were noted in the exercise HVR (pre-term 0.62±0.23; full-term 0.70±0.20; p=0.29). While a lower absolute MAP during the graded test was observed in pre-term compared to full-term individuals in both, normoxia and hypoxia, hypoxia-induced reduction of MAP was comparable (pre-term −8.6±0.4%; full-term −8.5±0.5%; p=0.31).

CONCLUSION: These findings support earlier studies indicating that the blunted resting HVR observed in prematurely born infants persists into adulthood. However, we show, for the first time, that the reduced ventilatory response to hypoxia is attenuated during moderate intensity exercise and even more importantly, that hypoxia-induced reduction of MAP is comparable between healthy pre-term and full-term born adults. Our data therefore suggest that exercise in hypoxic conditions does not seem to pose an additional clinical risk for healthy and physically active prematurely born adults.
REFERENCES:
Bates ML, et al. (2014). N Engl J Med, 370(6), 584-585.
Duke JW, et al. (2014). J Appl Physiol, 117(5), 473-481.
Richalet JP, et al. (2012) Am J Respir Crit Care Med 185(2):192-8.
ACKNOWLEDGEMENTS:
This work was funded by Slovene Research Agency (Grant No. J3-7536) and Ljubljana University Medical Centre (Grant Nr-TP20140088).
CONTACT:
tadej.debevec@fsp.uni-lj.si

SALIVARY CORTISOL UPON AWAKENING CORRELATES WITH RISK OF ACUTE MOUNTAIN SICKNESS

ESTOPPEY, J.2, VUISTINER, P.3, LÉGER, B.3, SARTORI, C.4, KAYSER, B.1,3
1INSTITUTE OF SPORTS SCIENCES, UNIVERSITY OF LAUSANNE, 2UNIVERSITY OF LAUSANNE MEDICAL SCHOOL, 3CLINIQUE ROMANDE DE RÉADAPTATION, 4LAUSANNE UNIVERSITY HOSPITAL , SWITZERLAND.

INTRODUCTION: Non-acclimatized subjects ascending rapidly to high altitude (HA) may develop signs of acute mountain sickness (AMS), such as headache, nausea, fatigue, dizziness and insomnia. Underlying mechanisms of AMS are still unclear. Since corticosteroids are effective for prevention and treatment of AMS, we hypothesised that cortisol homeostasis may be altered in AMS-prone subjects.
METHODS: Upon arrival at the Capanna Regina Margherita (4554m; HA), 102 alpinists completed a questionnaire about personal information, health and medication, acclimatization, history of altitude illness and physical activity. The following morning they provided 3 saliva samples (S) upon awakening (S1: 0, S2: 30, S3: 45 min). AMS was scored with the Lake Louise Score (LLS-5; cut-off≥5) and LLS without the sleep item (LLS-3-NS; cut-off≥3). >4 weeks after descent saliva was recollected at the same wake-up time at home (382±309m (mean±SD); low altitude (LA), N=59). Saliva cortisol was quantified by immunoassay (Salimetrics). Three cortisol indexes were calculated: first sample on awakening (S1), cortisol awakening response (area under curve with respect to S1, CAR) and total post awakening cortisol (area with respect to ground, AUC-G).
RESULTS: AMS prevalence was 31% with LLS-5 and 34% with LLS-3-NS.
S1 (450±190 vs 288±159µg/dl, p<0.0001) and AUC-G (387±137 vs 276±114µg/dl*min, p<0.0001) but not CAR (50±100 vs 60±81µg/dl*min, p=0.5498) were significantly higher at HA compared to LA.
S1 was higher both at HA (495±209 vs 384±176µg/dl, p=0.0156) and LA (354±160 vs 253±142µg/dl, p=0.0154) in LLS-5 AMS+ compared to AMS- participants. AMS+ participants had also lower CAR at LA (24±87 vs 79±72µg/dl*min, p=0.0128) but similar CAR at HA. AUC-G was similar in both groups at HA and LA.
Noteworthy, when AMS was scored with the LLS-3-NS, no differences in cortisol responses were found between AMS+ and AMS- participants both at HA and LA.
CONCLUSION: Salivary cortisol response upon awakening is altered in AMS+ versus AMS- subjects both at HA and LA. S1 was surprisingly higher in AMS+ vs AMS- subjects already at low altitude. This difference was associated with flattened cortisol awakening curves and appears to be related, at least in part, to sleep disturbance. Salivary cortisol assessment at LA may thus contribute to screen individuals at risk for AMS.

EFFECTS OF HYPOXIA ON SKELETAL MUSCLE MOLECULAR ADAPTATIONS TO HEAVY RESISTANCE TRAINING

FYFE, J., INNESS, M., PARKER, L., BILLAUT, F., AUGHEY, R., PETERSEN, A.
INSTITUTE OF HEALTH AND SPORT, VICTORIA UNIVERSITY

INTRODUCTION: We have previously shown that heavy resistance training in hypoxia (IHRT) results in greater strength improvements compared to the same training in normoxia (Inness et al., Front Physiol 2016). However, the mechanisms responsible for enhanced strength gains with IHRT have not been investigated. We therefore determined the effects of IHRT on skeletal muscle molecular adaptations that contribute to muscle strength.
METHODS: A pair-matched, placebo-controlled, single-blind study included 18 resistance-trained participants assigned to either IHRT or placebo (PLA) (n = 9 per group). Both groups performed 20 sessions over 7 weeks with either IHRT (FiO2 0.143) or PLA (FiO2 0.20). Groups were matched for body mass (mean ± S.D.; 83.1 ± 7.5, 80.2 ± 12.0 kg), height (1.83 ± 0.05, 1.81 ± 0.06 m), one-repetition maximum (1-RM) squat (121.4 ± 22.1, 125.5 ± 30.7 kg) and training history. Resting vastus lateralis muscle biopsies were taken following an overnight fast before and after the training programme. Biopsies were analysed for muscle fibre cross-sectional area (CSA), mTOR signalling, proteins involved in sarcoplasmic reticulum (SR) calcium uptake and release, and proteins involved in force transfer between the sarcomeres and extracellular matrix.
RESULTS: Training increased Type II fibre CSA in both groups (mean ± 90% confidence limits (CL), effect size (ES); IHRT: 16.0 ± 25.2%, ES 0.50; PLA: 22.0 ± 31.8%, ES 0.42). Type I CSA only increased in PLA (16.1 ± 23.3%, ES 0.48); however, the changes in Type I or II fibre CSA were not different between groups. Training caused no substantial change in total p70S6K in either group. Training caused a possibly trivial decrease in total mTOR in PLA, and a possibly small increase in IHRT, resulting in a greater increase in mTOR for IHRT compared to PLA (18.9 ± 27.3%, ES 0.65). The content of SR-associated proteins dihydropyridine receptor, SERCA1, and calsequestrin did not change in either group. In contrast, SERCA2 increased in IHRT only (23.5 ± 18.7%, ES 0.33), and this increase was greater compared to PLA (42.6 ± 52.2%, ES 0.63). The content of force transfer protein dystrophin did not change in either group; however, alpha-actinin increased only in IHRT (47.8 ± 67.5%, ES 0.67), and this was greater compared to PLA (63.1 ± 79.5%, ES 1.10).
CONCLUSION: The greater strength increases following heavy resistance training in hypoxia compared to normoxia are possibly due to enhanced SR calcium regulation and force transfer between sarcomeres and the extracellular matrix.

SUBSTRATE UTILISATION IS ALTERED IN NORMOBARIC HYPOXIA, COMPARED WITH NORMOXIA WHEN IN THE FASTED, BUT NOT FED STATE

GRIFFITHS, A., DEIGHTON, K., KING, R., MATU, J., SHANNON, O., OHARA, J.

LEEDS BECKETT UNIVERSITY

INTRODUCTION: The hypoxic exposure experienced at altitude is known to impair endurance performance, which may in part be related to changes in substrate utilisation. However, equivocal findings have been reported regarding the contribution of carbohydrate and fat to the total energy yield in hypoxia. These divergent findings may be due to differences in methodological design, such as the nutritional status of participants prior to exercise. As such, this study was the first to investigate the effect of the fasted and fed state on substrate utilisation during exercise in normoxia and normobaric hypoxia (NH).
METHODS: Twelve men rested and performed exercise twice in sea level (SL) conditions (~20.93% O2) and twice at NH equivalent to 4300m (Fi02~11.7%) in a randomised, crossover design. Participants entered the chamber after an overnight fast. After 1 hour, one trial within each experimental condition remained fasted, while the other included consumption of a high carbohydrate breakfast (567 kcal, 68% carbohydrate, 12% fat, 20% protein). One hour after consumption of breakfast (fed trials) or no breakfast (fasted trials), participants walked for one hour at intensities of 40%, 50% and 60% of altitude specific VO2max. Walking was performed on a treadmill at 10-15% gradient whilst carrying a 10kg backpack to simulate altitude trekking. Expired gas was measured throughout, using online gas analysis for the quantification of carbohydrate and fat oxidation.
RESULTS: Relative carbohydrate oxidation was significantly reduced in NH fasted conditions compared with SL fasted conditions at 40% (SL fasted: 38.5±15.5%; NH fasted: 22.4±17.5%; p = 0.03) and 60% VO2max (SL fasted: 50.1±17.6%; NH fasted: 35.4±12.4%; p = 0.03), with a trend observed at 50% VO2max (SL fasted: 38.0±17.0%; NH fasted: 23.6±17.9%; p = 0.07). Relative fat oxidation in the fasted state was reciprocal to the fasted relative carbohydrate findings at all intensities. No significant differences in relative carbohydrate oxidation were observed in NH fed conditions compared with SL fed conditions at 40% (SL fed: 48.5±13.3%; NH fed: 44.1±20.6%; p = 1.00), 50% (SL fed: 47.1±14.0%; NH fed: 43.1±11.7%; p = 1.00) and 60% VO2max (SL fed: 55.1±15.0%; NH fed: 54.6±17.8%; p = 1.00). Relative fat oxidation in the fed state was reciprocal to the fed relative carbohydrate findings at all intensities.
CONCLUSION: This study is the first to establish that relative carbohydrate contributions to energy expenditure decrease, while relative fat contributions increase, during exercise matched for relative intensities in NH compared with SL when in the fasted, but not fed state. These findings suggest that the feeding state of participants may explain some of the divergence within the current literature regarding the effects of hypoxia on substrate utilisation. Further, these findings should be considered when prescribing nutritional support for mountaineers and military personnel trekking at high altitude.

URINARY ALPHA-1-ACID GLYCOPROTEIN IS A SENSITIVE MARKER OF GLOMERULAR PROTEIN LEAKAGE AT ALTITUDE

TALKS, B., BRADWELL, S., DELAMERE, J., RAYNER, W., CLARKE, A., LEWIS, C., THOMAS, O., BRADWELL, A.

UNIVERSITY OF BIRMINGHAM

INTRODUCTION: Proteinuria is an established feature of ascent to high altitude and may be caused by a loss of charge on the glomerular capillary wall. To test this theory, we measured two similar size but oppositely charged proteins in urine: negatively charged alpha-1-acid glycoprotein and positively charged dimeric lambda free light chains, size 41-43 kDa and 50 kDa respectively. 24-hour urinary leakage was compared with albumin, a 66 kDa negatively charged protein. We hypothesised that urinary leakage of alpha-1-acid glycoprotein may better reflect changes in glomerular capillary wall charge and provide a more sensitive marker of glomerular protein leakage at altitude than albumin, and second that increases in excretion ratio of alpha-1-acid glycoprotein to lambda free light chains would support a reduction in glomerular capillary wall negative charge.
METHODS: 23 individuals were studied before and during an altitude research expedition to 5035 m on Chimborazo in Ecuador. Participants (age 23-78 years, male = 17) were members of the Birmingham Medical Research Expeditionary Society. In Birmingham (baseline at 140 m) and on each of the 10-day ascent, 24-hour urines and venous blood samples were collected and aliquots stored frozen until analysis in the UK. Alpha-1-acid glycoprotein, lambda free light chains, and albumin concentrations were measured in serum and urine samples using immunoturbidimetry and radial immunodiffusion (Binding Site Ltd).
RESULTS: There was a significant increase in median urinary leakage of alpha-1-acid glycoprotein ($p < 0.0001$; 6.85-fold) and albumin ($p = 0.0006$; 1.65-fold) with ascent to altitude, but no significant increase in leakage of lambda free light chains ($p = 0.39$; 1.14-fold). Urinary excretion of alpha-1-acid glycoprotein ($p = 0.0026$), but not albumin ($p = 0.19$) correlated with the daily ascent profile.
CONCLUSION: Urinary leakage of alpha-1-acid glycoprotein was a more sensitive marker of altitude proteinuria than urinary albumin and lambda free light chains. The differential urinary excretion of positively and negatively charged proteins supported the possibility of loss of glomerular capillary wall negative charges at altitude. Exercise proteinuria may also be attributable to the same loss of glomerular capillary wall negative charges.

Oral presentations

OP-PM34 Molecular response/signaling

AUTOPHAGY RESPONSE FOLLOWING A HIGH-INTENSITY INTERVAL TRAINING SESSION, BEFORE AND AFTER 3 WEEKS OF TRAINING, IN HUMANS.

BOTELLA, J., PERRI, E., GRANATA, C., BISHOP, D.J.

VICTORIA UNIVERSITY

INTRODUCTION: Mitochondrial health is critical for skeletal muscle function, and it is improved by both mitochondrial biogenesis and the removal of dysfunctional mitochondria (via autophagy). Although it is well known that exercise training increases mitochondrial biogenesis, little is known about the effects of exercise on markers of autophagy in human skeletal muscle. The purpose of this study was to explore the effects of a high volume of exercise training, which we have previously reported to increase both mitochondrial content and function, on basal markers of autophagy. We also investigated the effects of a single exercise session, before and after training, on markers of autophagy.

METHODS: Ten healthy participants (VO2max; 46.7 ± 8.2 mL/kg/min) performed a high-intensity interval training session (HIIT; 5x4-min at ~90% WPeak) twice-a-day, 7 days per week, for 3 weeks (high volume training; HVT). Muscle biopsies were taken from the vastus lateralis muscle before, immediately post, and 3 hours post a HIIT session performed before and after the training period. Initiation of autophagy was assessed by changes in Unc-51 like kinase-1 phosphorylation at serine 555 (ULK1 s555). Autophagy flux was assessed by changes in the protein content of microtubule-associated protein 1A/1B-light chain 3 (LC3), and sequestesome 1 (p62/SQSTM1) was used as a marker of lysosomal degradation.
RESULTS: LC3II content and the LC3-II/I ratio were reduced immediately following HIIT ($p<0.05$) and remained statistically reduced 3 hours after exercise after the HVT period. p62 content tended to decrease following exercise, both before and after the HVT, but was only significant 3 h post-exercise before the HVT period. No changes in ULK1 s555 were found following exercise. Basal p62 and LC3II content, and the LC3-II/I ratio, did not change from before to after the training period despite a 5-fold increase in training volume.
CONCLUSION: The present study shows that LC3-II/I is decreased following exercise in humans, and that autophagic flux was not increased following a period of HVT. This is in line with previous research showing a decrease in LC3-II/I and LC3-II, while no change in p62 protein content between 0 and 120 min after exercise. The decrease in p62 found in this study at 3 h post-exercise may indicate that lysosomal degradation may occur later in the recovery than previously thought in humans. Contrary to recent rodent studies, ULK1 was not phosphorylated at s555 between 0 and 3 h following exercise. It can be concluded that autophagic flux seems to be blunted acutely following exercise, and that it is not upregulated following a high volume of high-intensity training.

CHANGES IN MUSCLE FASCICLE LENGTH AND ORIENTATION FOLLOWING CONCENTRIC AND ECCENTRIC TRAINING ARE GRADED TO REGION-SPECIFIC MECHANOSENSITIVE RESPONSES OF COSTAMERIC PROTEINS

FRANCHI, M.V., RUOSS, S., VALDIVIESO, P., SMITH, K., ATHERTON, P.J., NARICI, M.V., FLÜCK, M.

UNIKLINIK BALGRIST

INTRODUCTION: Concentric (CON) vs. eccentric (ECC) resistance training (RT) can lead to similar changes in muscle size (1) and similar cumulative muscle protein synthesis (MPS) responses (2) but through distinct changes in muscle architecture (1, 2, 3). To gain insights into the molecular mechanisms underlying these remodelling patterns, we specifically targeted focal adhesion kinase (FAK) and Vinculin isoforms (gamma- and meta-), mechanosensitive costameric proteins, involved in the modulation of muscle remodelling and protein synthesis (4, 5, 6). Furthermore, we assessed the relationships between FAK, MPS, and muscle structural adaptations.
METHODS: Six young males trained both legs unilaterally 3 times/week for 8 weeks; one leg performed CON RT, the contralateral performed ECC RT. Muscle biopsies were collected after training from vastus lateralis midbelly (MID) and distal (Distal, i.e., 4 cm above distal myotendinous junction) sites at 0, 4, 8 weeks. Total FAK content and y397FAK activation were evaluated by immunoblotting. MPS was assessed by deuterium-oxide tracer technique and muscle morphological/architectural adaptations were evaluated by ultrasound and DXA.
RESULTS: The levels of pY397-FAK at the 8 weeks time point were ~4-fold greater after ECC RT at the Distal site compared to CON RT ($p<0.05$). When looking at ratio between pY397FAK and total FAK content (i.e., specific phosphorylation), ECC RT presented a significantly greater ratio at the Distal site at 4 (~2.2fold, $p<0.05$) and 8 weeks (~9fold, $p<0.001$) compared to CON RT. Meta-vinculin was found transiently increased at 4 weeks at the Distal site only after ECC RT. After 8 weeks, ECC RT presented greater fascicle length (Lf) increases (10.5% vs. 4%), whereas CON RT showed greater changes in pennation angle (PA) (12.3% vs. 2.1%). However, MPS did not differ between exercise types or muscle sites at all time points. The values of pY397-FAK and pY397-FAK/FAK at the Distal muscle site positively correlated to changes in Lf at 8weeks ($r=0.76$, $p<0.01$ and $r=0.66$, $p<0.05$, respectively) whereas pY397-FAK/FAK values negatively correlated to the changes in PA at 8Weeks ($r= -0.65$, $p<0.05$). In addition, Positive linear relationships between meta-vinculin and pY397-FAK, and between meta-vinculin and fast myosin levels were found at all time points.
CONCLUSION: The present data highlight that the specific Y397 phosphorylation of FAK in vastus lateralis muscle is modified by training in proportion to the impacting force and in the region, which subjected to the highest degree of loading. Y397FAK activity correlated to contraction-dependent architectural remodeling. Site-specific changes in pY397FAK, and meta-vinculin may play an important role in architectural adjustments of skeletal muscle to distinct mechanical stimuli.
References: 1) Franchi et al. Acta Physiol 2014
2) Franchi et al. Phys Reports 2015
3) Reeves et al. Exp Physiol 2009
4) Franchi et al. Acta Physiol 2018
5) Klossner et al. EJAP 2009
6) Li et al. J Anat 2013

COMPARING THE EPIGENETIC LANDSCAPE OF TWO PHENOTYPIC EXTREME SKELETAL MUSCLES - SOLEUS AND EDL

BENGTSEN, M.1, WINJE, I.M.,1, LANDSKRON, J.2, MEZA-ZEPEDA, L.A.3, GUNDERSEN, K.1

UNIVERSITY OF OSLO, NORWAY

INTRODUCTION: By varying the relative composition of different fiber-types within a muscle, an organism has the ability to fine-tune muscle function according to physiological demands.
The muscle myofibers are in a post-mitotic state hence phenotypical remodelling of adult tissue is achieved by regulating the expression of the genome in order to respond to changes in the environment. This requires alterations of the epigenetic landscape through different processes such as methylation and acetylation of histones.
Skeletal muscle tissue is composed of approximately 40 - 60 % myonuclei, while the remaining are non-muscle cells with a different origin such as stromal and hematopoietic. Therefore, it is important to isolate the subpopulation of interest from the whole tissue, as a mixed-cell population are prone to increase the number of false-positive results.
In this study, we present a novel method for isolating myonuclei from whole native muscle.
The resulting pure myonuclear fraction allowed us to explore the epigenetic landscape for the two phenotypic extremes the oxidative Soleus and the glycolytic Extensor Digitorum Longus muscle (EDL).
METHODS: Biochemical isolation of the myonuclei population from mouse Soleus and EDL muscles, followed by Chromatin Immunoprecipitation coupled with next-generation sequencing (ChIP-Seq) and bioinformatic analyses.
RESULTS: Using our novel method, we show that that the myonuclei epigenetic environment is significantly different compared to the whole tissue. Global analysis of the epigenetic landscape in the Soleus and EDL muscles show that there are large dynamic differences between the two muscle types which correlate with the myo-specific transcriptome and the properties of the muscles.

CONCLUSION: We have developed a novel method to isolate the myo-specific nuclei from skeletal muscle. We use the method to generate a global map of the epigenetic landscape of the two extremes the oxidative Soleus and the glycolytic EDL muscles and find that their physiological different properties are reflected in their epigenome.
Contact information: mads.bengtsen@ibv.uio.no

TRANSCRIPTION MECHANISMS REGULATING THE INCREASE OF OXPHOS PROTEINS AND TRANSCRIPTION REGULATORS CONTENT IN THE HUMAN SKELETAL MUSCLE

BOKOV, R.O.1, POPOV, D.V.1,2, LYSENKO, E.A.1,2, KUROCHKINA, N.S.1, VINOGRADOVA, O.L.1,2

1: IBMP RAS (MOSCOW, RUSSIA), 2: LOMONOSOV MOSCOW STATE UNIVERSITY (MOSCOW, RUSSIA)

INTRODUCTION: When stress factors (physical exercises) are regularly applied to the muscle cell, the adaptive changes in the content of specific proteins occur. We assume that the mechanisms responsible for these changes may differ for proteins with various functions. The aim of our work is to study at the transcription level the mechanisms regulating the training-induced increase of mitochondrial enzymes and transcriptional regulators content in the human skeletal muscle.
METHODS: Multiple biopsy sampling from human skeletal muscles provides an unique opportunity to assess changes in proteins content and genes expression before and after regularly applied stress (exercise training), as well as after acute stress (single exercise). Ten young untrained males performed the one-legged moderate intensity knee-extension for 1 h. Biopsies from m. vastus lateralis were taken prior to, at 1 h, and 4 h after the exercise. This test was repeated after aerobic training on the cycling ergometer (5/week, 8 weeks). The changes in the content of transcriptional regulators and OXPHOS proteins after 8-wk training were evaluated by Western blot. To evaluate the changes in gene expression after training and after a single exercise qPCR was used.
RESULTS: After 8-wk training, the content of OXPHOS proteins at rest (NDUFB8, SDHB, UQCRC2, MT-CO1, ATP5A1) increased (by 35-162%, $p<0.05$). There were no changes in the expression of genes encoding these proteins at rest and after a single exercise (both before and after 8-wk training). An increase in the content of transcriptional regulators was found after 8-wk training for CRTC2 (60%, $p<0.05$), NR4A3 (100%, $p<0.05$) and TFAM (20%, $p<0,06$). At the same time, the expression of the NR4A3 and TFAM genes increased ($p<0.05$) after a single exercise, both before and after 8-wk training. An increase in the expression of genes in response to a single exercise was also observed for other transcriptional regulators (PGC-1α, ESRRG), but there were no increase in the content of their proteins after 8-wk training, which may be due to the high proteolysis rate.
CONCLUSION: In conclusion, 8-wk training-induced increase in the content of OXPHOS proteins is not associated with changes in their gene expression at rest and after a single exercise. On the contrary, the training-induced increase in the content of some transcriptional regulators is associated with the activation of their mRNA expression after a single exercise.
This work was supported by the Russian Science Foundation (grant no. 14-15-00768).
[bokov@mail.bio.msu.ru]

EFFECT OF AEROBIC TRAINING ON THE BASAL EXPRESSION OF SIGNALING AND MITOCHONDRIAL PROTEINS IN HUMAN SKELETAL MUSCLE

POPOV, D.V.1,2, LYSENKO, E.A.1,2, BOKOV, R.O.1, KUROCHKINA, N.S.1, VINOGRADOVA, O.L.1,2

1 INSTITUTE OF BIOMEDICAL PROBLEMS OF THE RAS, 2 M.V. LOMONOSOV MOSCOW STATE UNIVERSITY

INTRODUCTION: Most of the studies investigating the molecular mechanisms of adaptation of human skeletal muscles to aerobic exercise evaluate the response to a single aerobic exercise. Changes in the basal content of signaling proteins caused by aerobic training remain much less studied. The goal of our study was to investigate the effect of 8-wk aerobic training on the basal content of signaling proteins in human skeletal muscle, namely: 1) the phosphorylation of kinases: ACC1/2_Ser79/222 (a marker of AMPK activity), CaMKII_Thr286, p38_Thr180/Tyr182, and ERK1/2_Thr202/Tyr204, and transcriptional regulators CREB1_Ser133 and FOXO1_Ser256; 2) the content of regulatory proteins involved in mitochondrial biogenesis: NR4A3, CRTC2, ESRRG, PGC-1a, TFAM, and NCOR1 as well as 3) the content of mitochondrial proteins.
METHODS: Ten untrained young males participated in an 8-wk aerobic cycling training. The basal (at rest) content of proteins and expression of genes in vastus lateralis muscle were evaluated before and after 8-wk cycling aerobic training using Western blot and qPCR, respectively.
RESULTS: Training increased aerobic performance (anaerobic threshold), the ADP-stimulated mitochondrial respiration in permeabilized muscle fibers, and the content of mitochondrial proteins in complexes I-V, without changing the expression of myosin heavy chain isoforms. The training caused an increase in the basal content of transcriptional regulators: NR4A3 ($P<0.05$), CRTC2 ($P<0.05$), and TFAM ($P<0.06$), while the content of PGC-1a, ESRRG, and NCOR1 did not change. In addition, an increase in the basal phosphorylation of CaMKII_Thr286 ($P<0.01$), CREB1_Ser133 ($P<0.05$) and FOXO1_Ser256 ($P<0.05$) was found. The basal phosphorylation of ERK1/2_Thr202/Tyr204, ACC1/2_Ser79/222, and p38_Thr180/Tyr182 remained unchanged.
CONCLUSION: In conclusion, it has been shown that in the human skeletal muscle, aerobic training increased the basal content of the transcriptional regulators NR4A3, CRTC2, and TFAM; activated the calcium-dependent signaling at rest, and deactivate the proteolysis regulator FOXO1 and mRNA expression of FOXO1-dependent E3 ligases. Activation of regulatory proteins and expression of genes after a single exercise are transient. Therefore, small but constant training-induced increases in the basal content of regulatory proteins can play an important role in the adaptation of skeletal muscle to aerobic training.
This work was supported by the Russian Science Foundation (grant no. 14-15-00768).

LONG-TERM EFFECTS OF DIFFERENT EXERCISE PROTOCOLS ON ADIPOSE TISSUE THERMOGENESIS-RELATED GENE EXPRESSION MARKERS IN OBESE MICE

MILESKI, K.S.L.1,2, COELHO, M.S.3, OLIVEIRA, F.C.B.3, NEVES, F.A.R.3, PORTO, L.G.G., LOFRANO-PORTO, A.2,3

1: FEF-UNB, 2: PPGCS-UNB, 3:FARMOL-FS-UNB

INTRODUCTION: Physical exercise is known to acutely increase thermogenesis and energy expenditure. However, studies investigating molecular mechanisms underlying the therapeutic potential of long-term exercise in obesity prevention and control were not extensively studied. We evaluated the effects of high intensity interval training and moderate intensity continuous training on the expression of thermogenesis-related genes in white and brown adipose tissue of diet-induced obese mice.

METHODS: Adult male mice C57BL/6 were fed with high-fat diet (HFD) in two different exercise groups: High intensity interval training (HIIT; n=5) and Moderate intensity continuous training (MICT; n=5). Control groups were fed with HFD (HC, n=5) or control diet (CC, n=5). Using a mice treadmill (AVS®), a ramp test was used to determine the maximum cardiorespiratory fitness (CRF) before exercise protocols. HIIT sessions consisted of 4-min high-intensity bouts at 90% followed by 3-min moderate-intensity bouts at 70%. MICT consisted in a single bout at 70%. Exercise training were performed 45-54 min/day, 5 days/week, for 8 weeks. Interscapular brown (BAT) and inguinal white adipose tissues (iWAT) were collected 72h after the last exercise session and weighted. Gene expression of thermogenic markers was analyzed by RT-qPCR. Kruskal Wallis with Dunn's post-hoc was used for comparison between groups (Mean and SE), considering p≤0.05.
RESULTS: In BAT, HIIT and MICT reduced the expression of the Ucp1: HIIT:0.80 ± 0.09 and MICT: 0.82 ± 0.09, versus HC: 2.24 ± 0.28 (p≤0.05). However, none of the exercise modified Ucp1 expression in iWAT- HIIT: 0.37 ± 0.23; MICT: 0.35 ± 0.25; CH: 0.15 ± 0.05 and CC: 1.04 ± 0.01, p>0.05). Unexpectedly, HIIT and MICT did not change thermogenesis-related genes expression in iWAT - Cidea (HIIT: 0.51 ± 0.10, MICT: 0.68 ± 0.22, HC: 0.59 ± 0.18, CC: 1.03 ± 0.01), Prdm16 (HIIT: 2.28 ± 0.40, MICT: 2.27 ± 0.12, HC: 3.02 ± 1.01, CC: 1.14 ± 0.05 and Pgc1a (HIIT 1.39 ± 0.24, MICT 1.83 ± 0.46, HC 1.96 ± 0.56, CC 1.03 ± 0.01, p>0.05).
CONCLUSION: Increased whole-body thermogenesis is one mechanism contributing to increased energy expenditure and weight loss. Ucp1 is the main thermogenic marker of adipose tissue, associated with a browning phenotype in adipocytes, increased mitochondrial biogenesis and oxygen consumption rate. The reduced Ucp1 expression in BAT of obese mice submitted to both exercise intensities may be related, specifically, to a long-term adaptive response to exercise or to an increased rate of Ucp1 protein synthesis and action. Our results are limited to the transcriptional level and may not reproduce direct thermogenic activation in the adipose tissue deposits in vivo.

Oral presentations

OP-PM35 Interval training 1

EFFECTIVENESS OF REPEATED-SPRINT TRAINING IN HYPOXIA INDUCED BY VOLUNTARY HYPOVENTILATION IN RUGBY PLAYERS

FORNASIER-SANTOS, C.1, STRIDGEON, P.2, NOTTIN, S.1, MILLET, G.P.3, WOORONS, X.4

UNIVERSITY OF AVIGNON

INTRODUCTION: Repeated-sprint ability (RSA) is an important fitness requirement in team sports. It has been shown that RSA is significantly improved after 6-8 sessions of repeated-sprint training in hypoxia (RSH) (Millet et al., 2017). In addition, voluntary hypoventilation at low lung volume (VHL) can induce levels of desaturation and muscle deoxygenation similar to those observed at moderate altitude (Woorons et al., 2010). The aim of the present study was therefore to determine the effects of RSH induced by VHL (RSH-VHL) on running repeated-sprint ability in rugby players.
METHODS: Twenty-one highly trained rugby players performed, over a 4-week period, 7 sessions of repeated 40-m sprints (outdoors on a rugby field) either with VHL (RSH-VHL, n = 11) or with normal breathing (RSN, n = 10). Before (Pre-) and after (Post-) the training period, an RSA test was implemented and consisted of repeating 40-m all-out sprints (starting every 30 s) until task failure (85% of the reference velocity assessed in an isolated sprint). Max velocity (Vmax), mean velocity (Vmean) from all the 40-m sprints were recorded and heart rate (HR) was continuously measured. Rating of perceived exertion (RPE) was assessed just after the completion of the last sprint and two blood samples were collected at the 3rd and 4th minute after the end of the test to obtain maximal lactate concentration ([La]max).
RESULTS: The number of sprints completed during the RSA test was significantly increased after the training period in RSH-VHL (9.1 ± 2.8 vs. 14.9 ± 5.3; + 64%; p < 0.01) but not in RSN (9.8 ± 2.8 vs. 10.4 ± 4.7; + 6%; p = 0.74). Vmax was not different between Pre- and Post- in both groups whereas Vmean decreased in RSN and remained unchanged in RSH-VHL. While [La]max was not significantly different between groups both in Pre- and Post, it was lower in Post- compared to Pre- in RSN (p=0.01) and unchanged in RSH-VHL (p=0.23). The mean SpO2 recorded over an entire training session was lower in RSH-VHL than in RSN (90.1 ± 1.4 vs. 95.5 ± 0.5%, p<0.01). In RSH-VHL, 35.5% of the total training session time was spent with SpO2 below 88%.
CONCLUSION: RSH-VHL could represent an effective "on-field outdoor" hypoxic training strategy for improving running RSA in team sport players. RSA enhancement can be obtained in specific conditions and can therefore be easily integrated in a conditioning program.
References:
Millet, G. P., Chapman, R. F., Girard, O., & Brocherie, F. (2017). Br J Sports Med, bjsports-2017-098083.
Woorons, X., Bourdillon, N., Vandewalle, H., Lamberto, C., Mollard, P., Richalet, J.-P., & Pichon, A. (2010). European Journal of Applied Physiology, 110(2), 367–377.
Contact: [charly.fornasier-santos@hotmail.fr]

THE EFFECTS OF RECOVERY DURATION ON PHYSIOLOGICAL AND PERCEPTUAL RESPONSES OF TRAINED RUNNERS DURING FOUR SELF-PACED HIIT SESSIONS

SCHOENMAKERS, P.P.J.M., REED, K.E.

UNIVERSITY OF ESSEX

INTRODUCTION: PPJM Schoenmakers1, KE Reed1,
1School of Sport, Rehabilitation, and Exercise Sciences
University of Essex, Colchester, United Kingdom
The development of non-motorized treadmills allow scientists to study self-paced high intensity interval training sessions (HIIT) in a more ecologically valid manner than was possible with externally controlled motorized treadmills. This study aimed to examine the effects of different recovery durations on self-selected running velocities, physiological responses (time spend ≥ 80, 90 and 95% VO2max and HRmax), and ratings of perceived exertion (RPE) in a commonly used HIIT protocol.
METHODS: Twelve male runners (age: 34±11 years; VO2max: 54.0±8 mL·kg−1·min−1) performed four simulated HIIT sessions on a non-motorized curved treadmill (Woodway Curve XL). Each session comprised six 4-min work intervals, separated by five recovery periods of either 1, 2, 3-min or a self-selected recovery duration (1MIN, 2MIN, 3MIN, ssMIN). In ssMIN, subsequent work intervals started when participants indicated an 'adequate recovery' (Edwards et al., 2011). Oxygen uptake and heart rate were measured continuously during all sessions. Participants were instructed to maintain the highest running velocity they could across the work intervals of each session,

and to finish the HIIT session with a RPE ≥ 17. Differences between protocols in physiological responses, perceptual parameters and running velocity were compared using repeated measures ANOVAs.
RESULTS: Mean running velocity (km·h-1) was significantly higher in 3MIN (12.0±1.0) compared to 1MIN (11.6±1.1), 2MIN (11.5±1.0) and ssMIN (11.7±1.0, P<0.01 for all). Further, the mean running velocity in ssMIN was higher than 2MIN (P=0.001). The self-selected recovery duration in ssMIN averaged 100±34 sec. Time spend ≥ 80% HRmax was significantly higher in 1MIN and 2MIN compared to both 3MIN and ssMIN (1340±72 and 1335±67 sec vs 1305±67 sec and 1303±72 sec respectively, P<0.05), but did not differ in the higher intensity zones (≥ 90 and 95% HRmax) between protocols. No significant differences in time spend ≥ 80, 90, or 95% VO2max were evident between the four protocols. RPE responses were similar across and within the protocols.
CONCLUSION: In a self-paced HIIT session of six 4-min work intervals, the length of recovery durations had a limited effect on the total physiological strain endured in the training. However, running performance was fastest when participants received the longest recovery period (3MIN) between subsequent work intervals. Longer recovery durations may facilitate a higher external training load (higher running intensity), whilst maintaining a similar internal load (physiological stimulus) and may, therefore, allow for greater training adaptations.
References: Edwards et al., (2011) Psychophysiology 48(1):136-41
Contact: ppscho@essex.ac.uk

RATING OF PERCEIVED EXERTION AND ASSOCIATED FACTORS IN OLDER INDIVIDUALS PERFORMING HIGH-INTENSITY INTERVAL TRAINING: A COMPARISON STUDY.

JABBOUR, G.
QATAR UNIVERSITY

INTRODUCTION: Today, there are a number of potential indicators used in order to increase our understanding of the exercise load and its effect on the individual. The rating of perceived exertion is one of the most popular tool that provide an comprehension on physiological stress during exercise as well as retrospectively information regarding perceived effort during exercise . While much is known about RPE responses and related factors in children and adults, little is known about the perceptual responses to exercise in an older population even more the factors associated with this indicator. Therefore, this study evaluates the Ratings of Perceived-Exertion during a graded cycling test and the effects of 6 weeks of high-intensity interval training on RPE and associated factors in young and older groups.
METHODS: Seventeen healthy young adults with average age of 26.2<2.4> year, and thirteen healthy older adults with average age of 54.5<2.3> year completed a 6-week HIIT intervention on an electromagnetically braked cycle ergometer. RPE were computed across stages corresponding to ventilator thresholds 1 and 2 of graded cycling test and 10 minutes following the end of graded cycling test.
RESULTS: Before training, RPE values were significantly higher in older group at stages corresponding to VT1 [8.9 <0.3>] and to VT2 [9.9 <0.3>] of graded cycling test . At VT2, the RPE index was significantly associated to systolic blood pressure and to oxygen consumption . At 10 min post-training, no significant difference was obtained between groups. After 6 weeks, the RPE decreased significantly compared to baseline for both groups at VT1, VT2 and 10 min following the graded cycling test
and were similar across groups. For both groups the multiple linear regression analysis demonstrated the decreases in oxygen consumption and in SBP correlated significantly to RPE decreases over 6 weeks at VT1 , VT2 and at 10 min following graded cycling test .
CONCLUSION: At moderate-intensity corresponding to 55% of maximal heart rate, older individuals do not appropriately estimate exercise intensity using RPE. However, high intensity interval training improved RPE index among older and adult individuals. These improvements were positively correlated with the declines in the VO2 and SBD values.
Reference: Halson SL. Monitoring Training Load to Understand Fatigue in Athletes. Sports Med. 2014; 44: 139–147. doi: 10.1007/s40279-014-0253-z.

THE EFFECT OF TWO DIFFERENT INTERVAL-TRAINING OROGRAMS ON PHYSIOLOGICAL AND PERFORMANCE INDICES

MECKEL, Y., SINDIANI, M., SEGEV, D., ELIAKIM, A.
THE ACADEMIC COLLEGE AT WINGATE

INTRODUCTION: The different training variables in an interval training session are usually constant throughout a single session (Weston et al., 2014; Milanović et al., 2015). Nevertheless, coaches sometimes deviate from this norm, creating incremental protocols where interval's distances are decreased or increased in a single session (Meckel et al., 2011). The aim of the present study was to compare the effect of an increasing-distance interval-training program and a decreasing-distance interval-training program, matched for total distance, on aerobic and anaerobic physiological indices.
METHODS: Forty physical education students were randomly assigned to either the increasing- or decreasing-distance interval-training group (ITG and DTG), and completed two similar relevant sets of tests before and after six weeks of training. One training program consisted of increasing-distance interval training (100-200-300-400-500m) and the other decreasing-distance interval training (500-400-300-200-100m).
RESULTS: While both training programs led to a significant improvement in VO2 max, the improvement in the DTG was significantly greater than in the ITG (14.5 ± 3.6 vs. 7.8 ± 3.2 %). While both training programs led to a significant improvement in all anaerobic indices, the improvements in peak power (15.7 ± 7.8 vs. 8.9 ± 4.7), mean power (10.6 ± 5.4 vs. 6.8 ± 4.4), and fatigue index (18.2 ± 10.9 vs. 7.0 ± 14.2) were significantly greater in the DTG compared to the ITG.
CONCLUSION: The finding indicate that beyond the significant positive effects of both training programs on aerobic and anaerobic fitness, the DTG showed significant superiority over the ITG in improving aerobic and anaerobic performance capabilities. Coaches and athletes should therefore be aware that, in spite of identical total work, an interval-training program might induce different physiological impacts if the order of intervals is not identical.

VIRTUAL-REALITY EXERGAMING CAN INCREASE ENJOYMENT AND PERFORMANCE DURING HIGH-INTENSITY INTERVAL TRAINING

FARROW, M.1,3, LUTTEROTH, C.2,3, ROUSE, P.1, BILZON, J.L.J.1,3
UNIVERSITY OF BATH

INTRODUCTION: High-intensity interval training (HIIT) has the potential to improve human cardiometabolic health, however concerns remain over real-world long-term adherence and compliance (Biddle & Batterham, 2015). Exergaming can increase enjoyment (a key

predictor of exercise adherence) and performance of cycling (Glen et al., 2017; Lewis et al., 2016). The objectives of this study were to determine if: i) virtual-reality (VR)-HIIT (track) can elicit higher levels of enjoyment and performance compared to a standard HIIT (blank) and; ii) performance during VR-HIIT can be increased by having participants race against their own performance (ghost) or by surreptitiously increasing resistance (hard).
METHODS: Sixteen participants (eight males, eight females, maximal aerobic capacity: 41.2 ± 10.8 ml/kg/min) completed four VR-HIIT conditions in a partially-randomised cross-over study; 1a) blank, 1b) track, 2a) ghost, and 2b) hard. VR-HIIT sessions consisted of eight 60 s high-intensity intervals interspersed by 60 s recovery intervals, at a resistance equivalent to 70% (77% for hard) and 12.5% maximum power output, respectively, at a self-selected cadence. Enjoyment was assessed using the Intrinsic Motivation Inventory (Ryan, 1982) immediately post-exercise. Paired t-tests were used (blank vs. track, track vs. ghost, ghost vs. hard) to assess differences between modes.
RESULTS: Enjoyment was higher in the track compared to the blank condition (4.7 ± 0.4 vs. 3.8 ± 0.7, P<0.01), with no other differences observed. Mean power output for each high-intensity interval was 9% higher during the hard compared to the ghost condition (199 ± 57 W vs. 181 ± 51 W, P<0.01) and 3% higher for the ghost compared to the track condition (176 ± 50 W) (P<0.01), with no differences between track and blank conditions.
CONCLUSION: VR-exergaming can increase the enjoyment of an acute bout of HIIT in recreationally active individuals and, given that enjoyment of exercise predicts adherence (Lewis et al., 2016), it may be effective for promoting adherence to HIIT in the general population. By helping individuals race against their previous performance and by surreptitiously increasing resistance, it is also possible to increase exercise intensity without compromising enjoyment. These may be effective techniques to maximise exercise stress and adaptation during a HIIT programme.
REFERENCES:
Biddle SJH, Batterham AM. (2015). Int J Behav Nutr Phys Act, 12(1), 1-8.
Glen K, Eston R, Loetscher T, Paritt G. (2017). PLOS One, 12(10), e0186526.
Lewis BA, Williams DM, Frayeh A, Marcus BH. (2016). Pyschol Health, 31(4), 456-469.
Ryan RM. (1982). J Pers Soc Pyschol, 43(3), 450-461.

Oral presentations

OP-PM16 MUSCLE INJURIES

ESR1 RS2234693 POLYMORPHISM AND SPORTS-RELATED MUSCLE INJURIES: A CASE-CONTROL ASSOCIATION AND PHYSIOLOGICALLY FUNCTIONAL STUDIES IN JAPANESE POPULATION

KUMAGAI, H., MIYAMOTO-MIKAMI, E., HIRATA, K., KIKUCHI, N., KAMIYA, N., HOSHIKAWA, S., ZEMPO, H., NAITO, H., MIYAMOTO, N., FUKU, N.

JUNTENDO UNIVERSITY

INTRODUCTION: The incidence of sports-related injuries is associated with athletic success and may result in termination of an athletes career in some situations. Muscle injury is the most common injury in sports that involve sprinting and jumping. Muscle stiffness is one of the risk factors for muscle injury and is lower in females than in males, which implies that sex differences-related genetic factors might influence muscle injury through muscle stiffness. However, whether such relationships exist is largely unknown. Thus, the aim of the present study was to investigate the associations of two genetic polymorphisms (rs2234693 and rs9340799) in the oestrogen receptor 1 gene (ESR1) with muscle injury and muscle stiffness.
METHODS: Study 1: The history of indirect muscle injuries were surveyed by questionnaire in 1,311 Japanese top-level athletes (men: n = 870, women: n = 441) and all muscle injuries were diagnosed by medical doctors (muscle injured group: n = 133, non-muscle injured group: n = 1,178).
Study 2: The stiffness of the biceps femoris, semitendinosus and semimembranosus were assessed by using ultrasound shear wave elastography in 261 physically active young Japanese adults (men: n = 152, women: n = 109). The stiffness of these three muscles was averaged to evaluate stiffness of the overall hamstring muscle. In both studies, the rs2234693 C/T and rs9340799 A/G polymorphisms in the ESR1 were analysed by using TaqMan SNP Genotyping Assay.
RESULTS: Study 1: The genotype frequencies of the ESR1 rs2234693 C/T polymorphism were significantly different between the injured and non-injured groups for the C-allele dominant (TT vs. TC+CC: odds ratio [OR] = 0.62, 95% confidence interval [CI] = 0.43-0.91) and an additive (TT > TC > CC: OR = 0.70, 95% CI = 0.53-0.92) genetic models.
Study 2: The stiffness of the hamstring muscle was lower in subjects with the TC+CC genotype than those with the TT genotype, and a significant linear trend was observed (r = −0.14, P = 0.029). In contrast, no association was found between ESR1 rs9340799 A/G and muscle injury or muscle stiffness.
CONCLUSION: Muscle stiffness is mainly influenced by collagenous connective tissue and oestrogen suppresses collagen synthesis. Aside from this, previous studies have suggested that the rs2234693 C/T polymorphism in the ESR1 alters its gene expression, and the muscle injury-protective C allele is associated with higher gene expression and increases oestrogen-induced actions. Thus, suppression of collagen synthesis by the action of oestrogen is the possible explanation of the relations between rs2234693 polymorphism in the ESR1 and muscle injury or muscle stiffness. In conclusion, we found that the ESR1 rs2234693 C allele carriers had a protective effect against muscle injury and lower muscle stiffness compared with the T allele carriers in Japanese populations. Our results suggest that the rs2234693 polymorphism in the ESR1 is associated with muscle injury due to muscle stiffness.
Contact: kumazin7@gmail.com

TRAINING LOAD PRIOR TO INJURY IN PROFESSIONAL RUGBY LEAGUE PLAYERS.

CUMMINS, C., KING, D., THORNTON, H., DELANEY, J., DUTHIE, G., WELCH, M., MURPHY, A.

UNIVERSITY OF NEW ENGLAND; UNIVERSITY OF NEW ENGLAND; LA TROBE UNIVERSITY; VICTORIA UNIVERSITY; AUSTRALIAN CATHOLIC UNIVERSITY; UNIVERSITY OF NEW ENGLAND; UNIVERSITY OF NEW ENGLAND

INTRODUCTION: Injury data analysis methods have focused predominately on univariate or simple multivariate correlations between training loads (TL) and injuries. These approaches result in limited insight into the overall effect of external TL variables and a lack of

reliable predictive power for injury risk. Conversely, machine learning (ML) algorithms are useful for modeling phenomena described by multidimensional data with complex (usually non-linear) relationships. The application of ML to predicting injury risk in high-performance sport is relatively limited to date. Consequently, this study examined the efficacy of applying ML to multidimensional TL in predicting injury risk in rugby league.
METHODS: All TL and injury incidence data (soft-tissue, non-contact) were collected from 46 professional rugby league players across a National Rugby League season. External-TLs were quantified utilising global positioning systems, including total daily distance (TD), daily high-speed distance (HSD) and daily acceleration/deceleration load (AccDec Load). Total, mean and standard deviation (SD) for moving windows of 7, 14, 21 and 28-days were calculated. To mitigate the skewed data (0.7% injuries), a generative data model was created to re-sample balanced, simulated, datasets that each contained 2000 non-injury and injury data-points respectively. Random forests were trained on the simulated data for 7, 14, 21 and 28-days and tested using the original 4,453 external-TL data-points. As these were not used to directly train the classifiers, they provide an out-of-sample test that is grounded in real-world data.
RESULTS: The 7-day window, only correctly predicted 68% of injuries (i.e. belonging to the injury class with a probability of > 50%), however the random forests trained using the 14, 21 and 28-day windows where able to correctly identify 91%, 94% and 92% of injury data-points respectively. All random forests correctly classified approximately 92% of non-injuries. Similar results were also observed when the classifiers were tested on out-of-sample simulated data. The sum of HSD, SD of TD and SD of AccDec Load are consistently highly ranked as important for prediction of injury within all windows.
CONCLUSION: The accuracy achieved (for 14-day or longer windows) indicates that the random forest ensemble classifier is capable of learning the complex underlying patterns required for successful prediction of injury in the following training session. The poor performance on the 7-day window is most likely due to a lack of data-points, providing the classifier with limited discriminative power. The higher importance of the SD of TD and sum of HSD for the prediction of injury is consistent with previous work in other sporting codes. It is important to note however, that the difference in the importance of the different variables is quite small, indicating that they all contribute significantly to the prediction of injury within the classifiers trained in this study.

APPLICATION OF A WHOLE EXOME SEQUENCING APPROACH TO UNRAVEL THE SUSCEPTIBILITY OF MUSCULOSKELETAL SOFT TISSUE INJURIES

SEPTEMBER, A.V., GIBBON, A., SAUNDERS, C.J., COLLINS, M., GAMIELDIEN, J.
THE UNIVERSITY OF CAPE TOWN AND THE UNIVERSITY OF THE WESTERN CAPE

INTRODUCTION: Musculoskeletal soft tissue injuries are complex phenotypes, with genetics as a proposed risk factor. Case-control association studies using the candidate gene approach have predominately been used to identify risk loci for these injuries. However, the ability to identify all risk conferring variants using this approach alone is unlikely. Therefore, this study aimed to further define the genetic profile of these injuries using a multifaceted approach involving whole exome sequencing and a customized analyses pipeline.
METHODS: The exomes of ten exemplar asymptomatic controls and ten exemplar cases with Achilles tendinopathy were individually sequenced using a platform that included the coverage of the untranslated regions and miRBase miRNA genes.
RESULTS: Approximately 200 000 variants were identified in the sequenced samples. Previous research was used to guide the targeted analysis of the TNC and COL27A1 genes located on chromosome 9. Selection of variants within these genes were however not predetermined but based on a tiered filtering strategy. Four variants in TNC (rs1061494, rs1138545, rs2104772 and rs1061495) and three variants in upstream COL27A1 gene (rs2567706, rs2241671 and rs2567705) were genotyped in larger Achilles tendinopathy and ACL rupture cohorts. The CC genotype of TNC rs1061494 (C/T) was associated with the risk of Achilles tendinopathy (p=0.018, OR: 2.5 95% CI: 1.2-5.1). Furthermore, the AA genotype of the TNC rs2104772 (A/T) variant was significantly associated with ACL ruptures in the female subgroup (p=0.035, OR: 2.3 95% CI: 1.1-5.1). Two overlapping inferred haplotypes in the TNC gene were also associated with the risk of Achilles tendinopathy and ACL ruptures respectively.
CONCLUSION: These results provide a proof of concept for the use of a customized pipeline for the exploration of a larger genomic dataset. This approach, using previous research to guide a targeted analysis of the data has generated new genetic signatures in the biology of musculoskeletal soft tissue injuries

CONCUSSION AND SUBSEQUENT LOWER EXTERMITY MUSCULOSKELETAL INJURY: INFLUENCE OF GENDER

BUCKLEY, T., OLDHAM, J.R.
UNIVERSITY OF DELAWARE

INTRODUCTION: Emerging evidence is suggesting that, in addition to subsequent concussion, there is an elevated risk of lower extremity (LE) musculoskeletal (MSK) injury in the year following concussion; however, most studies evaluate male collision sport athletes and women are understudied. Therefore, the purpose of this study is to compare post-concussion LE MSK injury between genders.
METHODS: We recruited 335 student-athletes (62.1% female, mean age, 21.2 ± 1.4 years old; mean collegiate athletic experience, 3.3 ± 1.2 years) across 13 sports from 17 US colleges from 2012 to 2014. The participants completed a previously validated and reliable (ICC: 0.92) 21-item questionnaire pertaining to injuries experienced during their collegiate career. Participants self-reported concussions under three categories: 1) self-reported concussions, 2) acknowledged unreported concussions (e.g., "hidden"), 3) unrecognized concussions (e.g., memory loss following a head impact) and a 4th variables "any concussion" was calculated for participants who reported any of the three categories. The LE MSK injuries were self-reported 1) lateral ankle sprains, 2) knee sprains, or 3) lower extremity muscle strain. Chi-square analyses were performed to identify the association between each of the 4 concussion variables (reported, unreported, potentially unrecognized, and any concussion) and LE variables (ankle sprain, knee injury, muscle strain) between self-reported genders (Male, Female).
RESULTS: For females, there was a significant association between 1) reported concussions and knee injuries (p=0.018, odds ratio=2.22, 95% CI: 1.18 – 4.21), 2) unreported concussions and knee injuries (p=0.005, odds ratio=3.73, 95% CI: 1.51 – 9.22), 3) unrecognized concussions and lateral ankle sprains (p=0.007, odds ratio=2.61, 95% CI: 1.32 – 5.15), and 4) any concussion and knee injury (p=0.003, odds ratio=2.67, 95% CI: 1.43 – 5.00). For males, there was only a significant association between unrecognized concussions and muscle strains (p=0.020, odds ratio=2.39, 95% CI: 1.16 – 4.92).
CONCLUSION: The results of this study suggest females are at higher risk of post-concussion subsequent MSK injury over the course of their collegiate athletic career. This was most evident for knee injuries and it should be noted that females have up to a 6x higher rate of ACL injuries which may contribute to these findings; however, it should be noted that only 24 ACL injuries were reported and 17 were among females thus limiting their overall influence on the outcomes. Consistent with recent concussion related findings, these results may highlight a gender difference in concussion response and suggests future studies continue to differentiate gender during analysis.

Clinically, health care professionals who manage concussion in an athletic population should be aware of an elevated risk of LE MSK following concussion and implement appropriate injury prevention strategies.

MUSCULOSKELETAL INJURIES IN SINGAPORE PHYSICAL EDUCATION TEACHERS- A PROSPECTIVE EPIDEMIOLOGICAL INVESTIGATION

MUKHERJEE, S., JOHARI, M.R., KEE, Y.H., VAN MECHELEN, W.

NATIONAL INSTITUTE OF EDUCATION, NANYANG TECHNOLOGICAL UNIVERSITY, SINGAPORE

INTRODUCTION: Physical education teachers (PETs) are at a high risk of musculoskeletal (MSK) injuries as their body parts are regularly exposed to various stresses and mechanical shocks during PE teaching. This study investigated the incidence of MSK injuries amongst PETs in Singapore schools.
METHODS: 103 primary (Pri) and 49 secondary (Sec) school PETs (116 male, 36 female) across 21 schools volunteered to participate. A two-weekly prospective online injury documentation survey was done using Qualtrics. Total 17 rounds of survey were done during the 2017 school calendar year. 50% response rates were 78% and 90.5% during the first and second half of the school year.
RESULTS: 98 PETs (Pri- 63, Sec- 35) reported 238 injuries (males- 168; females- 70; Pri- 155; Sec- 83) during the year. 61 injuries (25.6%) were sustained during PE teaching-related activities and 130 injuries (54.6%) during personal sports participation. Daily mean PE teaching load was 3.59 hours for Pri and 3.08 hours for Sec school PETs. Overall injury risk was 1.50 and 1.69 injuries/PET/year for Pri and Sec PETs respectively. Injury incidence rate was 94.70/1000 hours and 21.64/1000 hours of PE curricular exposure time for Pri and Sec PETs respectively. Practicing or playing with students during PE teaching led to most injuries (39.3%) followed by during skill, technique or movement demonstration (34.4%). Most injuries sustained during PE teaching were recurrent (37.7%) followed by acute injuries (27.8%) and aggravations (26.2%). Majority of injuries were non-contact type (44.2%) and were sustained during the first two PE lessons (54.1%) of the day. Lower back was the most commonly affected part (26.2%) followed by foot-and-ankle (21.3%) and knee (19.6%). Muscle-tendon strain was the commonest injury (PE- 21.3%, personal sport- 32.3%) followed by incomplete ligament sprain (PE- 19.6%, personal sport 17.6%). Injuries led to work absence (24 - 2 days, 7- 6 days, 5 >10 days) as well as pain and discomfort during PE teaching (46- 6 days, 18- 9 days, 63 > 10 days). Injuries also led to PETs missing personal sport participation (32- 9 days, 43- still not able). 82 PETs required medical attention and 46 PETs required long-term physiotherapeutic help.
CONCLUSION: PETs constitute a vulnerable occupational group with both Pri and Sec PETs in Singapore schools at a high risk of MSK injuries. Injuries led to inability to teach PE as well as pain and discomfort while PE teaching. This can adversely affect the quality of PE delivery and achievement of learning outcomes. Injuries also limited personal sport participation that may affect fitness, health gains and quality of life. Furthermore, the majority of injuries being recurrent and affecting muscle-tendon and ligaments present a risk of long-term MSK dysfunction and reducing the career longevity of PETs. Measures should be taken to further optimize the workload of PETs, reduce the incidence of injuries and the minimise the prospect of long-term MSK dysfunction in this population.

THE INDIVIDUAL AND COMBINED EFFECTS OF MULTIPLE FACTORS ON THE RISK OF SOFT TISSUE NON-CONTACT INJURIES IN ELITE TEAM-SPORT ATHLETES

ESMAEILI, A., HOPKINS, W., STEWART, A., ELIAS, G., LAZARUS, B., AUGHEY, R.

INSTITUTE OF HEALTH AND SPORT (IHES), VICTORIA UNIVERSITY, AUSTRALIA

INTRODUCTION: Relationships between common athlete-monitoring-derived variables and injury risk have been investigated predominantly in isolation. The aim of this study was to evaluate the individual and combined effects of multiple factors on the risk of soft-tissue non-contact injuries in elite team sport athletes.
METHODS: A cohort of 55 elite Australian footballers was prospectively monitored over two consecutive seasons. Internal and external training load was quantified using the session rating of perceived exertion and GPS/accelerometer units respectively. Cumulative loads and acute-to-chronic workload ratios were derived using rolling averages and exponentially weighted moving averages . History of injuries in the current and previous seasons was also recorded along with professional experience, weekly musculoskeletal screening, and subjective wellness scores for individual athletes. Individual and combined effects of these variables on risk of injury were evaluated with generalized linear mixed models.
RESULTS: High cumulative loads and acute-to-chronic workload ratios were associated with increased risk of injuries. The effects for measures derived using exponentially weighted moving averages were greater than those for rolling averages. History of a recent injury, long-term experience at professional level, and substantial reductions in a selection of musculoskeletal screening and subjective wellness scores were also associated with increased risk. The effects of high cumulative loads were underestimated by ~20% before adjusting for previous injuries, whereas the effects of high acute-to-chronic workload ratios were overestimated by 10-15%. Injury-prone players were at a more than five times higher risk of injuries compared to robust players despite adjusting for the effects of training load and previous injuries . Combinations of multiple risk factors were associated with extremely large increases in risk; for example, a hazard ratio of 22 <9.7–52> was observed for the combination of high acute load, recent history of a leg injury, and a substantial reduction in the adductor squeeze test score.
CONCLUSION: The information from athlete-monitoring practices should be interpreted collectively and used as a part of the injury prevention decision-making process along with consideration of individual differences in risk.

Oral presentations

OP-BN30 Resistance training 2

THE EFFECT OF CONCENTRIC AND ECCENTRIC KNEE FLEXOR STRENGTH TRAINING ON RECOVERY AFTER REPETITIVE SPRINT SESSIONS

DUHIG, S., BOURNE, M., BUHMANN, R., WILLIAMS, M., MINETT, G., ROBERTS, L., TIMMINS, R., SIMMS, C., SHIELD, A.

GRIFFITH UNIVERSITY

INTRODUCTION: To investigate whether knee flexor (KF) adaptations induced by five-weeks of concentric (CON) or eccentric (ECC) strength training have different effects on sprint running recovery.
METHODS: Thirty males (age, 22.8 ± 4.1y; height, 180.1 ± 6.4cm; weight, 85.2 ± 14.6kg) were allocated into either a CON or ECC group, both performing nine sessions of resistance training. Prior to and immediately after the five-week intervention, each participant's bicep femoris long head (BFLH) fascicle length (FL), pennation angle (PA), muscle thickness (MT), peak isometric KF torque and Nordic eccentric strength were assessed. Post intervention, participants performed two sprint sessions (10x80m) 48 hours apart. With reference to the first sprint session, blood samples and passive KF torque were collected before, after, 24 hours and 48 hours post.
RESULTS: After the five-week strength-training period fascicles lengthened in the ECC group ($p<0.001$; $d = 2.0$) and shortened in the CON group ($p<0.001$; $d =0.92$) while PA decreased for the ECC group ($p=0.001$; $d = 0.52$) and increased in the CON group ($p<0.001$; $d = 1.69$). Nordic eccentric strength improvements occurred in both the ECC ($p<0.001$; $d =1.49$) and CON ($p<0.001$; $d = 0.95$) groups. Peak isometric strength ($p=0.480$; $d=0.12$), passive KF torques ($p=0.807$; $d=0.16$), sprint performance decrements within ($p=0.595$; $d=0.24$) and between sprint sessions ($p = 0.910$; $d=0.05$) and creatine kinase ($p=0.818$; $d=0.06$) did not differ significantly between groups.
CONCLUSION: Despite significant opposing alterations in hamstring architecture between ECC and CON groups, no difference was observed for sprint recovery between sessions, which may have implications for strain injury.

TASK-SPECIFICITY AND TRANSFERABILITY OF RESISTANCE TRAINING WITH DIFFERENT STABILITY REQUIREMENTS

SAETERBAKKEN, A.H., BAARDSTU, H.B., ANDERSEN, V.

WESTERN NORWAY UNIVERSITY OF APPLIED SCIENCE

INTRODUCTION: The aim of the study was to examine the task-specificity in trained and transferability to non-trained exercise after attending a resistance-training program with different stability requirements.
METHODS: 59 recreational-trained men attended three weeks of familiarization with three squat exercises with low, medium and high stability requirements: Smith-machine (SM), free-weights (FW) and free-weights on balance discs (BD). After the familiarization, the participants were randomized to attend a 7 weeks squat-training program using SM, FW, BD or a control group (CON) twice a week. All participants were tested pre, after 3 weeks (wk3) and post intervention in 10RM, maximal voluntary contraction (MVC) and rate of force development (RFD) in all three exercises in addition to CMJ on stable and unstable surface and muscle thickness of vastus lateralis.
RESULTS: The familiarization period demonstrated similar improvement in 10RM loads in SM (23%), FW (22.5%) and BD (28%). The MVC increased in BD (16%, $p<0.001$), but not in FW (12%; $p=0.068$) or SM (7%; $p=0.144$). The CMJ increased 4.8% and 8.1% using stable and unstable surfaces ($p<0.001$) with a 14% greater height using a stable surface ($p<0.001$). The muscle thickness increased 2.5% ($p=0.008$). No improvements were observed in RFDs for the three exercises ($p=0.074$-1.000).
In the intervention period, all training groups demonstrated task-specificity in trained exercise (18-26%; $p<0.001$) and transferability of strength to non-trained exercise in 10RM loads (16-23%; $p<0.001$). Still, only the SM-group demonstrated task-specificity SM compared to FW-group (37%; $p=0.044$) and a strong tendency towards greater increase than the BD-group (34%; $p=0.059$). Comparing the other exercises, similar improvements were observed between the groups ($p=0.273$-0.472). Similar improvements between the groups were observed in MVCs, RFDs, CMJ on stable surface and muscle thickness ($p=0.510$-0.831). Still, all training groups improved the MVC in FW (10-20%, $p=0.004$-0.046). In SM, the MVC increased only in the SM- and BD-group (13-15%, $p=0.002$-0.004) and only the BD-group improved the MVC in BD (12%, $p=0.008$). In CMJ, the SM- and BD-group improved 3% and 12% on the unstable surface ($p=0.004$-0.034). However, the BD-group improvements were greater improvement than tall others groups ($p=0.001$-0.027). The CON-group demonstrated similar results at wk3- and post-test for all variables ($p=0.386$-0.866).
CONCLUSION: Despite training with different stability requirements, only the group training with low (SM) or high (BD) stability requirement demonstrated task-specificity. With exception of the 10RM results, the FW-group training with medium stability requirement, did not demonstrate transferability to non-trained exercise in contrast to the SM- and BD groups. Similar improvements may be a result of the massive improvements in the familiarization period and future studies should include a familiarization period to reduce the learning effects.

EFFECTS OF DIFFERENT RECOVERY INTERVALS BETWEEN RESISTANCE TRAINING SESSIONS ON MUSCLE PERFORMANCE ADAPTATION OF ELBOW FLEXORS IN RESISTANCE TRAINED MEN

SOARES, S., FERREIRA-JÚNIOR, J.B., FONSÊCA, A.C., PADILHA, U.C., GUEDES, R.A., VALERIANO, R.O., BOTTARO, M.

UNIVERSITY OF BRASILIA

INTRODUCTION: Recovery interval between resistance training sessions is an important factor for designing resistance training program. It has been recommended for advanced training 72h of interval between training sessions (ACSM, 2009). However, a recent study showed that resistance-trained men presented uncompleted recovery 72h following bench press exercise (Ferreira et al., 2017). Peak torque (PT) returned to baseline at 96h, while total work (TW) did not. An insufficient recovery between resistance training sessions can negatively alter muscle mass protein expression (Alves et al., 2014), suggesting an impaired muscle adaptation. Considering that controlled studies on the optimal recovery interval between training sessions are lacking, the aim of this study was to compare the effects of different intervals between resistance training sessions on muscle performance adaptation of elbow flexors in resistance trained men.
METHODS: Twenty-three trained men (25±5 years) were randomly divided into two groups: 1) G72h - subjects trained at each 72 h; and 2) G168h- subjects trained at each 168 h. All subjects performed 8 training sessions for elbow flexors muscles on Scott bench attached on isokinetic dynamometer. The elbow flexors isokinetic protocol consisted of 4 sets of 6 repetitions with ECC/CON isokinetic mode with

120°.s-1 and 60°.s-1 for eccentric and concentric muscle actions, respectively. Rest interval between sets was 2 min. Elbow flexors concentric mean PT and TW were measured during the 1st, 4th and 8th elbow flexors isokinetic training session.
RESULTS: Mean PT did not differ among G72h (1st= 55.0±9.4 N.m, 4th= 51.6±8.8 N.m and 8th= 53.69.1 N.m) and G168h groups (1st= 53.9±8.3 N.m, 4th= 54.6±8.6 N.m and 8th= 56.6±12.1 N.m) throughout training sessions (p>0.05). However, TW in the G168h group was higher on 8th training session (1781±423 J) when compared to 1st (1460±341 J) and 4th training session (1606±310 J) (p<0.05), while TW in the G72h group was not altered throughout training sessions (1st= 1707±152 J, 4th= 1647±307 J and 8th = 1739±343 J, p>0.05).
CONCLUSION: The main finding of the present study was that a high recovery interval between resistance training sessions is needed to improve muscle performance adaptation. Considering that mean PT was not different among groups, the increased TW of the elbow flexors observed in G168h group may be due to the positive interaction between stress and recovery surpassing the initial levels of training, which corresponds to supercompensation phenomenon (Issurin, 2010). In conclusion, if trained subjects want to improve muscle performance, 168h recovery interval between resistance training sessions is recommended.
References: ACSM (2009). Med Sci Sports Exerc, 41(3), 687-708.
Alves SRW, Aguiar AF, Vechetti-Junior IJ, et al. (2014). J Strength Cond Research, 28, 2338-2345.
Ferreira VD, Gentil P, Ferreira-Júnior BJ, et al. (2017). Physiol Behav, 179, 143-147.
Issurin VB (2010). Sport Med, 40, 189-206.
saulosoares26@gmail.com

CHANGES IN AVERAGE- VERSUS PEAK-FORM MEASURES OF MUSCLE FUNCTION FOLLOWING MULTIMODALITY RESISTANCE TRAINING

JAMES, L., KELLY, V., HAFF, G., BECKMAN, E.

THE UNIVERSITY OF QUEENSLAND; BRISBANE BRONCOS RUGBY LEAGUE FOOTBALL CLUB; EDITH COWAN UNIVERSITY

INTRODUCTION: Decisive athletic actions occur as a consequence of high forces expressed over windows of time lasting approximately 0.1 to 0.3s. However, while light ballistic and heavy strength training modalities have resulted in considerable increases in instantaneous measures of muscle function (e.g. peak velocity) derived from a countermovement (CMJ) jump, improvements in the equivalent average variables (e.g. average velocity) are more modest. This is problematic as average-form variables are calculated over periods more closely resembling those encountered in sport (generally the entire concentric phase), and therefore may provide a better indication of transfer. It is possible that the single exercise modalities previously used limited adaptations throughout the entire range of motion, resulting in attenuated improvements in average-form metrics. It is therefore the purpose of this investigation to determine whether multimodality resistance training would have a greater influence on muscle function measures in their average form when compared to their respective instantaneous variants.
METHODS: Sixteen recreationally trained males undertook 10 weeks of resistance training consisting of weightlifting, ballistic and plyometric actions under a spectrum of loads. Repetitions ranged from 3 to 6 and the loading, volume and exercise selection were structured based on periodisation principles. Muscle function was assessed via the CMJ on a force platform (2000 Hz) at baseline and posttest. Data were processed enabling construction of velocity- and power-time curves. Peak measures represented the highest instantaneous sample on the curve of interest. Average measures were calculated between the bottom of the countermovement (zero velocity) and takeoff. Average velocity and average power were then expressed relative to their respective peak function (average variable/peak variable). This enabled an index of average velocity (AvVindex) and power (AvPindex) to be examined.
RESULTS: Significant improvements in both AvVindex (P<0.001, d= 0.74) and AvPindex (P<0.001, d=0.84) were revealed following training. This was underpinned by a respective increase of 13.6 and 7.4% in average and peak velocity, alongside a 15.8 and 7.5% increase in average peak power, respectively.
CONCLUSION: Although both average and peak measures of muscle function were enhanced after multimodality resistance training, it is the findings of considerably greater improvements in average-form metrics that are most notable. This resulted in significant increases in AvVindex and AvPindex indicating a heightened ability to operate throughout greater ranges of motion and epochs (0.0005 vs 0.280s), and therefore a likely enhanced transfer to athletic performance. These results are in contrast to the common reports of greater increases in peak versus average metrics, and may potentially be attributed to the multiple modalities used in this present intervention.

COMPARISON BETWEEN ECCENTRIC AND CONCENTRIC RESISTANCE EXERCISES WITH BODY WEIGHT FOR THEIR EFFECTS ON MUSCLE AND FUNCTIONAL FITNESS OF OLDER ADULTS

KATSURA, Y.1, TAKEDA, N.1, HARA, T.2, TAKAHASHI, S.3, NOSAKA, K.4

1: KOGAKUIN UNIVERSITY , 2: SHIMANE UNIVERSITY , 3: DAITO BUNKA UNIVERSITY , 4: EDITH COWAN UNIVERSITY

INTRODUCTION: Eccentric resistance exercise training (ECC) of the knee extensors performed once a week for 12 weeks improved physical fitness, insulin sensitivity and blood lipid profiles of elderly men greater than concentric resistance exercise training (CON) (Chen et al. Front Physiol 2017). Basic resistance exercises can be performed without using resistance training machines or equipment, but with body weight (e.g., standing and sitting from a chair). However, no previous studies have investigated their effects on muscle function and physical fitness of older adults. The present study tested the hypothesis that ECC would improve muscle function and functional physical fitness of older adults greater than CON.
METHODS: Elderly healthy individuals (65 - 84 y) were placed into one of the two groups; ECC (n=9) and CON (n=8). No significant differences in the baseline measures were found between groups. ECC and CON consisted of 8 exercises such as chair squat, jump squat, one leg squat, calf raise, knee close and open, push up, sit up, elbow flexion and extension. The exercises were performed once a week for 11 weeks by increasing the range of motion, movement speed and repetitions gradually. In ECC, eccentric muscle contractions were emphasised, and load for concentric phase of each exercise was minimised by the investigators who assisted the movements for the concentric phase. In CON, the exercises were similar to those in ECC, but load in eccentric phase was minimised by the investigators. Systolic (SBP) and diastolic blood pressure (DBP), maximal voluntary isometric contraction torque of the knee extensors (MVC), muscle thickness of quadriceps (MT), balance ability assessed by center of pressure movement length and area with eyes open and close, and several functional physical fitness tests were taken before and after the 11-week training. Changes in the variables from baseline to post-training were compared between groups using a mixed-design two-way ANOVA.
RESULTS: Both groups showed changes (P<0.05) in SBP, MVC, MT, sit and reach, 30-s chair stand (CS) and 2-min step (2MS) from baseline to post-training, and changes (P<0.05) in DBP, timed up and go (TUG), balance ability with eyes close were evident only for ECC group. The magnitude of increases in MVC (38.3 ± 22.6% vs 8.2 ± 8.4%), MT (24.4 ± 12.4% vs 6.7 ± 7.1%), CS (51.0 ± 21.7% vs 34.6 ± 28.3%) and

2MS (9.9 ± 6.0% vs 6.0 ± 7.3%), and decreases in TUG (-16.7 ± 9.9% vs -6.3 ± 7.7%) and balance ability assessed by the length with eyes close (-35.1 ± 6.7% vs -8.8 ± 16.2%) were greater (P<0.05) for ECC than CON.
CONCLUSION: These results suggest that ECC was more effective than CON to improve lower limb strength, mobility and static and dynamic postural stability of older adults. It is possible that focusing on eccentric contractions in exercises that can be performed at home provide significant benefits to elderly individuals, when they are regularly performed.

Oral presentations

OP-BN05 MOTOR LEARNING, SKILL ACQUISITION AND COORDINATION

WHITE MATTER PLASTICITY MEDIATES THE BENEFICIAL EFFECT OF ENDURANCE EXERCISE ON MOTOR LEARNING

LEHMANN, N.1,2, VILLRINGER, A.2,3, TAUBERT, M.1,2

1: OVGU , 2: MPI CBS , 3: CHARITÉ AND HU

INTRODUCTION: Despite the fact that endurance exercise has shown to be a promising intervention strategy to facilitate motor learning (Taubert et al., 2015), the neurobiological mechanisms by which exercise elicits its effects on motor functions remain poorly understood. Based on earlier studies demonstrating a crucial role of structural brain properties and their practice-induced reorganization for motor learning (Taubert et al., 2010; Sampaio-Baptista et al., 2014), we hypothesized that structural brain plasticity mediates the effect of exercise on motor learning.
METHODS: To test our hypothesis, we conducted a longitudinal study involving 34 healthy, right-handed adults aged 18-35 y (3 drop-outs). Subjects were randomly assigned to two groups which learned a complex whole-body balancing task (BT) on a seesaw-like platform over a period of six weeks (Taubert et al., 2010). Before the learning phase, group EXELEARN (n = 15) underwent a two-week priming exercise intervention, whereas RESTLEARN (n = 16) continued with their habitual activities in the same period (life-as-usual). During the experiment, we acquired T1- and diffusion-weighted MRI data in regular time intervals, which allowed us to analyze structural neuroplasticity in brain's gray and white matter.
RESULTS: As was expected, behavioral analyses showed that EXELEARN learned the BT at a faster rate compared with RESTLEARN ($p < .05$). Multiple mediation analysis revealed that the intervention influenced learning rate mainly through exercise-induced changes of the diffusion index radial diffusivity in sensorimotor-related fiber tracts (significant indirect effect based on 95% bias corrected bootstrap confidence interval).
CONCLUSION: We conclude that a short endurance exercise intervention increases the speed of complex motor skill learning and that this increase is likely driven by exercise-induced white matter plasticity. Animal and post-mortem studies show that radial diffusivity is correlated with the degree of axonal myelination (Song et al., 2002, Klawiter et al., 2011), thus suggesting that priming exercise might have influenced motor learning by altered speed and/ or timing of information transfer in the brain. The fact that white matter changes were associated with learning rate in a widespread network leads us to speculate that the neuromodulatory effect of exercise might apply in a task-independent fashion.
Literature
Klawiter EC et al. (2011). NeuroImage, 55, 1454–1460.
Sampaio-Baptista C et al. (2014). NeuroImage, 96, 158–166.
Song S-K et al. (2002). NeuroImage, 17, 1429-1436.
Taubert M et al. (2010). J Neurosci, 30, 11670–11677.
Taubert M et al. (2015). Front Hum Neurosci, 9, 692.
Contact: nico1.lehmann@ovgu.de

ANTICIPATION CHANGES NEUROMECHANICS OF DROP JUMPS IN REGARD TO KNOWN OR UNKNOWN GROUND STIFFNESS CONDITIONS

HELM, M., RITZMANN, R., FREYLER, K., GOLLHOFER, A.

UNIVERSITY OF FREIBURG

INTRODUCTION: Anticipation determines the timing and efficiency of reactive motor performance (Leukel et al. 2012). With an emphasis on ballistic movements, an accurately anticipated neural control is an essential prerequisite to deliver a motor response coincidentally with the event of ground contact. This study aimed at investigating how previous knowledge in the ground condition affects proactive and reactive motor control in drop jumps (DJ). For this purpose, human anticipatory capacity of muscle activation was investigated in terms of muscle mechanics, joint kinematics and forces associated with drop jump performance.
METHODS: In 18 subjects, the effect of knowledge of two different surface conditions during DJs was evaluated in four conditions: two surface stiffnesses (hard/soft) were either known or unknown to the subjects. Peak force (Fmax), ground-contact-time (GCT), rate of force development (RFD) and jump height were assessed. Electromyographic (EMG) activities of the m. soleus (SOL), gastrocnemius medialis/lateralis (GM/GL) and tibialis anterior (TA) were assessed 150ms before (PRE) and during ground contact (GC) for the reflex phases short-, medium-, and long-latency response (SLR, MLR, LLR). Ankle and knee joint kinematics were recorded in sagittal plane, and pennation angle (PA) of GL was measured by ultrasound.
RESULTS: Unknown vs. known condition induced a decrease in Fmax, RFD and jump height (P<0.05), whereas GCT increased (P<0.05). A decline in proactive EMG activity in SOL and GM for PRE (hard surface) was measured in the unknown condition. During GC, a decline in EMG activity in the unknown condition was manifested for SOL and GM in all reflex phases (P<0.05), TA showed no changes. On the soft surface, both ankle and knee joint deflections during GC were increased in the unknown vs. known condition (P<0.05). PA was reduced during PRE in unknown vs. known (hard) condition and during GC (hard, soft) (P<0.05). Fmax and RFD were positively correlated to GM EMG in PRE and all reflex phases (P<0.05). Complementarily, negative correlations have been detected between GCT and GM EMG (P<0.05).
CONCLUSION: Results revealed that proactive and reactive changes in muscle activity and mechanics prior and during GC are interrelated to jump performance. Thereby, the unknown condition is described by a general activation pre-set prior to GC that on average is appropriate for both conditions, associated with muscle elongation that may lead to reduced muscle stiffness and thus, augmented joint

deflections. Findings underline that anticipation is the determining factor influencing timing and adjustment of motor responses to accomplish ballistic movements in regard to efficiency and performance.
REFERENCES:
Leukel C, Taube W, Lorch M, Gollhofer A (2012). Hum Mov Sci 31 (1), 152-160.
CONTACT:
michael.helm@sport.uni-freiburg.de

EFFECTS OF FOCUS OF ATTENTION FEEDBACK ON HIP AND KNEE COORDINATION IN THE LEARNING OF THE CLEAN WEIGHTLIFTING TECHNIQUE

RODRIGUEZ RIVADULLA, A.1,2, LAWRENSON, T.1, PREATONI, E.1

1. UNIVERSITY OF BATH , 2. SPORTS SURGERY CLINIC

INTRODUCTION: The learning of motor skills is thought to be enhanced when feedback is focussed on movement outcome (i.e. external focus of attention, EFOA) as opposed to directing attention to specific elements of movement execution (i.e. internal focus of attention, IFOA) (Wulf, 2013). Typical approaches of motor learning have used outcome measures to assess the effects of focus of attention (FOA). However, only a few studies have used dynamical systems quantities to describe coordination changes as a factor of different FOA feedback. The aim of this study was to assess the effect of FOA on Hip x Knee coordination in the learning of the clean weightlifting technique in a group novel to the task.
METHODS: Sixteen participants (12 males, 4 females) were randomly assigned to the EFOA or IFOA group (n = 8 each), and were asked to complete a 3-session training protocol consisting of 6 sets x 3 repetitions of the clean with individual feedback provided after each set. Motion capture was used to measure 3D full body kinematics. Right hip and knee flex/ext angles were time registered to 1001 data points and angle-angle plots were built. A modified vector coding technique was used to calculate the coupling angle (CA) between the vector connecting two subsequent data points and the positive horizontal axis. CA at each time point was classified into different coordination patterns (e.g. in-phase, anti-phase) and joint dominancy was identified (e.g. hip, knee) (Needham et al., 2015). Time spent on each coordination at post-test and pre-test was subtracted to define change in coordination. A repeated measure ANOVA (2 Groups x 4 Coordination patterns) was used to assess the effects of FOA on the change of Hip x Knee CA.
RESULTS: No Group x Coordination pattern interaction effect was found, suggesting that different type of feedback did not significantly change Hip x Knee CA ($F(1.293,42) = 0.056$, $p = 0.874$). Although not significantly, participants of both groups reduced the time spent on an in-phase coordination with knee dominancy (pre-test: EFOA, 47.3%; IFOA, 48.2%; post-test: EFOA, 44.3%; IFOA, 46.5%) and increased the time spent in an in-phase coordination with hip dominancy (pre-test: EFOA, 42%; IFOA, 39.1%; post-test: EFOA, 45.1%; IFOA, 44.4%).
CONCLUSION: Hip x Knee coordination was equally affected by EFOA and IFOA in inexperienced participants learning the clean weightlifting technique. These results are potentially explained by the skill level of the participants, as experience was suggested as a mediator of FOA effects (Poolton et al., 2006). Coordination variability analysis may help explain the effects of FOA on coordination and body's degrees of freedom. Also, studying experienced athletes could further our current understanding of the effects of FOA on coordination.
REFERENCES:
Needham R, Naemi R, Chockalingam N. (2015) J Biomech, 48, 3506-3511.
Poolton J, Maxwell J, Masters R & Raab M. (2006) J Sports Sci, 24(1), 89-99.
Wulf G. (2013). Int Rev Sport Exerc Psychol, 6(1), 77-108

EFFECTS OF A SINGLE BOUT OF AEROBIC EXERCISE ON MOTOR SKILL ACQUISITION AND CONSOLIDATION: A COMPARISON OF DIFFERENT EXERCISE INTENSITIES

WANNER, P.1, MÜLLER, T.1, PFEIFER, K.1, STEIB, S.1

1: FRIEDRICH-ALEXANDER UNIVERSITY ERLANGEN-NÜRNBERG

INTRODUCTION: Recent evidence suggests that single bouts of aerobic exercise performed in close proximity to motor practice can enhance skill acquisition and consolidation (Roig et al., 2016). High-intensity bouts have been suggested to be particularly effective in improving consolidation (Roig et al., 2012). However, to date this has only been demonstrated for fine motor skills. Further, high-intensity exercise may interfere with skill acquisition, and is not practicable in all settings. Thus, the aim of this study was to investigate the effects of aerobic exercise i) carried out immediately prior to motor practice, and ii) performed at different exercise intensities on learning a novel balancing task.
METHODS: 35 healthy young adults (age: 25.57 ± 2.66; BMI: 22.99 ± 2.15) were allocated after stratified block randomization to one of three groups performing either 1) high-intensity interval exercise at 90%/60% Wmax (EX-H; n = 10), 2) moderate-intensity interval exercise at 45%/25% Wmax (EX-M; n = 12), or 3) continuous minimal-intense exercise at 25 W (CON; n = 13). All groups exercised on a cycle ergometer for a total of 17 min immediately prior to practicing a novel motor skill. The task required participants to stand on a tiltable (30°) wooden platform (stabilometer), and to stabilize it in a horizontal position for 30 seconds. For each experimental condition, subjects performed 15 trials (3 blocks of 5 trials), followed by a retention test (2 trials) 24 hours later. Time in balance (platform within ±5° from horizontal) and average angular deviation from horizontal (RMSE) were calculated for each trial. Within- and between-group changes over time were tested using repeated measures ANOVA.
RESULTS: On acquisition day, all participants significantly improved balance time (+34.7%; TIME main effect: $F14,270 = 17.8$; $p < .001$) and RMSE (-56.2%; TIME main effect: $F14,277 = 28.2$; $p < .001$), with no differences observed between experimental conditions. At retention, all groups demonstrated sustained performance (change from last two acquisition trials to retention) in balance time ($F1,32 = 0.86$; $p = 0.360$), with no significant group differences ($F2,32 = 0.87$; $p = 0.434$). For RMSE, performance significantly worsened only in the EX-H group (+13.6%; $p = 0.008$), and a similar tendency existed in the CON group (+9.16%; $p = 0.067$).
CONCLUSION: Motor skill acquisition was not improved by aerobic exercise, irrespective of exercise intensity. Interestingly, a trend existed for improved consolidation by moderate-intense cycling. The present findings do not confirm the positive effects of high-intensity aerobic exercise on motor learning, when exercise is performed immediately prior to motor learning.
REFERENCES:
Roig, M., Skriver, K., et al. (2012). PloS one, 7(9), e44594.
Roig, M., Thomas, R., et al. (2016). Exercise and sport sciences reviews, 44(2), 81–88.
CONTACT:
philipp.wanner@fau.de

WORKING MEMORY SUPPRESSION DURING SKILL ACQUISITION: A PILOT STUDY OF A NEW IMPLICIT MOTOR LEARNING PARADIGM

HOSKENS, M.C.J.1, BOAZ-CURRY, K.1, BUSZARD, T.2, MASTERS, R.S.W.1

1 UNIVERSITY OF WAIKATO; 2 VICTORIA UNIVERSITY

INTRODUCTION: Implicit motor learning paradigms seek to reduce the involvement of working memory (WM) in skill acquisition, which has advantages for motor performance. Most of the paradigms use behavioural interventions; however, this study investigated whether WM activity can be suppressed by a cognitively fatiguing protocol in order to cause implicit motor performance.
METHODS: Twenty-nine participants were engaged in a cognitive fatigue intervention (N-back task) or control intervention (documentary viewing). Subjective feelings of fatigue, performance on a verbal WM capacity task were measured before and after the intervention. WM activity was determined by measuring the activity in the left dorsolateral prefrontal cortex (DLPF). Golf putting performance and the extent to which the golf putting task was performed implicitly were evaluated. Brain activity in the left temporal region was measured to determine the verbal-analytical engagement during the golf putting task.
RESULTS: The fatiguing intervention caused significantly higher feelings of fatigue. Activity in the left DLPF was significantly reduced for the cognitive fatigue group, during the post WM capacity task. However, performance on the WM capacity task did not significantly reduce after the intervention. Performance on the golf putting task was not different for groups, but brain activity was reduced in the left temporal region when participants were cognitively fatigued.
CONCLUSION: The results of this study reveal that the feeling of cognitive fatigue was increased, and WM activity changed after performing the cognitive fatigue intervention. However, the intervention did not influence the performance on the WM capacity task. Cognitive fatigue caused depressed activity in the left temporal region during the golf task, suggesting that verbal processing of information may have been reduced. Additional research needs to focus on specific suppression of verbal WM to clearly establish the implications for implicit motor learning. This experiment represents a first step in developing an implicit motor learning paradigm using suppression of WM to prevent conscious accumulation of task-relevant declarative knowledge during skill acquisition.

LEARNING A VISUOMOTOR SKILL FOLLOWING A SINGLE BOUT OF EXERCISE IN HEALTHY ADULTS

KODESH, E.

UNIVERSITY OF HAIFA

INTRODUCTION: Priming the motor system with a single bout of physical exercise (PE) influences brain plasticity and promotes the learning of motor skills. Despite evidence of the positive effects of a single bout of PE on learning, optimal type, duration and intensity of PE are yet to be determined. Aerobic effort has been previously studied, whereas other types of exercise like high intensity interval training have not been investigated. Aims: To compare the effect of three different PE regimes on learning of visuo-motor skill in healthy individuals and determine whether arousal mood and fatigue mediate the outcomes
METHODS: 50 healthy individuals, aged 18-45 years, were randomly assigned to 4 intervention groups: "Aerobic group" exercised continuously for five minutes at 70% of the heart rate reserve, "Interval-20" and "Interval-10" groups performed five repetitions of 20s or 10s respectively, of maximal cycling effort with 40s or 50s recovery periods respectively. Control group sat on the bicycle for five min. Following the interventions all participants performed five repetitions of the star mirror-tracing task. Time and accuracy of the star-tracking task were measured. Upon completion of the intervention participants rated their arousal mood and fatigue. Learning was evaluated using early (20 min. post practice) and delayed (24 hour post practice) retention/transfer that included one drawing of a star or man mirror-tracing. Additionally, upon completion of the intervention, participants rated their arousal, mood and fatigue. Two ways mixed-model ANOVAs were used for time, group and interaction effects. Correlation analyses between arousal, mood and fatigue and learning index were performed.
RESULTS: During practice, the tracing task significantly improved without differences between groups. Comparison of time to complete the task between the early and late retention tests showed a significant interaction effect ($p<0.04$). Whereas movement time significantly increased in the control group by 11.1%, in the PE groups it remained stable or decreased by ~8%.
A positive moderate correlation ($r = 0.32$ $p = 0.025$) was found between fatigue and skill acquisition. No correlation found between mood and arousal with tracking task learning.
CONCLUSION: PE improved delayed retention. This effect was most prominent when effort was maximal and for a short duration (Int-10). A single bout of maximal short PE seems to have a positive priming effect on the learning of a visuomotor task.

Oral presentations

OP-BN31 Sports with individuals with physical and intellectual disabilities

THE MEANING OF PARTICIPATION IN A PROFESSIONAL INTEGRATED DANCE COMPANY FOR INDIVIDUALS WITH AND WITHOUT DISABILITIES.

PANTANO, K., STEINERT, R., TUCHOLSKI, J.

CLEVELAND STATE UNIVERSITY

INTRODUCTION: Individuals with physical and cognitive disabilities often encounter social barriers in their daily lives that inhibit them from participating in activities that their non-disabled peers engage in. Integrated dance programs have been increasing in popularity as a way to diminish stereotypes and stigmas about disabled populations by partnering with non-disabled peers in various art forms as a means of inclusion and improvement of physical and psychological function. The purpose of this phenomenological study is to describe the perceptions and experiences of dancers with and without disabilities who participate in a professional integrated dance group.
METHODS: A qualitative study using surveys and in-depth interviews was conducted to study the meaning and experiences of disabled and non-disabled participants in Dancing Wheels, a professional Integrated Dance Company in Cleveland Ohio, U.S.A. Survey information provided descriptive statistics about the dancers studied. Audiotaped interviews were transcribed and data was reduced using thematic analysis. Triangulation established trustworthiness of the data.
RESULTS: Eleven sit-down (disabled) and standing (non-disabled) dancers from the Dancing Wheels Integrated Dance Company were interviewed for this study using a script of open-ended questions. Their average age was 28 years old and average length of participa-

tion in the dance company was 5 years. Qualitative data analysis resulted in thematic descriptions regarding the meaning of participation in an integrated dance group. Each collated theme was ranked in the order in which it was most frequently described during the interview process. The following themes were most frequently reported: First, both sit-down and stand-up dancers perceived that their involvement in an integrated dance company inspired, positively impacted and empowered others. Second, the shared experience of integrated dance advocated social awareness and equality for people with and without disabilities. Third, the integrated dance experience was perceived to promote independence, physical accessibility, team collaboration, and inclusion of all people in the arts.
CONCLUSION: This qualitative study provides a glimpse of the experience and meaning of participating in a professional integrated dance group. Participants expressed similar thoughts about the benefits of dance with the overarching theme being promotion and inclusion of all people in the arts. Integrated dance can be used as a source for creativity and artistic expression while increasing visibility of an under-represented group. Health professionals can be instrumental in promoting meaningful recreational & professional occupations for people of all abilities through inclusive community programs.

RELATIONSHIP BETWEEN MOTOR ABILITIES AND NONVERBAL INTELLIGENCE IN CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER

LIU, S.

PHYSICAL ACTIVITY PSYCHOLOGY

Relationship between motor abilities and nonverbal intelligence in children with Attention Deficit Hyperactivity Disorder
Sin-Chi Liua, Yu-Jung Tsaia, Chung-Ju Huangb, Tsung-Min Hunga
aNational Taiwan Normal University, Taiwan
bTaiwan University of Taipei, Taiwan
Introduction: A large body of studies have found that children with ADHD were impaired in motor skills and cognitive and academic domains . Previous studies suggested that cognitive and motor development could be linked in such a way that movement experiences in early childhood that facilitate interactions with the environment are necessary for cognitive development .
Methods: As research concerning the relationship between motor abilities and intelligence in children with ADHD is scarce, we address this issue by recruiting 54 children <54 boys aged between 7 years and 13 years> whom have been diagnosed with ADHD symptom by a psychiatrist. All participants underwent evaluation by Movement Assessment Battery for Children - Second Edition and Test of Nonverbal Intelligence-Third Edition .
Results and Discussion: Although bivariate correlation revealed that manual dexterity and total score were correlated with Nonverbal Intelligence percentile, the stepwise multiple regression found that only manual dexterity significantly predicted Nonverbal Intelligence percentage <β= .383, R2= .147, p = .004>. The magnitude of association between these two variables was equivalent to those observed in typically developing children . This finding render the legitimacy for examining the causal relationship between motor ability and intelligence, which may shed light on the possibility of utilizing motor abilities enhancement program for improving intelligence in children with ADHD.
References: Barkley, R. A. <2003>. Attention-deficit/hyperactivity disorder. In E. J. Mash & R. A.
Brossard-Racine, M., Shevell, M., Snider, L., Belanger, S. A., & Majnemer, A. <2012>. Motor skills of children newly diagnosed with attention deficit hyperactivity disorder prior to and following treatment with stimulant medication. Research in Developmental Disabilities, 33<6>, 2080–2087.
Campos, J. J., Anderson,D. I., Barbu-Roth,M. A., Hubbard, E. M., Hertenstein, M. J.,&Witherington, D. <2000>. Travel broadens the mind. Infancy, 1, 149–219.
Davis, E. E., Pitchford, N., & Limback, E. <2011>. The interrelation between cognitive and motor
development in typically developing children aged 4–11 years is underpinned by visual processing and fine manual control. British Journal of Psychology, 102, 569–584.
Contact: b6999@hotmail.com

THE ASSOCIATIONS OF PHYSICAL ACTIVITY AND SELF-PERCEPTION WITH MOTOR FUNCTIONING IN ADOLESCENTS WITH AUTISM SPECTRUM DISORDER

CHEN, P.L.1, MA, W.Y.2, HUANG, C.Y.1, SUNG, M.C.1, CHEN, F.C.1, PAN, C.Y.1

1: NATIONAL KAOHSIUNG NORMAL UNIVERSITY , 2: NATIONAL TAIWAN NORMAL UNIVERSITY

Introduction: Ample literature describes the impact of autism spectrum disorder (ASD) on social and behavioral skills; yet, information about how ASD is expressed in motor functioning is lacking. The substantial motor delays experienced by elementary-school-age children with ASD (Staples & Reid, 2010) and the persistence of motor skill-related difficulties during adolescence (Abu-Dahab, et al., 2013) indicate the need to identify the determinants of motor performance in this population. This study compared motor performance, physical activity (PA), and physical self-perception between adolescents with ASD and their typically developing (TD) peers, and assessed the associations between the three measures within each group.
Methods: A total of 126 adolescent males, aged 12–17 years, with (n = 63) and without (n = 63) ASD participated in the study. The Bruininks–Oseretsky Test of Motor Proficiency-2 and the Chinese version of the Physical Self-Perception Profile were administered. All participants wore a uniaxial GT1M Actigraph accelerometer during waking hours for 7 consecutive days. One-way multivariate analysis of covariance (i.e., age and BMI) was performed to evaluate the differences between the two groups. Partial correlations and stepwise multiple regressions were computed to identify factors associated with motor performance in each group.
Results: The adolescents with ASD had significantly lower scores (all $p < .01$) in all motor-area composites (i.e., fine manual control, manual coordination, body coordination, strength and agility) and PA levels (i.e., overall PA and MVPA), and viewed themselves as less competent in the domains of physical strength, physical condition, sports competence, and global self-esteem (all $p < .01$) compared with the TD adolescents. Regression modeling revealed that MVPA was a significant predictor of motor performance (i.e., manual coordination, strength and agility, and total motor composite) in the adolescents with and without ASD (all $p < .01$). The present study also confirms the close relationship between low motor performance and poor self-perceived physical condition in adolescents with ASD ($p < .01$).
Discussion: Future interventions aimed at improving motor performance in adolescents with ASD should focus on improving the time spent in MVPA and developing a positive self-perceived physical condition through motor skill or PA participation.
Acknowledgments
Supported by Taiwan MOST grants 106-2410-H-017-022-MY3.

References: Abu-Dahab, S. M. N., Skidmore, E. R., Holm, M. B., Rogers, J. C., & Minshew, N. J. (2013). Motor and tactile-perceptual skill differences between individuals with high-functioning autism and typically developing individuals ages 5-21. Journal of Autism and Developmental Disorders, 43, 2241-2248.
Staples, K. L., & Reid, G. (2010). Fundamental movement skills and autism spectrum disorders. Journal of Autism and Developmental Disorders 40, 209-217.
Contact: leo410257005@gmail.com

INCREASED DAILY ACTIVITY IMPEDES WEIGHT GAIN AND IMPROVES PHYSICAL ACTIVITY AND STATIC POSTURAL BALANCE OF ADULTS WITH INTELLECTUAL DISABILITY

STANGIER, C.1, REMARK, C.2, LONDON, I.2, TILLMANN, V.2, ABEL, T.1, STRÜDER, H.K.1, ANNEKEN, V.2

1: GERMAN SPORTS UNIVERSITY; 2:RESEARCH INSTITUTE FOR INCLUSION THROUGH PHYSICAL ACTIVITY AND SPORT

INTRODUCTION: Since people with mild intellectual disability (ID) have the same life expectancy as people without ID a regular and life-long physical activity (PA) is of increasing importance to prevent care dependency at an older age and to counteract against the high risk level for dementia (3) and obesity (2). Physical inactivity is also associated with a decrease in postural balance and the resultant higher risk of falling can contribute to inactivity, deconditioning and less mobility. Consequently, this study investigates the effects of increased daily activity on postural balance and level of PA in individuals with ID.
METHODS: A total of 216 individuals with ID were quasi-randomly assigned to either the intervention (42.3±14 y, 165.5±12.9 cm, 80.3±22.4 kg; 70 female, 72 male) or control group (47.7±14.5 y, 164.2±12.4 cm, 76.0±19.8 kg; 32 female, 42 male). While the control group (CG) maintained their daily habits participants in the intervention group (IG) completed 3 additional physical activities of at least 15 min each week for a total duration of 6 months. Participants´ body mass, PA (pedometer: Walking Style IV, Omron©) and static postural balance (5 static stances) (1) were measured pre and post intervention.
RESULTS: While participants in the IG maintained their body mass (80.7±22.7 kg; p=0.47) participants in the CG gained significantly weight (77.9±21 kg; p=0.008). PA was significantly increased after 6 months in the IG (4887±3210 vs. 5552±3509 steps/d; p=0.000) and slightly decreased in the CG (4607±2825 vs. 4408±2777 steps/d; p=0.38). Although both groups showed a significantly improved static postural balance (p=0.001), participants in the IG achieved the increased standing durations with less support (p=0.001) and less compensatory movements (p=0.001) compared to the CG.
CONCLUSION: The results indicate that an increase of daily activity (≥45min/week) is effective to impede weight gain in adults with ID. This is a very important result as people with ID have a higher prevalence of obesity compared to the general population, one of the main risk factors for cardiovascular diseases (2). The completed intervention was also valid to increase participants´ PA and improve static postural balance. Both are highly relevant abilities for an independent and mobile lifestyle. Since even low-threshold exercise elicited positive adaptations, the results demonstrate that a participation in health relevant resources is possible for individuals with ID living in different forms of assisted living.
References:
1Guralnik et al. 1994, J Gerontol. 49, 85-94.
2Hsieh et al. 2014, J Intellect Disabil Res 58, 851-863.
3Mccarron et al. 2017, J Intellect Disabil Res 61, 843-852.
Contact:
c.stangier@dshs-koeln.de

FACTORS INFLUENCING PHYSICAL ACTIVITY DURING RECESS IN CHILDREN WITH SPECIAL NEEDS: A PRELIMINARY STUDY

HUANG, C.Y.1, SUNG, M.C.1, CHEN, P.L.1, MA, W.Y.2, CHU, C.H.1, PAN, C.Y.1

1: NATIONAL KAOHSIUNG NORMAL UNIVERSITY , 2: NATIONAL TAIWAN NORMAL UNIVERSITY

Introduction: Creating an optimal environment at recess may be necessary to maximize physical activity (PA) participation in children (Huberty et al., 2011), especially those with special needs (Pan, 2008). The purpose of this study was to determine how individual and environmental factors to change PA behaviors (baseline vs. intervention) in children with special needs during school recess time (09:10-09:40 am).
Methods: The System for Observing Childrens Activity and Relationships during Play (SOCARP), the Test of Gross Motor Development-2 (TGMD-2), and the Adaptive Behavior Assessment System-2 (ABAS-2) were used. The SOCARP was designed for the simultaneous observation and recording of childrens PA levels, social group sizes, activity type, and social interactions during play. Eight targeted children with special needs were selected and observed over 4 weeks (1 recess period each day) during school days (Monday through Friday). Baseline data were collected during the first 2 weeks, and the intervention data were collect during the second 2 weeks. During the intervention period, children were give choices to play at 4 different activity zones (classroom, play room, playground, track-and-field) in recess. Data were analyzed using the Wilcoxon signed-rank test and the Spearmans rank correlation coefficient.
Results: The main SOCARP findings were that after the intervention (a) participants spent less time in lying and more time in sitting and vigorous PA (all $p<.05$); (b) participants were observed being alone and in medium groups (both $p<.05$); (c) participants engaged in more playground games and less sedentary activities (both $p<.05$); and (d) participants engaged in less occurrences of positive physical behaviors and negative physical conflict behaviors (both $p<.05$). For the baseline related factors, (a) gross motor skills were not associated with PA; and (b) adaptive behaviors (overall, $p<.05$; practical, $p<.01$) were significantly associated with negative physical conflict behaviors. For the intervention related factors, (a) gross motor skills were not associated with PA; (b) adaptive behaviors (overall, $p<.05$; practical, $p<.05$) were significantly associated with negative physical conflict behaviors; (c) sitting was associated with overall ($p<.05$) and practical behaviors ($p<.01$); and (d) practical behavior was associated with positive verbal behaviors ($p<.05$).
Discussion: The data suggest that school recess time provides children with special needs with daily opportunities to engage in play and social behaviors in a relatively unstructured environment. Some changes in students activity levels and play as well as adaptive behaviors were observed across the intervention period. Reducing recess time from the school day may negatively impact on students play choices, PA levels and social behaviors.
Contact: x820519x1@gmail.com

CASE REPORT: EVALUATION OF PROPRIOCEPTIVE PROGRAM IN A PATIENT WITH CEREBELLAR ATAXIA AFTER TRAUMATIC BRAIN INJURY

BARONE, G., ZAMBITO MARSALA, L., BENEDETTI, M.G., BRAGONZONI, L.

ISTITUTO ORTOPEDICO RIZZOLI AND UNIVERSITÀ DI BOLOGNA

INTRODUCTION: Traumatic brain injury (TBI) is one of the main causes of morbidity and mortality in the world. TBI could cause different cerebellar damage, the most common are: postural instability, tremors, balance dysfunctions, cognitive deficits and ataxia.
Proprioception has a significant role in rehabilitation to promote and improve a correct postural control. The aim of this study is to evaluate the effect of proprioceptive training in a patient with cerebellar ataxia after traumatic brain injury using Delos Postural Proprioceptive System (Delos).
METHODS: The subject is a male, 20 years old with a TBI, evolved in severe cerebellar ataxia, weighty gait and postural control disorder. Patient walks with the aid of a stick and shows uncoordinated gait. The patient leads an active lifestyle: water and postural rehabilitation, competitive climbing and amateur thai boxe. The proprioception has been evaluated using static Riva test (single stance) and stabilometric test (double stance) by Delos System (Delos S.r.l. - Torino). The Delos System allows measuring the proprioceptive control with visual feedback. The training consisted of different protocols, performed 2 days a week (45'-60') for 7 weeks. We compared the proprioceptive control before and after the protocol training.
To measure the level of proprioceptive control in single leg stance exercises, we used stability index (SI).
RESULTS: In open eyes tests, SI improve of 7.1% in the left limb and 27.3% in the right one. In close eyes tests, SI improved in left and right limbs respectively of 51.6% and 28.8%. Hands support decrease of 70pp in the left limb and 46pp in right limb. Visual dependence decrease of 17.4%. After training, the variations of the centre of mass were smaller than pre-training once.
CONCLUSION: The specific proprioception program is able to improve the proprioceptive control. The final tests show a higher stability index. The left limb had better result than right one, probably because it started from a worse condition. The patient reduced his support base and was able to perform final tests with heels together. During the first week of training, the patient needed double hands support in single stance training, instead, in the last session, he performed the tests with single hand support. There are few studies about proprioceptive rehabilitation in patients with cerebellar ataxia after TBI. Despite literature recommends proprioceptive rehabilitation techniques in ataxic patients, there are no studies that demonstrate their efficacy.
The proprioceptive protocol will be revise according to the patient's improvements and will be add Delos rocking board to increase instability conditions and range of motion of tibio-tarsal joint.
Other tests could be added as time up and go test, 10m walking test and Tinetti evaluation scale. In the future, a proprioceptive rescheduling protocol could be included in a rehabilitation program for ataxic people.

HAND HELD DYNAMOMETRY FOR FORCE MEASUREMENTS IN ADULTS WITH CEREBRAL PALSY; NORM VALUES AND VARIABILITY

EKEN, M.M.1, KOSCHNICK, S.2, LANGERAK, N.G.3, VEERBEEK, E.B.3, DU TOIT, J.1, FIEGGEN, A.G.3, LAMBERTS, R.P.1,4

1: STELLENBOSCH UNIVERSITY, RSA; 2: SAARLAND UNIVERSITY, GER; 3:UNIVERSITY OF CAPE TOWN, RSA; 4: STELLENBOSCH UNIVERSITY, RSA

INTRODUCTION: Quantifying strength in individuals with physical disabilities, such as cerebral palsy (CP), is essential to compile suitable rehabilitation programs in which strength training has become a central part [1]. However, only limited studies are published on force measurements in adults with CP [2,3]. In addition, no information on variability in force measurements is available in adults with CP, yet crucial for clinically interpreting the data. Hence, the aim of this study was to determine (I) differences in lower limb force between adults with spastic diplegia (CP) and typically developing (TD) peers and (II) differences in variability of force measurements between adults with CP and TD.
METHODS: Adults with spastic diplegia, who can walk with or without assistive devices, and TD peers exerted maximal isometric force against a handheld dynamometer (HHD), held perpendicular in specific movement direction of hip, knee and ankle (three attempts per leg per movement direction). Coefficients of variance (CV) between three force measurements were determined individually for the dominant and non-dominant side. Differences in force and CV between TD adults and adults with CP, categorized either in Gross Motor Function Classification System (GMFCS) level I, II and III, were analysed with a repeated measures ANOVA.
RESULTS: In total, 51 adults with spastic diplegia (GMFCS I: n=25; GMFCS II: n=19; GMFCS III: n=7; mean (SD) age in y:mo=37:6 (6:8)) and 61 TD (mean (SD) age in y:mo=37:10 (7:0)) adults participated in the study. Force and CV were similar for dominant and non-dominant sides within adults with CP and TD adults. Force was significantly lower in adults with CP with GMFCS I, II and III compared to TD in all movement directions ($p<0.001$). CV was significantly larger in CP than TD adults, especially in those classified in GMFCS III. CV ranged from 5.4% to 11.7% in TD adults, while it ranged from 9.3% to 15.1% in CP adults with GMFCS III.
CONCLUSION: Adults with CP were weaker across all movement directions of the lower limbs compared to their TD peers. Adults with CP in GMFCS I had a stronger hip flexion, abduction, adduction and knee flexion than adults in GMFCS III. In general, the variability in the force measurements was higher in the adults with CP than in TD. In addition, hip abduction and ankle dorsiflexion showed more variability in GMFCS III compared to GMFCS I & II. The variability and norm values established in this study will allow clinicians and researchers to better interpret force in adults with CP on a daily basis.
[1] Wiley ME, Damiano DL (1998) Dev Med Child Neurol 40(2):100-107
[2] Langerak NG et al. (2009) Childs Ner Syst 25:1593-1603
[3] Eken MM et al. (2014) Arch Phys Med Rehabil 95(10):1888-1894

Oral presentations

OP-PM40 Respiratory function

THE EFFECT OF 1600 µG SALBUTAMOL ADMINISTRATION ON 30M SPRINT PERFORMANCE IN FOOTBALL PLAYERS.

MERLINI, M.

UNIVERSITY OF KENT

INTRODUCTION: Football players with asthma related conditions are permitted to use inhaled salbutamol in accordance with current World Anti-Doping Agency (WADA) regulations1. Although a therapeutic dose of inhaled salbutamol ranges from 200-400 µg, football players are permitted to inhale up to 800 µg in any 12 hours period and 1600 µg in a 24 hours period. Limited data is available to explain whether football players may gain an ergogenic advantage from doses of inhaled salbutamol up to 1600 µg.
METHODS: In a randomised cross over single blind study 13 male non-asthmatic, football players were recruited (mean ± SD; age 18.1 ± 0.9 years; weight 69.5 ± 8.3 kg; height 178 ± 6.5 cm). Participants completed two visits and were assigned to either (SAL) or (PLA) treatment and performed a set of 3 sprints of 30 meters before and after the Yo-Yo IRT Lev 1test. Best sprint, mean sprint and fatigue index were analysed in addition to the distance covered during the Yo-Yo test; rate of perception of effort and heart rate were collected at the end of each level completed. Mixed Model Repeated Measures ANOVA was performed to investigate the changes in performance between groups.
RESULTS: Following the inhalation of 1600 µg salbutamol neither 30m sprint time (p=0.152; PLA 4,46 ± 0,12 s; SAL 4,45 ± 0,15 s) nor distance covered in the Yo-Yo test reported significant variation between conditions (p = 0.159; PLA 1660 ± 217 m; SAL 1610 ± 229 m). Blood lactate following the pre yo-yo test sprints was not different between SAL and PLA (p=0.455 SAL 6.47 + 1.5 mM vs. PLA 7.0 + 1.2 mM). The post Yo-Yo test sprint lactate values were not different between SAL and PLA conditions (SAL = 9.3 + 2.4 mM vs. PLA 10.0 + 2.1 mM; p=0.881). Moreover, heart rate and RPE did not show difference between groups.
CONCLUSION: The inhalation of 1600 µg salbutamol does not improve 30m sprint in football players either in non-fatigued or fatigued conditions. Our findings suggests the acute inhalation of salbutamol by athletes, in accordance with regulations outline in World Anti-Doping Agencies List of Banned Substances and Methods guidelines, will not lead to improvements in sprint and endurance performance in football players.

A NEW CALCULATION ALGORITHM REDUCES THE NOISE OF ALVEOLAR BREATH BY BREATH OXYGEN UPTAKE DATA

FRANCESCATO, M.P., CETTOLO, V.

UNIVERSITY OF UDINE

INTRODUCTION: Assessment of breath-by-breath (BbB) gas exchange during changes in workload is believed to provide insight into the dynamic responses of aerobic metabolism of exercising muscles. This is true, however, when gas exchange can be referred to the alveolar level, i.e. accounting for the changes in the lung gas stores. The obtained results might be improved by reducing the noise in BbB gas exchange data.
We recently proposed a new implementation of our breath-by-breath alveolar gas exchange algorithm (Cettolo & Francescato, Eur J Appl Physiol, 115:1897–1904, 2015) that was shown to provide reliable gas exchange data, although it neglects the contiguity in time of adjacent breaths. This work aims at illustrating the new algorithm and results obtained during exercise; a comparison with the corresponding values obtained with the most cited breath-by-breath alveolar gas exchange algorithm (i.e. the algorithm implemented by Beaver at al., J Appl Physiol, 51: 1662-1675, 1981), used as reference, was also performed.
METHODS: Respiratory flow, O2 and CO2 fractions at the mouth were continuatively recorded (CPET Metalyzer 3B, Cortex, Germany) in 20 healthy subjects (10 M; 10 F; 40±13 years old; 71±13 kg body mass) over 4 consecutive steps: 5 min at rest, 5 min unloaded pedaling, 6 min moderate intensity pedaling, and 10 min recovery. BbB gas exchange values were calculated from the gas and flow traces with both investigated algorithms, using computerised procedures developed in C language. Functional residual capacity, required to run the reference algorithm, was estimated from anthropometrical data (Roberts et al., Thorax, 46: 643-650, 1991). For every subject, an average value (over 3 min each), together with the corresponding standard deviation, was calculated at steady state of each step, thus obtaining 4 averages for each volunteer. Multivariate analysis of variance for repeated measures (MANOVA) was used to detect statistically significant differences. The slope of the linear regression between paired data was assumed to describe the average relative difference.
RESULTS: Average oxygen uptakes obtained with the two algorithms for the 4 steady state conditions were not statistically different (Algorithm effect, p=NS), the mean difference (i.e. the bias) amounting to –0.1 mL/min (95% limits of agreement: –31.6 mL/min to +31.4 mL/min). In all the conditions, significantly lower standard deviations were observed for the new algorithm as compared to the reference one (Algorithm effect, p<0.001). A significant correlation was observed between the standard deviations calculated with the two algorithms (r=0.727, p<0.001), the slope of the regression line amounting to 0.206.
CONCLUSION: Results showed that the new algorithm provided consistent average oxygen uptake values in steady state conditions, while significantly reducing the overall noise.

EXERCISE VENTILATORY LIMITATION IN CYSTIC FIBROSIS PATIENTS WITH NORMAL BREATHING RESERVE

REUVENY, R.1, VILOZNI, D.2, DAGAN, A.2, ASHKENAZI, M.2, VELNER, V.1, SEGE, M.J.1

1) THE PULMONARY INSTITUTE 2) THE PAEDIATRIC PULMONARY UNIT, THE EDMOND AND LILY SAFRA CHILDREN'S HOSPITAL, SHEBA MEDICAL CENTER

INTRODUCTION: Exercise ventilatory limitation (EVL) is conventionally defined by a reduced breathing reserve (BR). We hypothesized that EVL may be present despite a normal BR in cystic fibrosis (CF).
METHODS: Fifteen adult (f=8, age 34y, 18-43y)) CF patients with a wide range of pulmonary obstruction were studied. During a symptom-limited incremental exercise test on a cycle ergometer, we measured respiratory rate, tidal volume and changes in end expiratory lung volume (EELV). We also performed exercise flow-volume loop analysis. Results are reported as median (range).
RESULTS: Six patients had a severe airway obstruction (FEV1<50% predicted) and conventional evidence of EVL - BR < 11 L/min and VE/MVV > 0.92. The remaining 9 patients had mild to moderate obstructive defects on spirometry (median FEV1 61% predicted, range 50-86%), and a normal BR (21 L/min, 12-44 L/min) and normal VE/MVV (0.72, 0.65-0.81). We evaluated dynamic respiratory mechanics during exercise in these patients. In spite of a normal BR, the patients had a clear evidence of ventilatory limitation during exercise. An

abnormal breathing pattern was observed, including a high respiratory rate (54 min-1, 33-58 min-1), low tidal volume (1600 ml, 1000-2000 ml) and EILV/TLC (0.92, 0.8-0.96) at peak exercise, indicating mechanical constraint on the respiratory system. Inspiratory capacity was decreased by 250 ml (860-40 ml) during exercise, indicating dynamic hyperinflation. The exercise tidal flow met or exceeded the expiratory boundary of the maximal flow volume loop over 78% (41-90%) of the expiratory volume, indicating expiratory flow limitation.
CONCLUSION: We detected EVL in all fifteen CF patients with a wide range of severity of lung disease. BR was reduced in the six patients with the lowest FEV1 values. In the remaining 9 patients with mild to moderate disease , only assessment of dynamic respiratory mechanics during exercise revealed the ventilatory limitation.

EFFECT OF A RESPIRATORY TRAINING IN THE THORACOABDOMINAL MOTION PATTERN OF DANCERS

SILVATTI, A.1, RODRIGUES, I.1,2, LOPES, A.1, BERNARDINA, G.1, MASSARONI, C.3, CHIAPETA, A.2, PEREIRA, E.1, BARONI, G.4, CERVERI, P.4

1: UFV , 2: FACISA , 3: UCBM , 4: POLIMI

INTRODUCTION: The respiratory training (RT) has revealed positive results in athletes (Romer, McConnell and Jones, 2002), besides the years of experience could optimize the breathing pattern, as already showed in athletes (Silvatti et al., 2012). Considering the physical demands of dance practice, we aimed at evaluating whether the years of experience combined with a RT program would affect the dancers thoracoabdominal motion pattern at rest.
METHODS: Eight dancers (20.3±4 years, 1.6cm±0.1 height, 56kg±6.4 weight) with 11±4.5 years of experience and 16±4.9 hours of dance practice per week, were enrolled in performing a RT (nine weeks of daily strength breathing exercises with Respiron® and two times per week of breathing control exercises and manual release of diaphragm). To analyze the thoracoabdominal motions, they executed two breathing maneuvers at stand-up position: quite breathing (QB) lasting one minute and vital capacity (VC) with five breathing cycles. One set of maneuvers was acquired pre (PeT) and post RT (PoT). For the 3D kinematic analysis, 18 OptiTrack Prime 17W cameras (240Hz) were positioned around the dancers, capturing 32 retro-reflective markers fitted on dancer's trunk in a configuration that allowed a compartmental evaluation of breathing kinematics (superior thorax, ST; inferior thorax, IT and abdomen, AB; Ferrigno et al., 1994). The corresponding respiratory volumes were calculated for each compartment as a function of time, resulting in breathing cycles of QB and VC. The percentage of contribution (C%) was calculated to verify the most active compartment. For each compartment, the mean C% of each dancer was used to perform a linear regression ($p < 0.05$) to determine the association between years of experience and C% for QB and VC in PeT and PoT.
RESULTS: The PeT and PoT results in QB did not reveal any significant effect of the years of experience on C% in ST, IT and AB ($p > 0.05$). In VC PeT tests, the years of experience of the dancers caused a significant decrease of the C% in ST ($p = 0.0065$), with a corresponding increase in AB ($p = 0.0022$), but no effects were found in IT ($p=0.5918$). No significant influence of the years of experience were found on C% in any evaluated compartment in PoT VC tests ($p > 0.05$).
CONCLUSION: The results corroborate with Silvatti et al. (2012) that showed the effect of years of experience in swimmers. Moreover, our study suggests that the acute effect of RT could attenuate the effect of years of experience on breathing motion pattern. Further studies are needed to understand the specific effect of dancing training on the thoracoabdominal respiratory motion patterns.
REFERENCES:
Romer, L, McConnell, A and Jones, D. (2002). Med Sci Sports Exerc, 34(5), 785-792.
Silvatti, AP, Sarro, KJ, Cerveri, P, Baroni, G, Barros, RML. (2012). J Sports Sci, 30(14), 1551-1560.
Ferrigno G, Cavernali P, Aliverti A, Molteni, F, Beulcke G, Pedotti A. (1994). J Appl Physiol, 77(3), 1224-31.
ACKNOWLEDGMENT: FAPEMIG,CAPES,CNPQ
CONTACT: amanda.silvatti@gmail.com

Oral presentations

OP-PM65 Children and adolescents

DAY-SEGMENTED PHYSICAL ACTIVITY IN 4 - 7 YEAR OLD CHILDREN: THE GECKO DRENTHE COHORT

WIERSMA, R., LU, C., HARTMAN, E., CORPELEIJN, E.

UNIVERSITY MEDICAL CENTER GRONINGEN, UNIVERSITY OF GRONINGEN

INTRODUCTION: Nowadays, many children do not reach the physical activity (PA) guidelines. More insight is needed in PA patterns across the day to find which moment of the day children can be encouraged to be more physically active. Therefore, the aim of this study is to examine the PA and sedentary behaviour (SB) patterns of 4-7 year old children across the day, and compare these patterns between active and less-active, and overweight and non-overweight children.
METHODS: In children participating in the GECKO Drenthe cohort, daily PA was measured using accelerometers (ActiGraph GT3X) (n=958, age=5.7±0.8 years, 52.2% boys). The PA outcomes were: SB, light- (LPA), and moderate-to-vigorous PA (MVPA). Active and less-active children were classified as the highest and lowest tertile of MVPA, respectively. Overweight was classified according to Cole (2012)1. Five day-segments were used: early-morning, morning, afternoon, late-afternoon and evening. General linear mixed models with adjustments for age, sex and season were performed.
RESULTS: Children were on average most active in the late-afternoon and also the differences in activity levels between children were largest in that time segment. During weekdays, children were less sedentary in the early-morning (-5.9 min, $p<0.001$), and showed more LPA (9.1 min, $p<0.001$) and less MVPA (-5.2 min, $p<0.001$); in the late-afternoon they showed more SB (4.0 min, $p<0.001$) and less LPA (-2.0 min, $p=0.018$), and in the evening less MVPA (-6.4 min, $p=0.029$) compared to weekend days. Active children were more active and less sedentary on all time segments ($p<0.001$), on weekdays as well as on weekend days ($p<0.05$) (differences ranging from 6.4 to 44.9 min per segment), compared to less active children. No significant differences in overall SB and MVPA between overweight and non-overweight children were found, whereas overall LPA was marginally higher (6.33 min/day) in overweight children.
CONCLUSION: With regard to the development of overweight at preschool age, the differences in PA between overweight and non-overweight young children were minimal. The late-afternoon provides the best opportunity to increase MVPA levels in children, inspired by the large inter-individual variation in this segment.
REFERENCES:

1. Cole TJ, Lobstein T. Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. Pediatr Obes. 2012;7(4):284-294.
CONTACT:
r.wiersma@umcg.nl

TRACKING OF PHYSICAL FITNESS OF PRIMARY SCHOOL CHILDREN IN TRIER: A 4-YEAR LONGITUDINAL STUDY

ROTH, A., SCHMIDT, S., SEIDEL, I., WOLL, A., BÖS, K.

KARLSRUHE INSTITUTE OF TECHNOLOGY

Tracking of Physical Fitness of Primary School Children in Trier: A 4-Year Longitudinal Study
Roth, A.1, Schmidt, SCE.2, Seidel, I.1, Woll, A.2, Bös, K.2
1: KIT/FoSS (Karlsruhe, Germany), 2: KIT/IfSS (Karlsruhe, Germany)
Introduction: Due to individual differences in motor development, future motor performance is hard to predict. Measuring a sample at different points in time is called tracking, and provides a coefficient for the longitudinal stability of a certain variable (Malina et al., 1996). The aim of this study is to measure the motor development and tracking of physical fitness components of primary school children of Trier (Trier; population approximately 115,000) in Germany.
Methods: Two cohorts, of 1768 children (915f, 853m), aged 5–11 took part 4266 times over the course of the study. Participants of longitudinal cohort 1 (116f 137m; 6.80±0.42 years at baseline) were measured four times from grade 1–4 (2009-2012). Participants of longitudinal cohort 2 (166f, 149m; 6.70±0.36 years at baseline) were examined three times from grade 1–3 (2010-2012) with the German Motor Test 6-18 (DMT 6-18) (Bös et al., 2015).
Results: Physical fitness increased significantly over time in all test tasks except stand and reach. Gender specific differences were found in 20m sprint, 6-minute run, balancing backwards, jumping sideways, and stand and reach. For strength-based tasks, sit-ups and push-ups, results were inconsistent.
74.4% of physical fitness stability coefficients were moderate (r= 0.30 to 0.60). Stability of physical fitness declined with increased time frames. Tracking was lower in girls than in boys. This fact has also been found in other studies (Falk et al., 2001). Flexibility showed the highest stability among physical fitness variables (r>0.50). BMI showed the overall highest stability coefficient with r>0.7.
Conclusion
Gender-specific differences of physical fitness were obvious, but cannot always be secured statistically in primary school. Tracking was only moderate. Variability in the timing and speed of the adolescent growth spurt and sexual maturation influence stability of physical fitness. Results from longitudinal cohort 2 largely confirm those from longitudinal cohort 1.
References: Bös K, Schlenker L, Büsch D, Lämmle L, Müller H, Oberger J, Seidel I, Tittlbach S, Woll A. (2016). German Motor Test 6-18. Feldhaus, Hamburg.
Falk B, Cohen Y, Lustig G, Lander M, Yaaron M, Ayalon J. (2001). Tracking of physical fitness components in boys and girls from the second to sixth grades, Amer Journal of Human Bio, 13(1), 65–70.
Malina RM. (1996). Tracking of physical activity and physical fitness across the lifespan, Res Quart for Exer and Sports, 67(3), 48–57.
Contact: andreas.roth@kit.edu

THE BEST WAYS FOR RAISING AWARENESS OF PHYSICAL ACTIVITIES TO IRISH ADOLESCENTS

NG, K., MCHALE, F., O'SHEA, D., BARRETT, G., CLIFFORD, J., MURPHY, P., WOODS, C.

UNIVERSITY OF LIMERICK

INTRODUCTION: Many school-aged adolescents are unaware of the opportunities to take part in physical activities (PA). A lack of information has commonly been cited as a major reason for inactivity. The school has the largest potential for getting information out to adolescents. However, school budgets may be restricted and this can limit ways to get messages across to the pupils. Therefore, in this study, we investigated how school-aged adolescents perceived existing methods for raising awareness of PA and to find out how they feel messages could be improved.
METHODS: Irish school-aged adolescents (13-16y old), took part in focus groups during their school day. Depending on their availability, one or two groups consisting of two to six pupils were interviewed for up to 40 minutes. A focus group interview guide was used across the sessions, parental consent and pupil assent to take part in audio-recorded sessions was obtained. Adolescents were asked to rate the effectiveness of 1) social media, 2) newsletters, 3) posters, and 4) school intercom messages. They were then asked to discuss their reasons and provide some insight into how they can be more effective. The audio was transcribed and the text was analysed through content analysis.
RESULTS: Nine focus groups took place with 41 adolescents (8 boys, 33 girls). Seven out of nine focus groups placed social media as the most effective way of communicating PA. It was reported, that teenagers are on it all the time and effective messages have visual and text information. However, for some inactive adolescents, they felt there was too much social media around and such messages would be swiped away. The usefulness of newsletters was indecisive, and this may depend on the school culture. Some pupils felt it must be read and thought it was the most effective, whereas others felt the newsletters would never get read and opined it was the least effective. The majority of groups felt posters and intercom messages were the least effective.
CONCLUSION: Messages through social media were perceived to be effective ways of communicating with school-aged adolescents about PA. These results align with the current trends of digital natives and Kelly's ARCS theory of learning (1998). ARCS has four components that are considered as critical elements in student activities; Attention, Relevance, Confidence and Satisfaction. Social media to promote PA compliant with ARCS through multimedia, however targeted engagement may be difficult among adolescents who are generally not interested in PA.
Reference:
Keller J. (1998). Development and use of the ARCS model of instructional design. JID, 2, 2-10

LIPOPROTEIN SUBCLASSES AND THEIR ASSOCIATIONS WITH PHYSICAL ACTIVITY, CARDIORESPIRATORY FITNESS AND ADIPOSITY IN NORWEGIAN SCHOOLCHILDREN: THE ACTIVE SMARTER KIDS STUDY

JONES, P.R.1, KVALHEIM, O.M.2,3, RESALAND, G.K.4, ANDERSSEN, S.A.1, EKELUND, U.1

1: NIH , 2: UIB , 3: HVL , 4: HVL .

INTRODUCTION: Physical activity (PA), cardiorespiratory fitness (CRF) and adiposity are associated with certain lipoproteins. Research in adults has shown that these associations are not consistent across lipoprotein subclasses. We examined cross-sectional associations in children between objectively measured PA and sedentary time (SED), CRF and adiposity with a number of biomarkers of lipoprotein metabolism.
METHODS: We included 1055 healthy fifth-grade (mean age 10.2 yrs) Norwegian schoolchildren (47.4% females). Total PA (tPA), PA intensity (light (LPA); moderate-vigorous (MVPA)), and SED were assessed using triaxial accelerometery. We used the 20-m shuttle run test to assess CRF, and waist circumference to measure abdominal adiposity. We quantified 31 measurements of lipoprotein metabolism including subclass concentrations, and particle size of three major classes (VLDL, LDL, HDL) using nuclear magnetic resonance spectroscopy. We used linear regression (median regression for skewed data) models adjusted for age, sex, sexual maturity and socioeconomic status (standard model). Additional tPA, PA intensity and CRF models were adjusted for adiposity, and additional adiposity models were adjusted for moderate-vigorous PA (MVPA) and CRF separately. An isotemporal substitution regression model quantified associations of replacing 30-minutes LPA or SED with 30-minutes MVPA. We applied a false discovery rate (FDR) adjustment to p-values of each regression model.
RESULTS: Adiposity was significantly associated with all 31 biomarkers in the tPA and MVPA-adjusted models, and 29 biomarkers following adjustment for CRF. CRF was associated with each of the 31 biomarker measures in the standard model and 22 in the adiposity-adjusted model. Total PA, MVPA, LPA and SED were associated with 10, 18, 0 and 5 of the 31 biomarkers, respectively (standard model). The number of significant associations were attenuated after adjusting for adiposity (10, 12, 0, and 0), respectively. Substituting 30-minutes of SED and LPA for MVPA revealed significant associations with 22 and 21 biomarkers, respectively. Following adjustment for adiposity, 10 and 12 associations, respectively remained statistically significant (<0.05).
CONCLUSION: CRF is associated with a number of markers of lipoprotein metabolism independent of adiposity. PA, especially of higher intensity, is associated with some of these biomarkers independent of adiposity. Substituting time spent sedentary or in LPA for MVPA shows favourable associations with these biomarkers. This suggests that improving cardiorespiratory fitness and increasing physical activity of at least moderate intensity may favourably affect lipoprotein metabolism in healthy children. Future work should replicate these findings in other cohorts and determine the clinical significance of differences in these biomarkers.

INFANT CRAWLING AS A POTENTIAL MODULATOR OF THE ASSOCIATION BETWEEN SLEEP FRAGMENTATION AND OBESITY PARAMETERS AT 8 YEARS OF AGE

FONT-LLADÓ, R., CADELLANS-ARRONIZ, A., CAZORLA-GONZÁLEZ, J., PRATS-PUIG, A.

EUSES UNIVERSITY OF GIRONA

INTRODUCTION: Crawling onset is linked to sleep disruption during infancy. At childhood, shorter sleep duration and sleep fragmentation predisposes to obesity. Furthermore, the effect of crawling during infancy in sleep fragmentation and obesity at childhood is unknown. Our aim was to ascertain whether the association between sleep fragmentation index and obesity parameters at 8 year of age can be modulated by crawling during infancy.
METHODS: Sleep duration and fragmentation index were assessed with on average six nights of actigraphy in 59 healthy children (26 boys, 33 girls; age, 7.56 ± 0.35 yr; BMI z-score, -0.32 ± 0.83) included in the PEHC (Physical Education, Health and Children) project. We measured body mass index (BMI) z-score and waist circumference as obesity parameters. Associations between sleep duration and fragmentation index with obesity parameters were tested for crawling.
RESULTS: No differences were seen in Actigraphic sleep duration at childhood according to crawling during infancy. Crawling infants exhibited higher sleep fragmentation index (p=0.032) at childhood. At 8 years of age, children with higher sleep fragmentation index present lower BMI z-score (r= -0.405; p=0.001) and waist circumference (r= -0.364; p=0.003). The association between sleep fragmentation index and obesity parameters at 8 years of age was significant only in children who crawled during infancy [(BMI z-score (r= -0.397; p=0.009); waist circumference (r=-0.383; p=0.012)]. These associations remained significant after adjusting for confounding variables such as age and gender in linear regression models.
CONCLUSION: We report new evidence for infant crawling as a potential modulator of the association between sleep fragmentation index and obesity parameters at childhood.

THE RELATION BETWEEN METABOLIC RISK FACTORS AND HEALTH RELATED QUALITY OF LIFE IN ADOLESCENTS

MOREIRA, C.1, EVARISTO, O.1, AGOSTINIS-SOBRINHO, C.1, LOPES, L.1, SANTOS, P.C.1,2, OLIVEIRA-SANTOS, J.1, OLIVEIRA, A.1, ABREU, S.1, SANTOS, R.1, MOTA, J.1

FACULTY OF SPORT, UNIVERSITY OF PORTO

INTRODUCTION: The metabolic syndrome, a cluster of several cardiovascular disease risk factors, is a complex entity of metabolic disorders that significantly increases the risk of cardiovascular disease. Moreover, cardiovascular disease has been associated with decreased health-related quality of life (HRQoL). Therefore, the aim of this study was to examine the relation between metabolic risk factors and HRQoL in adolescents.
METHODS: A cross-sectional, school-based study was conducted on 521 Portuguese adolescents (262 girls) aged 12-18 years. Anthropometry (weight and height), plasma biomarkers (total cholesterol, HDL-cholesterol, triglycerides), systolic blood pressure, cardiorespiratory fitness, socioeconomic status and adherence to Mediterranean diet were obtained from each participant. HRQoL was measured with the Kidscreen-10 questionnaire. The 20- m shuttle run test was used for the estimation of cardiorespiratory fitness. Adherence to the Mediterranean diet was assessed with the KIDMED index. Adolescents' socioeconomic status was assessed with the Family Affluence Scale.
A metabolic risk score (MRS) was constructed by summing the Z scores by age and sex, of the following individual risk factors: total cholesterol/HDL-cholesterol ratio, triglycerides, glucose, systolic blood pressure, body mass index and cardiorespiratory fitness (multiplied -1). High risk was considered when the individual had ≥1SD of this score.

RESULTS: High MRS was observed in 12.7% of the sample. The mean value of the Kidscreen-10 was 39.3 (with 50 being the highest score). Multivariable linear regression model showed that high MRS was negatively associated with HRQoL (B = -0.171, p = 0.016), after adjusting for age, sex, socioeconomic status and adherence to Mediterranean diet.
CONCLUSION: To the best of our knowledge this is one of the first studies to examine the relation between metabolic risk factors and HRQoL among adolescents. As previously reported in adults (Ford et al., 2008) we found that, MRF is significantly associated with decreased HQRoL scores after adjusting for potential confounders.
Adolescents with high MRS showed lower HRQoL scores. Therefore, it is important to develop preventive strategies concerning cardiovascular and mental health in adolescents.
Reference
Ford ES, Li C. Metabolic syndrome and health-related quality of life among U.S. adults. Ann Epidemiol. 2008; 18(3):165-71.

Oral presentations

OP-PM64 Pacing 2

THE INFLUENCE OF PACING ON RACE PERFORMANCE DURING THE 'BIRKEBEINERRITTET' CROSS-COUNTRY MOUNTAIN BIKE EVENT

MOSS, S., FRANCIS, B., CALOGIURI, G., HIGHTON, J.
UNIVERSITY OF CHESTER

INTRODUCTION: Pacing strategy is widely considered as a key determinant to performance in endurance cycling events, although the optimal pacing strategy for cross-country marathon mountain biking events is poorly understood. The aim of this study was to investigate the distribution of pace according to race finish time in an 86 km mass-participation race.
METHODS: Data was recorded from 8,182 participants (male 7,178; female 1,005; elite 169; non-elite 8,013) competing in the 2016 'Birkebeinerrittet' race. Each participant's start, finish and intermediate split times (5 sections) were recorded via a transponder timing system. Individual section split times, average speed and variability in speed across each race section were calculated. Participants were grouped into quartiles according to race speed (first fastest [n = 2,103], second [n = 1,993], third [n = 2,066], fourth [n = 2,020]) for analysis.
RESULTS: Differences in average speed were apparent between quartiles (1st = 25.74 ± 2.3 km/h, 2nd = 23.09 ± 1.9 km/h, 3rd = 21.23 ± 1.7 km/h, 4th = 17.38 ± 2.0 km/h, d = 0.9 – 1.06) with better placed participants exhibiting faster average speeds across all race sections. Faster participants also exhibited higher relative speeds in sections 1 ($P < 0.0001$, d = 0.31 – 0.37), 3 ($P < 0.0001$, d = 0.0.24 – 0.29) and 4 ($P < 0.0001$, d = 0.47 – 0.69), all of which were characterised by an uphill profile. Conversely, the slower groups had a faster relative speed in the final race section ($P < 0.0001$, d = 0.60 – 0.69), which was characterised by non-technical descending. The CV [%] in race speed across each section was lowest in the fastest group (24.02 ± 2.8%), and sequentially increased for each slower group (2nd = 26.83 ± 3.2%, 3rd = 28.44 ± 4.1%, 4th = 32.03 ± 5.8%).
CONCLUSION: To enable fast race completion, this study favours execution of greater relative speeds during uphill sections and lower relative speeds during non-technical downhill sections, resulting in lower variability in race pace. This study is the first to reveal that greater time-savings can be made via more effective distribution of pace, representative of a 'variable' pacing strategy, in a cross-country marathon mountain-biking event. These results could be used to inform training recommendations and pacing strategy for participants motivated by a fast performance time.

THE EFFECT OF ANTICIPATED TASK DIFFICULTY ON PACING AND EFFORT PERCEPTION DURING SELF-PACED 3000M RUNNING TIME TRIALS

BRICK, N.E., TURKINGTON, R., FITZPATRICK, B.L.
ULSTER UNIVERSITY

INTRODUCTION: Existing models of self-paced endurance performance suggest that knowledge of event distance, previous experience of events of varying duration, and perception of effort are important factors influencing pace-related decision-making. No studies to date have investigated the effects of anticipated task difficulty on pace regulation during equivalent distance endurance tasks, however. The present study aimed to address this gap.
METHODS: Twenty-two trained endurance runners (VO2max 52.4 ± 7.5 ml.kg-1.min-1) completed three 3000m self-paced time trials on a motorised treadmill. On separate days, subjects first completed a baseline trial (BL) on a 0% gradient, followed by two trials during which the gradient was elevated from 0% to 7% for the final 800m. One was a Known Incline trial (KI) before which subjects were informed that the incline would increase to 7% for the final 800m. The second was an Unknown Incline trial (UI) before which subjects were informed that the gradient would remain at 0% throughout. The order of KI and UI was randomised (Order 1: BL, then KI, then UI; Order 2: BL, then UI, then KI). The data presented will focus on speed, standardised relative to BL, for the first 2200m and the final 800m and on effort perception (RPE 6-20 scale) averaged over the same segments for each trial. Statistical significance was accepted as $p < .05$ and Cohen's d values are provided as an estimate of effect size.
RESULTS: Trial X Order interaction effects for standardised speed revealed that subjects in Order 1 completed the first 2200m 2.47% slower during KI than BL, but 0.72% faster during UI than BL. In contrast, subjects in Order 2 completed the first 2200m 2.28% faster during KI than BL and 3.34% faster during UI than BL. Trial X Order interaction effects for perceived effort revealed that only subjects in Order 1 reported lower effort perceptions during the first 2200m of KI than BL. In contrast, only subjects in Order 2 reported higher effort perceptions during the final 800m of both KI and UI than BL. Main effects for trial were also noted. Speed over the first 2200m was slower during KI than UI (d = -0.43) and was also slower over the final 800m during both KI and UI than BL (all d > 4.00). Perceived effort was lower over the first 2200m during KI than BL (d = -0.39) but was higher in the final 800m during UI than BL (d = 0.54).
CONCLUSION: Anticipated task difficulty impacted pace regulation such that subjects (Order 1) ran slower and reported lower effort perceptions when they had accurate prior knowledge of a difficult running task, but had no prior task experience. In contrast, prior task experience (Order 2) appeared to moderate this relationship and facilitated running performance. This study adds to knowledge of factors that may impact pace-related decision-making. The findings suggest that anticipated task difficulty, in conjunction with task experience, may be an important, but currently unrecognised factor influencing pace regulation during endurance performance.

ROLE OF COMPETITORS AND MOTIVATIONAL ORIENTATION ON 5 KM TIME TRIAL PERFORMANCE AND PACING STRATEGY

POLMAN, R.C.J., HIBBERT, A.W., BILLAUT, F., VARLEY, M.C.

QUEENSLAND UNIVERSITY OF TECHNOLOGY

INTRODUCTION: Surprisingly few studies have been conducted investigating the presence of other competitors or the potential moderating role of motivational orientation on pacing behaviour in athletes. Therefore the present study investigated how pacing and performance are influenced when exercising in the presence of one competitor or multiple competitors. In addition, it investigated the influence of goal orientation on the magnitude of performance change by manipulating the ability of competitors in a group setting.
METHODS: In a randomized order, 24 participants performed a 5-km cycling TT individually (IND), with one similarly matched participant (1v1), and in a group of four participants (GRP). For the GRP session, two pairs of matched participants from the 1v1 session were used. Pairs were selected so that TT duration was considered either inferior (INF) or superior (SUP) compared to the other pair of participants.
RESULTS: Overall, TT duration (P = 0.86, ?p2 < 0.01) was not different between conditions, whilst heart rate (HR) was significantly greater in GRP compared to IND (P < 0.01, ?p2 = 0.16). For INF, a large effect size for both mean power (P = 0.07, ?p2 = 0.15) and HR (P = 0.05, ?p2 = 0.16), indicates greatest effort in GRP. Pacing behaviour was affected by competition but similar in 1v1 and GRP for SUP, whilst large effect sizes indicate an increased power output in the initial 750-m for INF in GRP. Additionally, for INF, there was a significant correlation with ego orientation for an increase in TT duration between the GRP session and both the IND and 1v1 (r = 0.54, P = 0.01) sessions.
CONCLUSION: The presence of a competitor is known to influence pacing and performance. However, this study found no significant difference in 5-km TT performance between 1v1 or GRP competition settings. Yet, large effects on power indicate that INF participants are motivated to match SUP competitors in the initial stages of GRP exercise that may lead to small improvements in overall performance. Yet in a GRP setting, SUP participants may be detrimental to INF participants who are ego orientated, whilst INF participants provide no benefit to the performance of SUP participants. Overall, these findings demonstrate that competition is an important determinant of pacing and performance, and consideration should be given to the ability of competitors in a group setting to provide adequate motivation to achieve performance improvements.

GETTING THE PACE RIGHT: TESTING PACING STRATEGIES IN NOVICE CYCLISTS

ROBINSON, D.T., CLOAK LAHART, I., LANE, A.M.

UNIVERSITY OF WOLVERHAMPTON

Judging and maintaining an intense pace is important for endurance performance. The popular press and scientific literature give athletes differing advice. An athlete can concentrate on numerous factors during performance like monitoring ongoing pace, which relies on the availability of performance feedback. Alternatively, an athlete could concentrate on internal sensations of effort and perceptions of pace. The aim of the present study was to compare the effects of riding with full feedback versus 'riding on feel' (no feedback), and using either a narrow-internal focus of attention or a broad-external focus of concentration during an ergometer pacing task.
A within-subject design was used. Participants (N = 9; Age, M = 24.3, SD = 4.5 y) were healthy fit individuals but inexperienced cyclists, hence without a history of previous rides on which to monitor performance. First, participants completed three 3-min maximal cycle bouts on an ergometer (WattBike,UK). Participants were then asked to ride at 80% of the average power output (W) achieved over the three maximal bouts under four conditions: A) no feedback; B) narrow-internal focus of attention designed to help the rider concentrate on the skills needed to ride efficiently; C) a broad-external focus designed to help the rider disassociate from the ride; and D) full feedback where the rider had access to ongoing watts and time. Participants completed the blind feedback condition first and full feedback last, whereas the order of narrow-internal and broad-external focus was randomised. All rides were performed on the same day, with five minutes between each ride. A magnitude-based inference approach was used to analyse data, and a Cohen unit of 0.2 was employed as the smallest meaningful change in outcome. All analyses were adjusted for weight.
Participants averaged 220 W (SD = 40W) for the 3-min maximal test. In the no feedback condition, participants average power output was 82.7% of max (M = 182, SD = 52W), which although 2.7% greater than the full feedback condition, cannot be emphasized (95% CI -8.7 to 15.5%, d = 0.13). During the narrow-internal concentration focus participants rode at 75.9% of their max (M = 167, SD = 35W), which was 4.4% lower than when cycling with full feedback (95% CI -14.1 to 6.3, d = -0.23). However, participants maintained only 70.9% of their performance goal (M = 156, SD = 37W) during the broad-external concentration focus condition, which was meaningfully lower compared with full feedback (% MD = -11.3%, 95% CI -19.7 to -1.9, d = -0.60; 93% likely reduction). To show that differences were not due to fatigue, participants rode at 79% (M = 174, SD = 32W) in the final trial with full feedback (MD = 1.84 W, 95% CI -0.2, 3.8).
In conclusion, using an external focus of attention resulted in lower-intensity cycling performance, and full feedback along with ongoing availability of feedback facilitates accurates pacing.

THE INFLUENCE OF AGE, GENDER AND RACE EXPERIENCE ON PACING DURING THE 'BIRKEBEINERRITTET' CROSS-COUNTRY MARATHON MOUNTAIN BIKE EVENT

HIGHTON, J.1, FRANCIS, B.1, CALOGIURI, G.2, MOSS, S.1

1. UNIVERSITY OF CHESTER 2. INLAND NORWAY UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Pacing is an important determinant of performance in mountain biking competitions (Abbiss et al., 2013); however, little is known about the factors that influence a pacing strategy during cross-country marathon events. The aim of this study was to explore the influence of age, gender and race experience on pacing and performance during an 86 km mass-participation mountain bike race.
METHODS: Data was collected from a single Birkebeinerrittet event. Average speed, as well as speed in five race sections (15.1 [predominantly climbing], 31.4, 52.3, 74.4 and 100% [predominantly descending] of total race distance), was analysed for 8182 participants. Participants' relative speed (%) for each race section was also calculated to explore pacing distribution (section speed/average speed x 100). Data was grouped and analysed according to age (16-24 [n = 382], 25-34 [n = 1018], 35-44 [n = 2178], 45-54 [n = 2977], 55-64 [n = 1320], 65+ [n = 307]), gender (female [n = 1004], male [n = 7178]) and prior Birkebeinerrittet race experience (<2 [n = 1620], 2-3 [n = 1887], 4-9 [n = 2952], >9 [n = 1723]).
RESULTS: Males were faster than females (~3.2 km/h) in all race sections. Males' relative speed was also higher than females in the first 3 sections of the race (effect size (d) = 0.16 – 0.39), but was lower in the final race section.
Average speed was fastest in the 16-24 yr age group (~24.5 ± 4.7 km/h; d = 0.31 – 0.85), and slowest in the 65+ yrs group (~19.75 ± 2.8 km/h; d = 0.53 - 0.85). Relative to average speed, 16-25 yr olds were significantly slower in the final race section (d = 0.22 – 0.35), which

was offset by being significantly faster in the second race section (d = 0.27 – 0.66) and the penultimate race section compared to all groups (d = 0.23).
Participants who had previously completed between 4 and 9 races were quickest (~22.81 ± 3.3 km/h) to complete the course (d = 0.26 – 0.5), followed by those who had previously participated on 2-3 occasions (~21.9 ± 3.6 km/h; d = 0.2 – 0.26). Those that had completed 4-9 races exhibited a lower relative speed than all other groups in the final race section (d = 0.21 – 0.34), which was offset by having a higher relative speed across each race section compared to other groups.
CONCLUSION: Pacing and performance in cross-country marathon mountain biking is related to age, sex and race experience. Specifically, better performance was observed in younger age groups, males, and those that had previously performed 4-9 races. These groups typically adopted a greater relative speed in climbing race sections and lower relative speed during later descents.
References: Abbiss CR. Megan L. Garvican L. Ross N. Pottgiesser J. Martin D. (2013) J Sports Sci, 7, 787-794.

THE INFLUENCE OF PACING STRATEGY ON MARATHON WORLD RECORDS

SANTOS-CONCEJERO, J., FERNÁNDEZ, E.J., DÍAZ, J.J.

UNIVERSITY OF THE BASQUE COUNTRY UPV/EHU

INTRODUCTION: The limits of human performance in the marathon are still debated although several authors have proposed a potential limit that lays between 1:57:58 and 2:01:52 (Joyner et al, 1991; Denny, 2008). The pacing strategy adopted during the competition is one of the key factors in determining marathon performance as athletes can win or lose depending on their ability to spend energy adequately and prevent premature fatigue before the end of the event. The question arises whether the pacing strategies adopted by world record holders over the last decades and recent years has been ideal and whether there is still margin for improvement. Thus, the aim of this study was to analyse the influence of the pacing strategies used by marathon world record holders when setting every world record in the last 50 years.
METHODS: We divided former marathon record holders into two groups: classic runners (record holders between 1967 and 1988) and contemporaneous runners (record holders between 1988 and 2018). The total distance of the marathon was divided into eight sections of 5 km and one last section of 2.195 km, and the relative average speed of each section was calculated individually.
RESULTS: On average and analysing all world records together, athletes were slightly faster in the first half marathon than in the second one, where they slowed down progressively (ES=0.28, small effect). However, when comparing the first half marathon to the second one in classic vs. contemporaneous athletes, we observed that classic athletes decreased their speed in the second half (ES=1.06, moderate effect), whereas contemporaneous athletes were faster in the second half of the race (ES=1.16, moderate effect). When analysing the normalised relative speed (%) by section of the classic world records vs. contemporary records, we observed that both groups used different pacing strategies: the classic athletes started significantly faster than their contemporaneous counterparts (p=0.03, ES=1.16, moderate effect), although after 25 kilometres, the classic athletes' speed dropped dramatically, being meaningfully slower than in contemporaneous athletes (ES=2.41, very large effect).
CONCLUSION: This study shows that the pacing strategies of the best marathon runners in the world have changed over the last 50 years. Classic athletes used to start off relatively faster, and consequently, they used to slow down dramatically in the second half of the race. Although a negative pace distribution has been proposed as the most efficient option, a pacing strategy characterised by very little speed changes across the whole race may be the way to go in the future.

Oral presentations

OP-PM50 Ageing and age related disease

ENTROPY IN POSTURAL AND CARDIAC-AUTONOMIC CONTROL AS A MARKER OF ADAPTABILITY TO A MENTAL TASK IN YOUNG VS. MIDDLE-AGED HEALTHY MALES

BLONS, E.1, GILFRICHE, P.1,2, ARSAC, L.M.1, DESCHODT-ARSAC, V.1

UNIV. BORDEAUX

INTRODUCTION: A number of studies have shown that the time series generated by diverse free-running healthy physiologic dynamics demonstrate complex fluctuations that are not simply due to uncorrelated random errors. This is true for physiological systems whose main purpose seems to be reducing variability and maintaining a steady state, as for example, postural control and cardiac autonomic control (1). Complexity is closely linked to coordination between systems components so that a too a regular (metronomic) or a too an erratic (random) signal output, has been associated with abnormal control, pointing to a lack flexibility to adapt to everyday life demands. Complexity indices such as signal entropy are believed to be greater markers of neurophysiological control than temporal and frequency markers (2). Here we aimed at assessing signal complexity/regularity (entropy) in both postural and cardiac control when young and middle-aged healthy subjects are challenged by a mental task.
METHODS: Twelve young and eleven middle-aged healthy males participated to the present study. Heart inter-beat (RR) time series and center of pressure (CoP) oscillations were obtained in quite conditions (Control), and again when performing a prefrontal cortex activating task (Cognitive task). RR intervals were recorded (Polar belt) during 10min and CoP displacement (Winposturo platform) during 51.2s at 40Hz. Multiscale Entropy (MSE) was computed between scales 1-4 for RR series and 1-10 for CoP series. The entropy index EI was derived by calculating the area under the curve produced by the calculation of sample entropy at each time scale.
RESULTS: In control situations, the entropy index (EI) in heart and postural control showed no difference between young and middle-aged. In contrast, differences due to age appeared when confronted to a cognitive load both in postural and in heart control. In heart control, EI increased in young (Control: 5.4 ± 0.2 vs Cognitive task: 5.9 ± 0.1, $p<0.05$) but not in middle-aged during mental task (Control: 5.3 ± 0.2 vs Cognitive Task: 5.2 ± 0.3). In CoP signal, EI increased dramatically in young (Control: 5.2 ± 0.4 vs Cognitive task: 7.5 ± 0.4, $p<0.01$) but moderately in middle-aged (Control: 5.8 ± 0.6 vs Cognitive task: 7.5 ± 0.8, $p<0.05$).
CONCLUSION: In young people, prefrontal cortical arousals associated with a cognitive task increased entropy in cardiac and postural signal output, which is interpreted as an improved multiscale coordination in neurophysiological control. No such positive response was observed in middle-aged. This might rely on a disrupted interconnectivity between central and peripheral systems components when constrained by a cognitive task. The present results point to MSE as a sensitive, and thus promising tool, to evaluate early stages in impairments in neurophysiological control associated with ageing.

(1) P.M Wayne et al., Contemporary Clinical Trial 34, 2013.
(2) M. Costa, A.L. Goldberger and C.-K. Peng, Physical review E, 71, 2005.

EXERCISE STIMULATES A PREFERENTIAL INCREASE IN SENESCENT-ASSOCIATED CD28NULL ANGIOGENIC T-CELLS IN OLDER, BUT NOT YOUNGER MALES

ROSS, M.1, INGRAM, I.1, TAYLOR, G.2, MALONE, E.1, SIMPSON, R.3, WEST, D.2, FLORIDA-JAMES, G.1
EDINBURGH NAPIER UNIVERSITY

INTRODUCTION: Ageing is associated with elevated cardiovascular disease risk. As a result of ageing, endothelial dysfunction develops, due to, in part, reduction in vascular regenerative capacity. CD31+ T-cells (angiogenic T-cells) possess highly angiogenic capabilities, however, these cells are significantly reduced in older populations. In addition, older populations possess significantly higher senescent and highly differentiated T-cell levels in circulation, and these are reported to be highly exercise responsive. We investigated if older adults display greater levels of circulating senescent (CD28null) angiogenic T-cells, and if these cells were more exercise responsive than CD28+ TANG cells.
METHODS: Young (18-25yrs; n=9) and older (60-75yrs; n=10) healthy males undertook a 30 minute cycling bout at 70% V̇O2max, with circulating angiogenic T-cells (CD3+CD31+CD28+/null; including CD4+ and CD8+ subsets) measured pre, post and 1 hour post-exercise by flow cytometry.
RESULTS: Older adults display reduced basal levels of angiogenic T-cells, despite a greater proportion of these cells being CD28null (26.26 ± 5.08 vs. 13.36 ± 2.62%, p=0.044). Exercise significantly increased the circulating number of angiogenic T-cells cells in both young and older men, but the response was blunted in older men in comparison to younger counterparts. However, in older men alone, exercise preferentially mobilized CD28null CD8+ angiogenic T-cellss compared to CD28+ subset (Δ74 ± 29 vs. Δ27 ± 15 cells·μL, p = 0.059), with no such difference observed between these phenotypes in the young population.
CONCLUSION: In conclusion, despite observing lower circulating numbers of angiogenic T-cells, older adults display greater levels of senescent cells in comparison to younger individuals, and these cells are more exercise responsive than CD28+ angiogenic T-cells. Lower number of circulating angiogenic T-cells and greater levels of senescent-associated CD28null cells may contribute to greater CVD risk with advancing age.

SYSTEMIC OXIDATIVE STRESS IS DECREASED IN OLDER SUBJECTS WITH COPD AFTER A 12-WEEK EXERCISE PROGRAM COMBINING HIIT AND POWER TRAINING

ALCAZAR, J.1,2, LOSA-REYNA, J.2,3, RODRIGUEZ-LOPEZ, C.1,2, GARCÍA-GARCÍA, F.J.2,3, PEREZ-MARTINEZ, A.2, ESPINOSA-DE LOS MONTEROS, M.J.2, ALFARO-ACHA, A., ALEGRE, L.M., ARA, I., GUADALUPE-GRAU, A.
1:GENUD TOLEDO RESEARCH GROUP, UCLM . 2:BIOMEDICAL RESEARCH NETWORKING CENTER ON FRAILTY AND HEALTHY AGING, CIBERFES . 3:HOSPITAL VIRGEN DEL VALLE, CHT . 4

INTRODUCTION: Oxidative stress has a central role in the pathophysiology of chronic obstructive pulmonary disease (COPD) (1,2). The evidence regarding exercise training as a countermeasure of systemic oxidative stress in older COPD patients is inconclusive (3), while several models of exercise training remain to be investigated. Our main goal was to assess the effects of a concurrent exercise program on oxidative stress in older COPD patients.
METHODS: Eighteen older subjects (78±7 y) with COPD (BODE index=2±1) were randomly assigned to a physical exercise group (PE; N=9; 24 sessions combining high-intensity interval training (HIIT) on a cycle ergometer and power training on the leg press) or a control group (CON; N=9; usual care) during 12 weeks. Quadriceps muscle cross-sectional area (QCSA) (computed tomography), leg press maximal muscle power (Pmax) (linear position transducer), endurance capacity (6-min walking test, 6-MWT) and physical function (5-repetition sit-to-stand test, 5-STS) were evaluated. Oxidative stress was assessed by the identification of protein carbonylation in blood samples (Oxyblot kit, Millipore). Both groups were evaluated again one year after the baseline.
RESULTS: Protein carbonylation decreased significantly in the PE group (-25±27%) compared to the CON group (+73±123%) after the 12-week intervention period (time*group effect: p=0.034), and returned to baseline values in the PE group after 40 weeks of detraining, while no changes were observed in the CON group (time*group effect: p=0.080). Significant differences regarding changes in QCSA (+7% vs -2%), Pmax (+55% vs 0%), 6-MWT (+3% vs -7%) and 5-STS time (-23% vs +9%) were found between the PE and CON groups, respectively (all $p<0.05$). A significant association was found between changes in protein carbonylation and changes in Pmax ($r=-0.46$) and 5-STS time ($r=0.72$).
CONCLUSION: A 12-week exercise program combining HIIT and power training reduced oxidative stress and increased muscle size and power, endurance and physical function in older adults with COPD. Our findings showed that the inclusion of power training in pulmonary rehabilitation might achieve additional benefits for the older COPD patients in comparison with other exercise programs (3).
References:
1.Zinellu et al. Respir Res. 2016;17:150.
2.Barreiro et al. Thorax. 2009;64:13-9.
3.Rodriguez et al. Free Radic Biol Med. 2012;52:88-94.

MUSCLE FIBER SIZE, MYONUCLEAR CONTENT AND SATELLITE CELLS IN THE VERY OLD (83+ YEARS), AND THE EFFECT OF 12 WEEKS HEAVY RESISTANCE TRAINING.

KARLSEN, A., BECHSHOEFT, R.L., MALMGAARD-CLAUSEN, N.M., ANDERSEN, J.L., KJAER, M., MACKEY, A.L.
UNIVERSITY OF COPENHAGEN AND BISPEBJERG HOSPITAL, DENMARK

INTRODUCTION: Age related loss of muscle mass is a combination between loss of muscle fibers and atrophy of the type II muscle fibers. As muscle satellite cells can donate new myonuclei to the muscle fiber to support an increase in fiber size, they have received a great amount of attention in the past years. Several studies have observed a decline in satellite cells in the type II fibers as early as the 7th decade of life, whereas a decline in the number of myonuclei per fiber is normally not observed. However, it is possible that a decline in the number of myonucle/fiber occurs at a later stage of aging (Verdijk et al. 2014), but information on satellite cells and myonuclear content is scarce in very old individuals. Therefore, the aim of the present study was to investigate age-related changes in muscle fiber size, satellite cells and myonuclei in very old individuals (83+ years), and the response to 12 weeks of heavy resistance exercise.

METHODS: 19 men and 11 women (83-94 years) were randomized into either a heavy resistance training group (HRT) or a control group (CON). The HRT group completed 12 weeks of supervised resistance training, 3 times per week, starting at 70% 1RM. A biopsy was obtained from the vastus lateralis muscle at baseline and after the intervention and stained by immunohistochemistry for determination of fiber area, myonuclei and satellite cells. The baseline-biopsies from HRT and CON was furthermore pooled into one group (OLD) and compared with baseline-biopsies from 9 young men (YOUNG), included in a previous study.
RESULTS: At baseline the type II fibers were significantly smaller (-49%, P<0.001), and had a lower number of myonuclei/fiber (-21%, P<0.01) and satellite cells/fiber (-51%, P<0.001) in OLD compared to YOUNG, whereas no significant differences was observed for the type I fibers. In addition the myonuclear domain (fiber area/myonucleus) was slightly lower (-13%, P<0.05) in OLD type I fibers and markedly lower (-37%, P<0.001) in OLD type II fibers. There were no significant changes in muscle fiber size, myonuclei/fiber or satellite cells/fiber in the HRT-group after 12 weeks of resistance training.
CONCLUSION: As expected the OLD had smaller type II fibers and a lower number of satellite cells in the type II fibers compared to YOUNG. Extending the findings of Verdijk et al. (2014), we observed a lower number of myonuclei in the type II fibers in these very old individuals, suggesting that myonuclear content is reduced in type II fibers at very old age. Interestingly, the myonuclear domain was slightly reduced in type I fibers and markedly reduced in type II fibers in the OLD. In theory this should allow for an increase in fiber size, without myonuclear addition from satellite cells. Nevertheless, we did not observe any changes in fiber size, or the number of myonuclei and satellite cells after 12 weeks of resistance training.
References: Verdijk LB, Snijders T, Drost M et al.(2014). Age 36:545–557
Contact: anders.karlsen@regionh.dk

MUSCULATURE AND COMPOSITION OF THE THIGH IN THE ELDERLY: A NEW PERSPECTIVE

ICHINOSE, H.1, EVANGELIDIS, P.1, YAMAGISHI, T.1, TANAKA, F.1, SHIBATA, S.2, KAWAKAMI, Y.1
WASEDA UNIVERSITY

INTRODUCTION: Segmental musculature such as the cross-sectional area (CSA) is often assessed as an indicator of exercise performance of the elderly while the amount of non-contractile tissues is overlooked. In addition to the decline of skeletal muscle mass, it has been shown that intermuscular non-contractile tissue (neurovascular & adipose tissue, NVAT) increases with aging (Delmonico et al. 2009). However, it is not clear that whether the amount of NVAT is associated with other age-related parameters including body fatness, subcutaneous adipose tissue and muscle sizes. This study therefore sought to investigate the relationships between NVAT of the thigh and musculature and body composition of the elderly.
METHODS: Participants were 16 healthy older adults (8 males and 8 females: aged 73.3 ± 5.9 years). Axial scanning of the right leg was performed with MRI, and CSA of the quadriceps femoris (QF), NVAT within the fascia lata and subcutaneous adipose tissue CSA (SAT) at a level 50% of the thigh length were measured. Body composition (percentage of body fat, %BF) was determined using bioelectrical impedance analysis. Pearson's correlation coefficients were used to analyze the relationships between NVAT, %BF, SAT and QF CSA.
RESULTS: A strong positive correlation between %BF and SAT ($r = 0.86$, $p < 0.01$), and negative correlation between NVAT and CSA of QF muscle ($r = -0.88$, $p < 0.01$) were found in the females. In contrast, no significant correlation was observed in any parameters in the males. The NVAT was not significantly correlated with %BF and with SAT in either gender.
CONCLUSION: The results show that the amount of intermuscular NVAT are not associated with %BF or SAT in the elderly of both genders. This indicates that changes in the whole-body (%BF) and peripheral (SAT) fat content and those in non-contractile tissues do not occur in parallel with aging. Dependence of NAVT on QF CSA in females suggests the impact of daily exercise habit on the amount of NAVT especially in elderly females which is in line with a previous study (Bang et al. 2018) that demonstrated association of the amount of NVAT with daily step counts in the elderly.
This work was supported by Council for Science, Technology and Innovation (CSTI), Cross-ministerial Strategic Innovation Promotion Program (SIP), "Technologies for creating next-generation agriculture, forestry and fisheries" (funding agency: Bio-oriented Technology Research Advancement Institution, NARO).
Delmonico, M. J., Harris, T. B., Visser, M., Park, S. W., Conroy, M. B., Velasquez-Mieyer, P., Boudreau, R., Manini, T. M., Nevitt, M., Newman, A. B., Goodpaster, B. H. (2009). Am J Clin Nutr, 90: 1579-85.
Bang, E., Tanabe, K., Yokoyama, N., Chijiki, S., Tsuruzono, T., Kuno, S. (2018). Eur J Appl Physiol.

PULMONARY, HEART RATE AND MUSCLE DEOXYGENATION KINETICS IN VERY OLD INDIVIDUALS

FERRI, A.
VICTORIA UNIVERSITY

INTRODUCTION: While is well known that oxygen uptake (VO2) kinetics during moderate-intensity exercise are slowed with ageing, a detailed analysis of the response to high-intensity exercise is missing from the literature. The effects of ageing on skeletal muscle oxidative metabolism, and in particular on VO2, heart rate (HR), and deoxygenation of the vastus lateralis (VL) muscle at the onset of moderate- and high-intensity exercises, were evaluated in 18 elderly (E) (77.1±3.7 y, mean±SD) and 25 young (Y) (27.4±4.6 y) sedentary individuals.
METHODS: After an incremental exercise test to voluntary exhaustion on a cycle ergometer, to evaluate peak VO2 and the gas exchange threshold (GET), individuals completed three, 6-min constant-load exercises below (GET). Pulmonary VO2, VCO2, and ventilation were determined breath-by-breath. HR was measured continuously by 12-lead ECG, and recorded beat-by-beat. VL oxygenation was determined by near-infrared spectroscopy (NIRS), and changes in deoxygenated hemoglobin+myoglobin concentration [deoxy(Hb+Mb)] were taken as a muscle oxygenation index.
RESULTS: VO2peak in E (17.7±4.4 mL·kg-1·min-1) was about 50% lower ($p<0.001$) than in Y (32.2±7.4 mL·kg-1·min-1). The time constant (τ) of the primary component of VO2 kinetics was higher ($p<0.01$) in E than in Y, in both GET (57.0±16.9 vs 36.1±9.7 s). Differently from Y (amplitude of the slow component, SC= 20.8±6.2 %), E did not show a SC of VO2 kinetics for >GET. The HR primary component was also slower in E with respect to Y ($p<0.05$), for both moderate- and high-intensity exercises (59.2±32.7 vs 20.5±18.1 s and 56.4±35.6 vs 31.9±19.7 s, respectively). During exercise >GET, a HR SC was present in both Y and E with a similar amplitude (32.7±17.7 and 32.9±12.0 %). While the Mean Response Time (MRT) of the [deoxy(Hb+Mb)] was similar in E and Y during exercise GET there was a tendency ($p=0.05$) toward a slower MRT in E vs Y (26.6±14.0 vs 18.9±6.3 s).
CONCLUSION: During both moderate- and high-intensity exercises, E presented slower VO2 kinetics with respect to Y, in part due to an O2 delivery limitation (as shown by the slower HR kinetics). In E, MRT was significantly faster with respect to VO2 τ, and for exercise GET in elderly could be explained by a preferential atrophy of type II fibres, or by a reduced differentiation between fibre types.
Financial support by EC Contract QLK6-CT-2001-00323 ("Better-Ageing") is acknowledged.

Oral presentations

OP-BN44 EMG

COMPARATIVE ANALYSIS OF BIOMECHANICAL AND ENERGY CHARACTERISTICS OF THE RUNNIING UNDER DIFFERENT GRAVITATIONAL LOAD ON MUSCULOSKELETAL SYSTEM

SHPAKOV, A., ARTAMONOV, A., VORONOV, A.

RESEARCH INSTITUTE FOR SPACE MEDICINE FEDERAL RESEARCH CLINICAL CENTER OF FEDERAL BIOMEDICAL AGENCY OF RUSSIA; FEDERAL RESEARCH CENTER OF PHYSICAL EDUCATION AND SPORTS

INTRODUCTION: The aim of the study was a comparative analysis of the biomechanical parameters of locomotion under different gravitational load (GL) on musculoskeletal system (MSS).
METHODS: 24 healthy men participated in the investigation (25.1±5.2 y.o., 78.5±6.6kg, 179.7±6.3cm). They performed test on the treadmill – running (10km/h). Running were carried out at under different GL on MSS: 100% and 70% of the body weight (100-BW, 70-BW). Change of GL on MSS produced by the vertical suspension. The biomechanical parameters of running were determined using video analysis of movements. Dynamic parameters and ground reaction force (GRF) were determined using force plate housed in treadmill. We analyzed the angles in the joints of the feet (hip, knee, ankle); EMG-activity of mm. Vastus lateralis (VL), Rectus femoris (RF), Biceps femoris (BF), m. Tibialis anterior (TA), Soleus (Sol), Gastrocnemius (GM); dynamic parameters and GRF of the running. To evaluate the locomotion strategy, an analysis of phase trajectories in the joints. We analyzed the kinetic energy of rotational motion associated with flexion (negative angular velocities) and extension (positive angular velocities) of the joint.
RESULTS: During the run 70-BW angular kinematics in all joints of the feet changed both in stance phase and swing phase compared to running at 100-BW. The hip and knee joints revealed less flexion during first peak phase and swing phase. In the ankle joint flexion was increased during first peak phase and extension was increased during push back phase and during swing phase. The EMG amplitude of leg muscles during running 70-BW decreased compared to running at 100-BW. In TA, Sol and BF the reduction was 12%, GM was not detected. The VL and RF amplitude decreased by 36% and 49%. Analysis of dynamic parameters and GRF at 70-BW revealed an increase in the length and time of the step, a change in the ratio of stance and swing phases of the step, a decrease in the values of the support reactions, and an increase in the width of the step. When analyzing the phase trajectories of running 70-BW, a decrease in the area in the hip and knee joints was found, a slight increase in the ankle joint. During running at 100-BW the kinetic energy of flexion prevails over the kinetic energy of extension in the hip joint. With a reduction in the GL of up to 70-BW, this ratio tends to one in the direction of decrease, which indicates an equivalent contribution of flexion and extension to the control of movement in hip joint. The ratio of the ankle flexion and extension of the energy tends to unity in the direction of increasing.
CONCLUSION: The method of vertical suspension can be used in clinical practice and rehabilitation of patients with MSS disorders. By adjusting the level of weight of load and controlling the muscle activity can increase the effectiveness of rehabilitation, optimize and accelerate the recovery process.
The research was supported by the Russian Foundation for Basic Research №16-34-60070.

EFFECTS OF HIP FLEXION ANGLE ON UNILATERAL AND BILATERAL NORDIC HAMSTRING EXERCISE FORCE AND HIGH-DENSITY EMG ACTIVITY

HEGYI, A.1, LAHTI, J.2, GIACOMO, J.P.3, NOULE, T.2, CRONIN, N.J.1, MORIN, J.B.2

1:NMRC, 2:UCA-LAMHESS, 3:CEAPS

INTRODUCTION: Nordic hamstring exercise (NHE) is a popular injury prevention and rehabilitation exercise. Conventionally, NHE is performed bilaterally and with extended hip joint, i.e. at a relatively short muscle length. According to Askling et al. (2013), exercises performed at longer muscle lengths are more effective in hamstring rehabilitation. Furthermore, it is unclear whether NHE performed unilaterally can elicit higher hamstrings excitation compared to the bilateral condition. Thus, we aimed to examine the effect of hip flexion in unilateral and bilateral NHE on eccentric knee flexion force and hamstring activity.
METHODS: 13 football/rugby players performed unilateral and bilateral NHE both with extended hip joint (NHE0) and with hip flexed in 90 degrees (NHE90) at a pace of 5 seconds on a novel device. Two repetitions at eccentric one-repetition maximum load were performed per condition. Force from each leg was measured via the load cells of the device. Biceps femoris long head (BFlh) and semitendinosus (ST) electromyography (EMG) activities of the dominant (kicking) leg were measured with high-density EMG electrodes recording from 16 cm along each muscle. Peak force in the dominant leg and average EMG activity for each muscle were calculated. ST-BFlh activity ratio was calculated to define their relative contribution to each task. Cohen's d ±90% confidence intervals were calculated to locate and quantify differences.
RESULTS: NHE90 resulted in higher peak force and ST-BFlh ratio compared to NHE0 (d range = 0.58-0.97 and 1.52-1.94, respectively), however BFlh and ST activities were higher in NHE0 than in NHE90 (d range = 0.62-2.07). In both NHE0 and NHE90, peak force was higher unilaterally than bilaterally (d = 0.27 ±0.27 and 0.54 ±0.21, respectively) with no difference in ST-BFlh ratio between uni- and bilateral conditions (d = 0.18 ±0.19 and 0.06 ±0.22, respectively). ST and BFlh activities were higher unilaterally than bilaterally in NHE90 (d = 0.40 ±0.34 and 0.37 ±0.40, respectively), which was not evident in NHE0 (d = 0.14 ±0.44 and 0.02 ±0.53, respectively).
CONCLUSION: NHE90, wherein hamstrings operate at relatively longer lengths, seems to be a good alternative to conventional NHE0, especially when selective ST involvement and higher passive hamstring force is targeted. Higher relative BFlh activity in NHE0 is likely due to an active hip extension effort, which is presumably not present in NHE90. In NHE90, hamstring excitation can be further increased by performing the exercise unilaterally while eliminating the effects of bilateral deficit. These novel combinations of NHE may further improve hamstring injury management practices.
REFERENCES:
Askling CM, Tengvar M, Thorstensson A. (2013). Br J Sports Med, 47(15), 953-959.
CONTACT:
andras.a.hegyi@jyu.fi

THE INFLUENCE OF EXTERNAL LOADING ON ACCELERATION AND ELECTROMYOGRAPHY ACTIVITY DURING WHOLE BODY VIBRATION OF VARYING FREQUENCIES.

SANDERSON, M.1, SPROULE, J.2, TURNER, A.2

UNIVERSITY OF THE WEST OF SCOTLAND

INTRODUCTION: Whole body vibration (WBV) has had inconsistent effects in the current literature with varying protocols used (Rittweger, 2010). One contributing factor may be differences in participants' body mass and therefore external load applied to the WBV platform, affecting the stimulus and electromyography (EMG) activity. Previous research has inferred a dampening effect by external load on WBV magnitudes (Pel et al, 2009). While the influence of external load on WBV outputs remains largely unknown, direct measurement of the magnitude is now possible (Rauch et al, 2010). However, research is limited by narrow ranges of external loads and lack of simultaneous WBV stimuli and EMG measurements. The aim of this study was to investigate the influence of external loading on acceleration and EMG activity during WBV at varying frequencies.
METHODS: 10 male participants (mean ± sd; 25.5 ± 4.6 years, 176.3 ± 6.2 cm, 73.4 ± 3.1 kg), with a history of resistance training, performed 20s reps of vertical WBV at 4 frequencies (0, 30, 40, 50 Hz) with different total external loads (80, 90, 100 kg) using weighted vests; in a randomised frequency single-blinded design. Tri-axial acceleration (platform, P; tibia, T; iliac, I) and EMG (vastus lateralis, VL; rectus femoris, RF; gastrocnemius, G) were recorded and used to calculate resultant acceleration (AR) and EMG root mean square (RMS) respectively.
RESULTS: Increased external load had no effect on AR ($p=0.08$, effect sizes expressed as Partial Eta2 (r) = 0.50), but increased WBV frequency resulted in an increase in AR ($p<0.001$, $r=0.95$). Lower AR was observed in superior body segments (AR at I < T < P) ($p<0.001$, $r=0.98$). Increased external load increased VL and RF activation ($p<0.001$, $r=0.88$; $p<0.001$, $r=0.77$ respectively), but there were no frequency x load interactions ($p=0.51$, $r=0.24$; $p=0.39$, $r=0.32$ respectively). The direction of oscillation and derived peak to peak displacement values differed to manufacturer's specifications and the latter appeared to be frequency dependent (anecdotal evidence).
CONCLUSION: The WBV stimulus was resistant to loading as AR was external load-independent although as anticipated, AR increased with increasing frequency in agreement with Rauch et al, (2010). In contrast, EMGRMS was independent of frequency (except 0Hz) yet increased with greater external load. An assumption that changes affecting AR necessarily result in proportional changes in EMGRMS activity may need further investigating. Given the lower AR at higher body segments a potential dampening effect appears plausible. This methodological approach may allow for future dose-response monitoring procedures to be developed for specific body segments; as well as development of safe WBV protocols. The results suggest that WBV stimuli and the physiological response (EMG activity) are affected by changes in frequency and external load differently. This more robust methodological protocol quantifying and validating AR output should form the new direction in WBV research.

MUSCLE ACTIVATION CHANGES IN BARBELL HIP THRUST AT INCREASING LOADS

RUEDA, J., COLLAZO, C., OLLERO, E., NAVARRO, E.

UNIVERSIDAD POLITÉCNICA DE MADRID

INTRODUCTION: In recent years, the development of the muscles of the hip pelvis has gained an interest in the field of fitness and rehabilitation (Bishop et al., 2017) and one of the most commonly used exercises for this is the "Barbell Hip Thrust" (HP) (Andersen et al., 2017). Increasing the load in an exercise has proved to increase muscle activity (Boyden, Kingman, & Dyson, 2000) and this information can be very useful for sport professionals to optimise training load, but to our knowledge no study has focused on analysing these changes in HT and in the muscles considered in this study. Our aim was to analyse the changes in lower body muscles activity in an incremental test of Barbell Hip Thrust.
METHODS: For this study a total of 7 healthy men was selected (Age 29.7±4.6; Height 176.9±5.8 cm; Weight 74.4±8.2 Kg; 1RM in HT 153.6±11 Kg), all of them being personal trainers and used to the technique of the Barbell Hip Thrust. The muscles analsyzed for this study where Rectus Femoris (RF), Vastus Medialis (VM), Vastus Lateralis (VL), Biceps Femoris (BF), Semitendinosus (ST), Gluteus Maximus (GM) and Gluteus Medius (Gme). A Maximum Voluntary Isometric Contraction (MVIC) was recorded for each muscle, and the subjects performed a HT incremental test of at least 5 repetitions starting with 20-30% of RM following a 40-50% of RM and finishing with a 60-70% of RM. EMG data was filtered and rectified and expressed as % of the MVIC of each muscle. A Friedman ANOVA was conducted to analyse difference between the 3 tests.
RESULTS: There were no significant differences between the three test conditions in the RF and Gme ($X2(2)=5.33$;$p=.069$). On the other hand significant differences were found in VM ($X2(2)=10.33$;$p=.006$), VL ($X2(2)=7$; $p=.03$), BF ($X2(2)=7$;$p=.03$), ST ($X2(2)=12$; $p=.002$) and GM ($X2(2)=9.33$; $p=.009$). In all of this muscles the differences were only found between the 20-30%RM and the 60-70%RM: VM($p=.004$), VL($p=.028$), BF ($p=.028$), ST ($p=.002$) and GM ($p=.012$). No significant changes were found between 20-30%RM and 40-50%RM and between 40-50%RM and 60-50%RM ($p<.005$).
CONCLUSION: Our results agree with the works of Boyden G. et al., (2000) and Paoli A. et al., (2009), the EMG activity in a lower body exercise increases as we work with greater loads but only after modifying a 40-50% of the RM (≈60Kg). We suggest that a better way to achieve this could by changing the exercise technique as this has been already shown by these same authors lowering the injury risk as we attempt with lighter loads.
1. Bishop, C., Cassone, N., Jarvis, P., Turner, A., Chavda, S., & Edwards, M. (2017). J Strength Cond Res.
2. Andersen, V., Fimland, M. S., Mo, D. A., Iversen, V. M., Vederhus, T., Rockland, L. H., ... & Saeterbakken, A. H. (2017). J Strength Cond Res.
3. Boyden, G., Kingman, J., & Dyson, R. (2000). J Strength Cond Res, 14(4), 379-382.
4. Paoli, A., Marcolin, G., & Petrone, N. (2009 J Strength Cond Res, 23(1), 246-250.

SPINAL AND CORTICO-SPINAL RESPONSES OF THE SOLEUS MUSCLE DURING CONTRACTION, MOTOR IMAGERY AND REST

BOUGUETOCH, A., GROSPRETRE, S., MARTIN, A.

INSERM-U1093 , EA-4660 C3S

INTRODUCTION: Motor imagery (MI) may be defined as a state during which sensations of a given motor act are internally rehearsed in working memory without any overt motor output. This brain activity has been evidenced by the increased size of motor evoked potentials (MEPs), induced by transcranial magnetic stimulation (TMS) over the primary motor cortex, during MI compared to rest conditions (1).

Moreover, some studies have shown that excitability of the spinal reflex was facilitated during MI (2). The aim of this study was to measure the impact of MI on the soleus H-reflex and MEPs on a wide range of intensities and compare the evolution of the response to voluntary contraction (CON) and rest conditions (REST).
METHODS: Six young healthy subjects performed one testing session during which they seated on an isokinetic chair with their foot tied on a pedal and set at a 90°-angle of the ankle. M-waves and H-reflexes of the soleus muscle were elicited by stimulating the posterior tibial nerve with an electrode placed in the popliteal fossa. The intensity of the stimulus was progressively increased from H-reflex threshold to maximal M-wave to build H-M recruitment curves of the soleus. MEPs were elicited by a cone coil placed over the primary motor cortex of the triceps surae with several intensities from the motor threshold to the maximal MEP amplitude. H-M and MEP recruitment curves were recorded under three conditions: MI of maximal plantar flexion, weak contraction (5% of maximal voluntary contraction) and rest.
RESULTS: All intensities used for the H-M recruitment curves were expressed as percentage of Hmax intensity.
No significant difference between the three conditions was observed for any of the normalized H/Mmax (p=0.175). Regarding cortico-spinal excitabilities, a significant difference between all conditions was observed for the three highest intensities of MEPs tested (p≤0.02). The threshold to elicit MEP was lower in contraction than in MI, and lower in MI than at rest.
CONCLUSION: Despite a low sample of subjects, we can observe a significant difference between MEPs elicited in the three conditions (REST/MI/CON). Concerning cortico-spinal factors, MI seems to be an intermediate state between REST and CON.
Regarding spinal excitability, no significant difference was observed at any tested intensities. However, some trends indicate that a higher number of subjects could induce some difference. It can be assumed that a continuum exists between these three conditions, REST≤MI≤CON, for cortico-spinal and probably spinal excitabilities as well.

Oral presentations

OP-PM63 Exercise training in diverse populations

WHOLE-BODY VIBRATION TRAINING DOES NOT CONTRIBUTE TO EITHER STRENGTH OR SPRINT SWIMMING PERFORMANCE ENHANCEMENTS IN ADOLESCENT SWIMMERS

MUÑIZ PARDOS, B.1,2, GÓMEZ-BRUTON, A.1,2,3, MATUTE-LLORENTE, A.1,2,4, LOZANO-BERGES, G.1,2,4, MARÍN-PUYALTO, J.1,2,4, GÓMEZ-CABELLO, A.1,2,5, GONZÁLEZ-AGÜERO, A., CASAJÚS, J.A., VICENTE-RODRÍGUEZ G.
UNIVERSITY OF ZARAGOZA

INTRODUCTION: Sports scientists started as early as 1978 to explore the effects of mechanical vibration as a potential stimulus to enhance muscle function and athletic performance (Zagorskaia, 1978). A recent systematic review (Hortobagyi, Lesinski, Fernandez-Del-Olmo, & Granacher, 2015) highlighted the inconsistent effects of the existing vibration training (VT) interventions on different sports and found that the efficacy of VT has not yet been proven in swimmers. Thus, the main aim of the present study is to identify the effects of VT in both strength development and swimming performance.
METHODS: Thirty-three adolescent swimmers [22 males, 11 females; 14.8(1.3) y; 58.2(11.0) kg; 168.3(10.7) cm; 10.3(1.9) h of training/week] were recruited. The intervention group (IG; n=20) was involved in an incremental 6-month whole-body vibration training (WBVT) program, in addition to the habitual swimming training performed by the control group (CG; n=13). Fifty and 100 m swimming official times (SWT) pre- and post- intervention were converted into FINA points in order to compare results from different events. Horizontal jump, 30-m run test, maximal isometric strength of the knee extensors, maximal isometric strength from half-squat position and countermovement jump height were tested before and after the intervention. To determine any potential influence of sex, a group-by-sex interaction was tested. Subsequently, both fitness and SWT variables were subjected to age-adjusted repeated measures ANCOVA to detect any potential group-by-time interaction and, thus, to determine the potential effect of WBVT on both SWT and fitness development.
RESULTS: No group-by-sex interactions were found and therefore the sample was analyzed as a whole. No group by time interactions were found, suggesting that LBVT did not show any positive effects on any of the fitness or SWT performance variables (all p>0.05; partial eta square ranged from 0.00 to 0.04).
CONCLUSION: Supporting previous evidence studying the effects of VT on other sports, the present study rejects the use of WBVT to enhance either strength development or swimming performance in adolescent swimmers. However, the exposure to VT took place during a competitive phase of the swimmers' season. This could hinder the potential effects of WBVT as the athlete's condition may differ vastly at these two time-points.

IMPACT OF EXERGAME VS. TREADMILL EXERCISE ON CARDIORESPIRATORY FITNESS, ENDOTHELIAL FUNCTION AND EPICARDIAL FAT THICKNESS IN PATIENTS WITH HIGH CARDIOVASCULAR RISK

JO, E.
KOSIN COLLEGE OF MEDICINE

INTRODUCTION: Exergame, is a promising technology that uses interactive games to increase exercise behavior, has been used as an exercise modality. However, it is still unclear whether "exergames" are as effective as conventional aerobic exercise for cardiovascular risk factor reduction. The aim of this study was to compare the effects of treadmill exercise and exergame engaged in the aerobic running video game on cardiorespiratory fitness, endothelial function and epicardial fat thickness (EFT) in patients with high cardiovascular (CV) risk.
METHODS: Forty-six patients (mean age: 61.7±12.1 years old) with high CV risk were randomized to aerobic exergame using Exer-heart (n=19), treadmill (n=15) and control (n=12) group. The Exer-heart and treadmill groups performed equal volumes of energy expenditure for 230 MET-min/day with moderate to vigorous intensity. Each group completed a fully supervised 3 times a week for 12-week training. Participants were examined for peak oxygen uptake (VO2peak), EFT measured by echocardiography, and flow-mediated dilation (FMD) using ultrasonography. Blood samples were collected to measure endothelial progenitor cells (EPCs) such as CD34/CD117+ using flow cytometry.
RESULTS: Compared to the baseline, both 12 weeks Exer-heart and treadmill aerobic exercise significantly improved VO2peak (Exer-heart, 38% , p<0.001; treadmill, 27%, p<0.001; control, 0%; p=0.984), EFT (Exer-heart, 0.13mm; p<0.01; treadmill, 0.17mm; p<0.01; control,

0.05mm; p=0.579), FMD (Exer-heart, 9.3%, p<0.001; treadmill, 8.7%, p<0.01; control, 2%; p=0.785), and CD34/CD117+ (Exer-heart, 26/μL, p<0.05; treadmill, 25/μL; p<0.01; control, -2/μL; p=0.552).
CONCLUSION: Aerobic exergame had the similar exercise effects as a conventional treadmill exercise of moderate to vigorous intensity in improving cardiorespiratory fitness, endothelial function and EFT in patients with high CV risk. These finding suggest that the aerobic exergame may have a role as an attractive exercise program in prevention and treatment of CV risk factors.

BENEFICIAL EFFECTS OF ENDURANCE TRAINING ON SKELETAL MUSCLE MICROVASCULATURE IN PATIENTS WITH SICKLE CELL DISEASE.

MERLET, A., MESSONNIER, L., BARTOLUCCI, P., HOURDE, C., LACROIX, R., GELLEN, B., PEYROT, S., RUPP, T., GALACTEROS, F., FEASSON, L.

LABORATORY OF HUMAN MOVEMENT SCIENCES

INTRODUCTION: Sickle cell disease is a genetic haemoglobinopathy leading in two major clinical manifestations: severe chronic haemolytic anaemia and iterative vaso-occlusive crisis. Recently, we have highlighted that SCD is accompanied by a profound and deleterious remodelling of muscle tissue and in particular at the microvascular level . In the literature, the beneficial effects of endurance training on microvascular network are widely known in healthy and pathological population. Since safety and functional benefits were present following an adapted physical activity program in SCD patients, the aim was also to evaluate the effects of this program on muscle microvascular adaptations.
METHODS: Forty SCD patients were randomized in two groups: group E followed a training program in endurance while group C maintained its usual lifestyle. Adaptive physical activity consisted of a 45-minute ergocyle exercise, 3 sessions per week for 8 weeks. The individual intensity was determined by a submaximal cardio-pulmonary exercise test and re-evaluated at the end of the program. A biopsy of the vastus lateralis muscle was performed before and after the training period.
RESULTS: Muscle microvascular benefits was highlighted after the training program with in particular an increases of the i> capillary density , number of capillaries around a fibre , iii> functional surface of exchange . Conversely, the morphology of capillaries was unchanged in response to such program.
CONCLUSION: A well-controlled moderate-intensity exercise endurance training improve the blood supply to muscle tissue and partly reverses the microvascular deficits previously observed in SCD patients.

CMJ TRAINING IS MORE EFFECTIVE THAN DJ TRAINING IN ENHANCING VERTICAL JUMP HEIGHT IN FEMALE AMATEUR VOLLEYBALL PLAYERS

RUFFIEUX, J., ANDREY, S., TAUBE, W.

UNIVERSITY OF FRIBOURG

INTRODUCTION: Vertical jump ability is a key factor in many sports, such as volleyball. The typical jump types in volleyball (attack and block) can be characterized as countermovement jumps (CMJs). Various exercises have been proposed to improve CMJ jump height, including drop jumps (DJ). Due to the greater mechanical output compared to CMJs, DJs have been suggested to be effective in enhancing CMJ performance (Bobbert, 1990). This has been confirmed by multiple training studies (Markovic, 2007). However, to the best of our knowledge, no study has to date compared the effect of a DJ training to that of a "simple" CMJ training on CMJ performance. This was, therefore, the aim of this study.
METHODS: 26 female volleyball players of a regional level (21.2 ± 3.8 years, 169.6 ± 4.4 cm, 63.9 ± 7.4 kg), were allocated to either a CMJ training group or a DJ training group, which were matched for age and jump height at the pre-test. The training comprised 2 sessions per week for 6 weeks. In each session the participants performed 60 jumps, of which 20 % were performed in the jump type of the other group. During pre- and post-measurements, jump height was assessed in 4 different jump types: CMJ (hands akimbo), CMJ with arm swing (similar to a block jump in volleyball), CMJ with run-up (similar to an attack in volleyball), and DJ (37 cm drop height). The best trial out of 5 in each jump type was used for statistical analysis (2x2x4 mixed-design ANOVA: time*group*jump type).
RESULTS: On average, the CMJ group improved jumping height by 16.7 ± 9.2 %, the DJ group by 7.3 ± 5.4 %. The statistical analysis showed that the improvements were significant in both groups ($p < .001$) but that the CMJ group improved more (time*group: $p < .001$). This effect was not significantly different between jump types ($p = 0.068$), although there was a trend toward a greater difference in the CMJ with run-up.
CONCLUSION: The results show that both training forms considerably improved vertical jump ability. However, the CMJ was significantly more effective. This was true for all jump types, including the DJ, but most pronounced for the CMJ with run-up, which resembles the attack in volleyball. These findings suggest that training interventions with a high percentage (80 %) of CMJs and a low percentage of DJs are more efficient than a concentration on DJs to improve volleyball-specific jump abilities.
REFERENCES:
Bobbert MF. (1990). Drop jumping as a training method for jumping ability. Sports Med, 9, 7–22.
Markovic G. (2007). Does plyometric training improve vertical jump height? A meta-analytical review. Br J Sports Med, 41, 349–355.
CONTACT:
jan.ruffieux@unifr.ch

INFLUENCE OF BELAY TRAINING ON EXECUTION OF THE BRAKE HAND PRINCIPLE IN UNEXPERIENCED BELAYERS

MATIAS SANTOS, V.M.1,2, CRONRATH, M.1, PLATEN, P.2

RUHR UNIVERSITÄT BOCHUM

INTRODUCTION: Most climbing accidents occur during lead climbing [1]. Violating the brake hand principle (BHP) is one of the most frequent operating errors [2]. An exclusive belay training with Grigri does not sufficiently teach the BHP compared to a belay training with Tube. There are belaying devices with safety qualities between Grigri and Tube like the Mega Jul [3]. The purpose of the study was to compare the effects of exclusive belay training with Grigri, Tube, and Mega Jul to analyze the effects on error rate (ER) in BHP.
METHODS: 34 healthy subjects (m = 23; w = 11; age = 22.9 ± 2.2 yrs) were randomly divided into a Grigri group (GG: n = 13), a Mega Jul group (MG: n = 11) and a Tube group (TG: n = 10). The GG, MG and TG were trained 11 hours with their belaying device. Every group was instructed one hour on the other two belaying devices. One week after subsequent training, participants conducted a filmed test session in which they belayed a trained lead climber with a Grigri, Mega Jul and Tube for approximately 5 min per each belay device during fall

training. ER of the three belaying devices in each group were added and afterwards compared between groups. ER in the BHP were evaluated by five independent persons using video recordings. Significance was set at 0.05.
RESULTS: Number of errors in the BHP was significantly higher in GG and MG compared to TG and there was no difference between GG and MG (number of errors, mean ± SD: GG: 2.7 ± 2.4; MG: 2.4 ± 2.3; TG: 0.2 ± 0.4; TG vs. GG, TG vs. MG $p < 0.01$; GG vs. MG $p > 0.05$).
CONCLUSION: Belay training using only a Grigri or a Mega Jul does not sufficiently teach the BHP. Procedural memory is created by procedural learning [4]. A deficit in procedural memory regarding BHP is likely to be attributed to the absence of negative feedback throughout errors in preceded simulations. Therefore, the behaviour during belaying cannot completely be related to the theoretical knowledge but rather to the experience on belaying [5]. Mega Jul does not provide an advantage in learning the BHP despite its similarities with the Tube. In order to train unexperienced belayers a Tube should be the first option. Using other belaying devices like Mega Jul or Grigri after a belay training with the Tube requires at least one hour of specific belay training with the new belaying device.
REFERENCES:
[1] Woollings KY et al (2015). Sports Med, 49, 1094-9.
[2] Funk F et al (2013). Panorama, 2, 66-9.
[3] Hellberg F et al (2014). Bergundsteigen, 3, 85-87.
[4] Anderson J (2015). Cognitive Psychology and Its Implications. NY: W. Publishers.
[5] Cronrath M (2010). Bergundsteigen, 2, 40-6.
CONTACT:
victor.matiassantos@rub.de

Friday, July 6th, 2018

08:00 - 09:30

IS-EX01 ECSS-ACSM exchange symposium: Exercise is Medicine

EXERCISE IS MEDICINE; ON A GLOBAL HEALTH INITIATIVE

SALLIS, R.

UC RIVERSIDE SCHOOL OF MEDICINE

Exercise is a very powerful tool for both the treatment and prevention of chronic disease, for mitigating the harmful effects of obesity, and for lowering mortality rates. In fact, there is a linear relationship between activity level and health status. This association between disease and an inactive and unfit way of life exists in every age group: children, adults, and the elderly. The results of studies consistently show that those who are active and fit are healthier. For this reason, many have suggested that physical inactivity is the major public health problem of our time.
This strong connection between physical activity and health was highlighted in a series of articles that the journal Lancet published in 2012. The series reached this conclusion: "In view of the prevalence, global reach, and health effect of physical inactivity, the issue should be appropriately described as pandemic, with far-reaching health, economic, environmental, and social consequences." Can you imagine the public outcry if such strong words had been used to describe a "pandemic" caused by an infectious disease or injury? You can bet there would have been numerous large-scale campaigns mounted and associated publicity to deal with such a pandemic. Unfortunately, the clear identification of the inactivity pandemic in Lancet barely generated any media response.
It was for the above reasons that the Exercises Is Medicine (EIM) initiative was established. The stated goal of the EIM initiative is "to make physical activity assessment and exercise prescription a standard part of the disease prevention and treatment paradigm for all patients." The initiative was started by the American College of Sports Medicine in conjunction with the American Medical Association in November 2007. A national launch was held in Washington, DC, that was attended by then US Surgeon General Steve Galson, along with the directors of the President's Council on Physical Fitness and Sports and the California Governors Council on Physical Fitness and Sports.
In May 2008 the first World Congress on Exercise Is Medicine was held in conjunction with the American College of Sports Medicine's annual meeting to announce the global launch of this program. Since that time, EIM has spread to more than 50 countries, including 6 regional centers. It has been interesting to note the worldwide acceptance of the basic tenets of EIM, including recommendations for weekly physical activity to improve health. Most countries have established physical activity guidelines that are essentially the same, suggesting that adults should get 150 minutes of moderate to vigorous activity each week. It is amazing to have a major public health problem in which almost everyone worldwide agrees on the proper treatment.
This lecture will celebrate the 10 year anniversary of the EIM initiative, while providing an update and discussion of future directions around the world.

EXERCISE IS MEDICINE AT THE WORKPLACE: A FEASIBLE OPTION?

VAN MECHELEN, W.

VU UNIVERSITY MEDICAL CENTER

The prevalence of lifestyle-related, chronic disease is still on the rise. Physical inactivity is the 4th leading cause of death due to lifestyle-related diseases, according to the WHO. Therefore, it is important to enhance population levels of physical activity worldwide. This is easier said than done, since human nature is geared towards the preservation of energy. Interventions to enhance levels of physical activity can be directed at either the individual him-/herself for instance through Exercise is Medicine initiatives, or at the environment (, or both). These interventions are probably best delivered to a 'captive' audience, in order to maximize intervention effect. One such a captive audience is found in the workplace. Purpose of this presentation is to present research findings of interventions that were carried out at the workplace both for people and places, with the aim to enhance employee's levels of daily physical activity. Also the results will be presented of worksite exercise interventions for disabled workers with non-specific low back pain, with the aim to have them return-to-work. Finally, some issues related to barriers and facilitators of worksite physical activity will be discussed.

Oral presentations

OP-PM19 Cardiovascular physiology 1

INTERFACE PRESSURE, PERCEPTUAL AND MEAN ARTERIAL PRESSURE RESPONSES TO EXERCISE IN DIFFERENT BLOOD FLOW RESTRICTION SYSTEMS

HUGHES, L.

ST. MARY'S UNIVERSITY

INTRODUCTION: Different blood flow restriction (BFR) systems, composed of a cuff and inflation device, are used in BFR application (Hughes et al., 2017). However, the actual pressure between the cuff and the limb, perceptual and mean arterial pressure (MAP) responses to exercise, in the different BFR systems, has not been examined. Therefore, this study aimed to examine the cuff to limb interface pressure, perceptual and MAP responses to exercise in different BFR systems.
METHODS: Eighteen participants completed 4 sets of unilateral leg press exercise at 30% of one repetition maximum with BFR at 80% of limb occlusion pressure in a randomised, crossover, counterbalanced design. Different BFR systems were used across 3 sessions: an automatic rapid-inflation (RI), automatic personalised tourniquet (PT) and manual handheld pump and sphygnamometer (HS) system. Each BFR system comprised a method of pressure regulation: the RI system adjusts pressure automatically; the PT system automatically

adjusts pressure around the set pressure; and the manual HS system does not automatically regulate pressure. Interface pressure was measured using a universal interface device with pressure sensors. A clinical limit of ± 15 mmHg was set a priori, as the recommended pressure window for safe and effective restriction of blood flow (Mcewen, 1981). Inter-set pain and exertion were measured alongside MAP at pre-, 1 min post- and 5 min post-exercise.
RESULTS: Interface pressure was, on average, 10.24 ± 8.01 and 47.65 ± 35.95 mmHg higher than the set pressure in the RI and HS systems ($p<0.01$), with no differences in the PT system ($p>0.05$), during exercise, and within the clinical limit of ± 15mmHg for the RI and PT systems. Pain and exertion were greater in sets 3 and 4 in the RI and HS systems compared to the PT system ($p<0.01$). MAP was higher in the RI and HS systems compared to the PT system at 1-min and 5 min post-exercise ($p<0.01$).
CONCLUSION: Higher interface pressure during exercise may be attributed to a combination of muscle contraction, method of pressure control, cuff properties and participant factors. Automatic BFR systems appear to regulate pressure effectively within an acceptable range during BFR exercise and reduce perceptual and MAP responses.
References: Hughes, L., Paton, B., Rosenblatt, B., Gissane, C. and Patterson, S. D. (2017) Blood flow restriction training in clinical musculoskeletal rehabilitation: A systematic review and meta-analysis, British Journal of Sports Medicine, 51(13), pp. 1003-1011. doi: 10.1136/bjsports-2016-097071.
Mcewen, J. A. (1981) Complications of and improvements in pneumatic tourniquets used in surgery, Medical Instrumentation, 15(4), pp. 253-257.

REGULAR PHYSICAL EXERCISE, PRIOR TO LOWER LIMB ARTERIAL OCCLUSION DEVELOPEMENT, AMELIORATES WALKING CAPACITY AND ISCHEMIC LIMB PERFUSION IN A MOUSE MODEL

PELLEGRIN, M., MAYER, M., BOUZOURÈNE, K., AUBERT, J.F., MAZZOLAI, L.
UNIVERSITY HOSPITAL OF LAUSANNE

INTRODUCTION: Lower extremity artery disease (LEAD) is a significant public health problem characterized by occlusion of lower limb arteries due to atherosclerosis. As a consequence of decreased blood flow and perfusion to the muscles, patients with LEAD can experience diminished walking ability. Physical exercise (PE) is recommended to improve walking capacity in LEAD patients with intermittent claudication (Aboyans et al., 2017). However, little is known about the preventive effect of PE prior to LEAD development. The present study therefore explored whether PE prior to LEAD induction can prevent subsequent walking ability impairment and decreased limb perfusion in mice.
METHODS: Atherosclerotic C57BL/6 Apolipoprotein E-deficient (ApoE-/-) mice were allowed free access to voluntary wheel running (WR) or remained sedentary (SED) for 5 weeks before induction of experimental LEAD via unilateral iliac artery ligation/occlusion (Pellegrin et al., 2014). Thereafter, the two groups were kept sedentary for 5 weeks. Walking capacity was determined by calculating the maximal walking distance (MWD) using an incremental treadmill running test. Hindlimb perfusion was assessed using laser Doppler imaging. Real-time RT-PCR was used to determine macrophage phenotype (pro-inflammatory M1 versus anti-inflammatory M2 macrophages) in hindlimb quadriceps muscle. Flow cytometry was employed to analyze blood circulating monocyte subsets (Ly6Chigh inflammatory versus Ly6Clow anti-inflammatory monocytes).
RESULTS: MWD significantly improved by 23% in WR compared to SED mice at end of the study ($P<0.05$). Compared to SED mice, ischemic hindlimb perfusion in WR animals was significantly increased at week 3 (+40%, $P<0.01$), week 4 (+50%, $P<0.001$), and week 5 (+28%, $P<0.05$) after LEAD induction. In SED mice, M1 marker CD11c mRNA levels tended to increase in ischemic quadriceps muscle (2.1-fold versus non-ischemic contralateral quadriceps muscle, $P=0.065$) while M2 marker CD206 mRNA levels significantly increased in WR mice (1.7-fold versus non-ischemic muscle, $P<0.05$). WR significantly decreased the number of circulating pro-inflammatory monocytes (-41% versus SED) while increased that of anti-inflammatory monocytes (+45%) ($P<0.01$).
CONCLUSION: PE prior to LEAD development is effective in preventing disease severity. Mechanistically, PE polarizes circulating monocytes and muscular macrophages towards an-anti-inflammatory phenotype. Our study provides the first experimental evidence of the role of PE in primary prevention of LEAD.
References: Aboyans V, Ricco JB, Bartelink MEL, et al., (2017). Eur Heart J, 26, 1-60
Pellegrin M, Bouzourene K, Poitry-Yamate C, et al., (2014). Physiol Rep, 25, e00234

FACTORS AFFECTING OCCLUSION PRESSURE AND ISCHEMIC PRECONDITIONING

BROWN, H.1,2,3, BINNIE, M.J.1,2, DAWSON, B.1, BULLOCK, N.3,4,5, SCOTT, B.R.6, PEELING, P.1,2
1: UNIVERSITY OF WESTERN AUSTRALIA, 2: WESTERN AUSTRALIAN INSTITUTE OF SPORT, 3: AUSTRALIAN INSTITUTE OF SPORT, 4: AUSTRALIAN CANOEING, 5: BOND UNIVERSITY, 6: MURDOCH UNIVERSITY

INTRODUCTION: Ischemic preconditioning (IPC) literature has reported small beneficial effects on performance, although equivocal results have also been recorded. Uncertain aspects relating to IPC intervention are whether complete arterial occlusion is required to elicit the full impact, and if the cuff pressures typically used in IPC research to date (200-220 mmHg) are sufficient to elicit complete arterial occlusion in athletic populations. Therefore, the aim of this study was to investigate the relationship between selected methodological variables and arterial occlusion pressure (AOP) in athletes.
METHODS: Twenty well-trained athletes were recruited to attend 3 laboratory sessions. Participants were firstly assessed using surface anthropometry and dual x-ray absorptiometry (DXA) to provide measures of body size and composition. In subsequent sessions their blood pressure (BP) was taken, followed by a determination of AOP for each limb using an incremental step protocol and Doppler ultrasound of the posterior tibial and radial arteries. Limbs were measured one at a time, with AOP recorded as the lowest 10 mmHg increment at which no pulse was detected. For arms, small (6 cm) or medium (13 cm) cuffs were used, and for legs medium or large (18 cm) cuffs employed in a crossover design. A 5 min occlusion was then performed at the measured AOP with pulse monitored throughout, and cuff pressure increased by a further 10 mmHg if pulse returned, with the adjusted pressure recorded as the final AOP. Data were pooled between left and right limbs, then AOP was compared between sexes, limbs and cuff sizes. The influence of anthropometric, DXA and other variables on AOP was assessed using linear regression models.
RESULTS: Mean AOP was higher in legs than arms (161±18 vs. 133±12 mmHg; $p<0.001$), and with smaller cuffs in arms (161±16 vs. 133±12 mmHg; $p<0.001$), but not legs (161±16 vs. 170±26; $p=0.222$). Sex and resting systolic BP accounted for 77% (small cuff) to 83% (medium cuff) of variance in AOP for arms, and 61% (medium cuff) to 63% (large cuff) in legs. Including anthropometry accounted for 82% (small cuff) to 89% (medium cuff) and 78% (medium cuff) to 79% (large cuff) of variance for arms and legs, respectively. Adding DXA variables improved the explained variance up to 83% (small cuff) to 91% (medium cuff) and 79% (medium cuff) to 87% (large cuff) for arms and legs, respectively.

CONCLUSION: Upper limb AOP in athletes can be accurately predicted using sex and systolic BP alone, while surface anthropometry should be included for lower limbs. Cuff pressure of 200-220 mmHg is likely sufficient to elicit full arterial occlusion where appropriate cuffs have been used, however, the use of individualised occlusion pressures based on the direct measurement of AOP or regression models may increase the efficacy of future IPC protocols.

EFFECTS OF A FAILURE VS. A SUBMAXIMAL PROTOCOL OF BLOOD FLOW RESTRICTED RESISTANCE EXERCISE ON CHANGES IN MUSCLE SIZE

MANGSETH, H.1, SANDNES, N.V.1, GERBI, S.1, LINDBERG, K.1, SØRLI, T.1, VÅRVIK, F.2, WERNBOM, M.3, BERNTSEN, S.1, PAULSEN, G.4, RAASTAD, T.5, BJØRNSEN, T.1

1UNIVERSITY OF AGDER, 2NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY, 3UNIVERSITY OF GOTHENBURG, 4NORWEGIAN OLYMPIC FEDERATION, 5NORWEGIAN SCHOOL OF SPORT SCIENCES

INTRODUCTION: Short-term high-frequency blood flow restricted resistance exercise (BFRRE) has been observed to increase muscle size with loads as low as 20% of 1 repetition maximum (1RM) (1). However, the training effort that has the most potent effect on muscle hypertrophy during high-frequency BFRRE is less investigated. Therefore, the aim of the present study was to compare the effects of a failure versus a submaximal BFRRE protocol on muscle- thickness and cross-sectional area (CSA).
METHODS: Twenty-nine untrained men and women (18-45 yrs old) were randomized to either a non-exercising control group (n=9) or a BFRRE group (n=20). The participants in the BFRRE group performed four sets to voluntary failure with one leg, and a submaximal protocol consisting of 20, 10, 10, 10 repetitions with the other leg. Fourteen BFRRE sessions with unilateral knee extensions (20% of 1RM) were distributed over two five-day blocks, separated by a ten-day rest period. To restrict blood flow, a 145mm wide cuff was inflated to a pressure of 100 mmHg. Ultrasound measurements were recorded at 40% (distal) and 60% (proximal) of the femur length in m.rectus femoris (RFdist & RFprox) and m.vastus lateralis (VLdist & VLprox). Statistical analyses were conducted using linear-mixed models with Fishers LSD post-hoc test and independent sample t-tests.
RESULTS: Over the time course of the study, the failure protocol induced significantly larger increase in muscle thickness of RFprox (Fail: 6.2% vs. Sub: 4.4%), VLprox (Fail: 4.9% vs. Sub: 3.2%), VLdist (Fail: 5.3% vs. Sub: 3.9%), as well as CSA of RFprox (Fail: 7.2% vs. Sub: 5.7%) and RFdist (Fail: 10.4% vs. Sub: 8.0%) than the submaximal protocol ($p<0.05$). No differences between protocols were observed in thickness of RFdist. Muscle- thickness and CSA increased significantly from baseline to measurement time points between 10 and 24 days of detraining. The CSA of RFprox, and thickness of RFprox, VLprox and VLdist were increased more in the failure leg compared to the submaximal leg at training day 17 and 19. No changes in muscle size were observed in the control group. The failure leg performed significantly more repetitions per session (78, SD=21) than the submaximal leg (50, SD=3) ($p<0.001$).
CONCLUSION: High-frequency low-load BFRRE to voluntary failure induced larger gains in muscle- thickness and CSA than the submaximal protocol. This might indicate that training to voluntary failure may be favorable, if increased muscle size is the desired outcome. However, the failure protocol induced more muscle swelling during BFRRE than the submaximal protocol. Which in turn could have influenced the post measurements.
References:
1. Nielsen JL., et al. (2012) J Physiol 590: 4351-4361.

SUCROSE BUT NOT NITRATE INGESTION REDUCES HIGH-INTENSITY EXERCISE-INDUCED GUT INJURY

JONVIK, K.L., LENAERTS, K., SMEETS, J.S.J., KOLKMAN, J., VAN LOON, L.J.C., VERDIJK, L.B.

MAASTRICHT UNIVERSITY

INTRODUCTION: During high-intensity exercise many athletes suffer from gastrointestinal (GI) complaints, which are likely related to splanchnic hypoperfusion, resulting in intestinal injury. Increasing circulating nitric oxide (NO) levels or inducing postprandial hyperemia may improve splanchnic perfusion, thereby attenuating intestinal injury during exercise. Therefore, we investigated the effects of both dietary nitrate ingestion and sucrose ingestion on splanchnic perfusion and intestinal injury induced by high-intensity exercise.
METHODS: In a randomized cross-over manner, 16 well-trained male athletes (age: 28±7 y; Wmax: 5.0±0.3 W/kg) cycled 60 min at 70% Wmax following acute ingestion of: sodium nitrate (NIT; 800 mg NO3), sucrose (SUC; 40 g) or a water placebo (PLA). Test days were planned on the same week day and time of day, separated by 1-wk washout. Splanchnic perfusion was assessed by determining the gap between gastric and arterial pCO2 (pCO2gap) using gastric air tonometry. Plasma intestinal fatty-acid binding protein (I-FABP) concentrations, reflecting enterocyte damage, were assessed every 20 min during exercise and up to 60 min of post-exercise recovery. Total area under the curve (AUC) for I-FABP and for pCO2gap, were calculated and analyzed using repeated measures ANOVA with treatment (NIT, SUC or PLA) as within-subjects factor. Continuous data for I-FABP (increase from baseline in %), pCO2gap, plasma nitrate, plasma nitrite and plasma glucose were analyzed using repeated measures ANOVA, with time and treatment as within-subjects factors. Statistical significance was set at $P<0.05$, and any interaction or main effect was subsequently analyzed using a Bonferroni corrected post hoc test for pre-planned comparisons (i.e., SUC vs PLA and NIT vs PLA). All data are presented as means ± SDs.
RESULTS: As expected, plasma nitrate and nitrite concentrations were higher in NIT vs PLA throughout the test day (all $P<0.001$), and plasma glucose concentrations were higher in SUC vs PLA ($P=0.008$). The exercise protocol resulted in splanchnic hypoperfusion, as pCO2gap levels increased during exercise (from ~0 to ~2 kPa, $P<0.001$), with no differences between treatments ($P=0.47$). Although plasma I-FABP concentrations increased during exercise and post-exercise recovery for all treatments ($P<0.0001$), the increase was different between treatments ($P<0.0001$). Post-hoc comparisons showed an attenuated increase in I-FABP in SUC vs PLA ($P=0.020$). In accordance, I-FABP area under the curve (AUC) was significantly lower in SUC vs PLA (4,622±6,291% vs 10,099±6,783%, $P=0.004$). No differences were observed between NIT and PLA ($P=0.78$).
CONCLUSION: Sucrose but not nitrate ingestion lowers gut injury evoked during high-intensity exercise. These results suggest that sucrose ingestion, but not nitrate, prevents hypoperfusion-induced GI damage during exercise and, as such, may help to lower exercise-related GI complaints.
Supported by the Dutch Technology Foundation STW

Oral presentations

OP-PM23 ESSA-ECSS Exchange: Muscle metabolism

EXERCISE-INDUCED IMPAIRMENTS IN MITOCHONDRIAL ADP SENSITIVITY CONTRIBUTES TO THE INDUCTION OF PGC-1A GENE EXPRESSION THROUGH ENHANCED MITOCHONDRIAL H2O2 EMISSION

MIOTTO, P.M., HOLLOWAY, G.P.

UNIVERSITY OF GUELPH

INTRODUCTION: Acute exercise rapidly induces mitochondrial biogenesis, however, the role of mitochondrial derived reactive oxygen species in regulating this response remains controversial. We reasoned that the reduction in mitochondrial ADP sensitivity that occurs during exercise could have a biological role in increasing mitochondrial-derived ROS production, and ultimately promote the induction of mitochondrial gene transcription.
METHODS: To address this possibility, we utilized mitochondrial creatine kinase knockout mice, an animal model that we have recently shown have improved ADP sensitivity in permeabilized muscle fibres during exercise, to determine if ADP sensitivity influences ROS production and mitochondrial adaptations .
RESULTS: While exercise similarly induced calcium/calmodulin-dependent protein kinase II and AMP-activated protein kinase phosphorylation in wildtype and KO mice, in stark contrast, KO mice exhibited improved ADP sensitivity during exercise in association with reduced mitochondrial ROS emission and the absence of exercise-induced PGC-1α gene transcription . Furthermore, while 4 weeks of exercise training increased markers of mitochondrial content and reduced ADP sensitivity in permeabilized muscle fibres from WT mice , in concert with our acute experiments, KO mice had blunted responses in these parameters.
CONCLUSION: Combined, these data suggest that exercise-induced attenuations in mitochondrial ADP sensitivity mediate redox signals that may contribute to the induction of mitochondrial biogenesis.

THE EFFECT OF LIFE-LONG EXERCISE ON SIRT3 AND SOD2 PROTEIN EXPRESSION IN HUMAN SKELETAL MUSCLE

BORI, Z., KOLTAI, E., RADAK, Z.

UNIVERSITY OF PHYSICAL EDUCATION

INTRODUCTION: Aging causes significant loss in muscle mass and function. Physical exercise is a natural tool to attenuate this process. Since ageing is associated with reduced levels of physical activity and disuse causes muscle wasting and reductions in oxidative capacity master athletes provide an excellent model to study the effects of ageing per se on muscle, not confounded by disuse. The purpose of this investigation was to study the differences in the mRNA and protein mitochondrial expression between master athletes and age-matched controls.
METHODS: We recruited master athletes at European Veterans Athletics Championships (Nyíregyháza, Hungary), and control participants at nursing home (Győr, Hungary). Subjects older than 65 years were included in this study. The master athletes reported that they all had been training for more than sixty years, while control subjects were sedentary. The study was approved by the ethical committee of Semmelweis University (Budapest, Hungary). All participants had given written informed consent before inclusion. Muscle biopsy samples were taken from vastus lateralis. Quantitative real-time PCR and Western blot analyses were performed. Statistical significance was assessed by unpaired, two-tailed Students t-test or χ^2 test. Significance level was set at $p < 0.05$.
RESULTS: The mRNA levels of seven key proteins were studied: Sirtuin 1 (SIRT1) and Forkhead Box Protein O1 (FOXO1) mRNA levels were significantly higher in skeletal muscle of master athletes than that of control groups (Vascular Endothelial Growth Factor, Insulin-like Growth Factor 1, Mechano Growth Factor, Peroxisome Proliferator-Activated Receptor Gamma Coactivator 1-alpha, Mitochondrial Calcium Uniporter were not significant). At protein level immunoblot data revealed that expression of Sirtuin3 (SIRT3) and Superoxid Dismutase 2 (SOD2) proteins from the muscle samples of master athletes were higher than that in the control subjects.
CONCLUSION: FOXO1 is involved in glycolytic and lipolytic flux, and mitochondrial metabolism, hence the exercise-induced expression of FOXO1 in the muscle of master athletes is important part of adaptive response.
Our main finding is that life-long physical exercise significantly increases SIRT3 level thus inhibiting the age-associated decline in SIRT3 levels. This is a powerful beneficial effect of exercise against age-associated functional deterioration of mitochondria. Moreover SIRT3 deacetylates SOD2 and promotes its antioxidant activity, reducing the level of ROS in the mitochondria.
In conclusion physical exercise through the activation of SIRT3 and SOD2 can significantly attenuates the age-associated decline in mitochondrial function and suppress oxidative stress.

THE EFFECTS OF GRADED MUSCLE GLYCOGEN CONCENTRATIONS ON EXERCISE-INDUCED CELL SIGNALLING: IMPLICATIONS FOR TRAINING ADAPTATION

HEARRIS, M., MORTON, J., LOUIS, J.

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Commencing exercise with low muscle glycogen augments cell-signalling responses associated with exercise-induced regulation of mitochondrial biogenesis. Accumulating data suggests that a muscle glycogen threshold may exist (Impey et al. in press), whereby a critical level of glycogen must be surpassed for significant activation of signalling kinases and augmented expression of metabolic genes. However, the level of glycogen required to facilitate this response requires further investigation. As such, we sought to investigate the effect of various graded levels of muscle glycogen on exercise-induced cell signalling responses within human skeletal muscle.
METHODS: Eight trained amateur male cyclists, completed three bouts of high-intensity cycling exercise in a randomised, crossover design. Following an evening bout of glycogen depleting cycling, subjects received three graded amounts of carbohydrate over the subsequent 36h; 2.0 g·kg-1 BW (LOW), 6.0 g·kg-1 BW (MED) or 14.0 g·kg-1 BW (HIGH) prior to completing a bout of high-intensity interval cycling exercise. Muscle biopsies and venous blood samples were collected pre, post and 3 h post-exercise. Muscle biopsies will be analyzed for muscle glycogen content, gene expression and phosphorylation of key signalling kinases known to regulate mitochondrial biogenesis and venous blood samples analyzed for blood glucose, lactate, glycerol and NEFA concentrations.

RESULTS: No differences in heart rate (LOW: 175 ± 8, MED: 174 ± 8, HIGH: 173 ± 9 bpm) or RPE (LOW: 16 ± 1, MED: 15 ± 2, HIGH: 15 ± 2) were observed between trials during the high-intensity interval cycling exercise ($P > 0.05$).. Fat oxidation was significantly higher in the LOW trial (0.66 ± 0.19 g.min-1) compared with both MED (0.28 ± 0.23 g.min-1) and HIGH (0.15 ± 0.12 g.min-1) trials ($P < 0.05$). Concomitantly, CHO oxidation was significantly lower in the LOW trial (3.21 ± 1.08 g.min-1) compared with both MED (3.86 ± 0.93 g.min-1) and HIGH (4.39 ± 0.92 g.min-1) trials ($P < 0.05$).
CONCLUSION: We conclude that commencing high-intensity endurance exercise with graded differences in muscle glycogen availability induces significant changes in substrate utilisation, whereby lipid oxidation is augmented under conditions of low glycogen availability. This data has important implications for training prescription where changes in substrate utilisation during exercise are the key focus of the session.

VITAMIN D BIO-AVAILABILITY AND VITAMIN D RECEPTOR EXPRESSION AND TRANSCRIPTOMICS IN THE REGULATION OF SKELETAL MUSCLE MASS AND RESPONSES TO RESISTANCE EXERCISE TRAINING

BASS, J.J.1, WILKINSON, D.J.1, PHILLIPS, B.E.1, SMITH, E., SZEWCZYK, N.J.1, CLEASBY, M.E.2, GALLAGHER, I.J.1, ATHERTON, P.J.1
1MRC/ARUK CENTRE FOR MUSCULOSKELETAL AGEING RESEARCH, UNIVERSITY OF NOTTINGHAM, UK. 2 MOLECULAR PHYSIOLOGY OF DIABETES, ROYAL VETERINARY COLLEGE, UK. 3 FACULTY OF HEALTH SCIENCES & SPORT, UNIVERSITY O

INTRODUCTION: Vitamin D (VitD) deficiency is prevalent in ~25% of the population. VitD deficiency is associated with adverse athletic performance, low muscle mass/function, insulin resistance and whole-body metabolic dysfunction (1). In contrast to this, VitD has positive actions upon skeletal muscle; for instance, combined VitD supplementation and resistance exercise training (RET) has been demonstrated to augment muscle hypertrophy and function (2). VitD regulates and exerts its effects through the ubiquitously expressed VitD receptor (VDR), a transcription factor (TF) upregulated by RET (3), substantiating observational studies suggesting that the VDR mediates muscle growth and regeneration (4). Nonetheless, the roles of VitD and the VDR in the mechanistic regulation of skeletal muscle, remain poorly defined.
METHODS: To investigate the significance of VitD status and muscle VDR expression in relation to muscle, we studied 37 men/women (20-75y) who underwent 20-weeks of whole-body RET (3 times/week fully supervised), with DXA scans and m.vastus lateralis muscle biopsies being taken pre/post RET.
To further examine the mechanistic role of VDR in muscle mass regulation, we constitutively over-expressed (VDR-OE) or knocked-down (VDR-KD) the VDR in rat hind-limbs by cDNA or shRNA lentiviral transfection (under 2.5% isofluorane and 50mg/kg carprofen). RNA from muscles was exposed to RNA-Seq and gene-set/transcription factor enrichment analysis.
RESULTS: Upon examining relationships between VitD bio-availability, VDR expression and muscle responses to RET in humans, neither serum 1,25(OH)2D3 (active VitD) nor 25(OH)D (inactive) were associated with VDR or thigh muscle hypertrophy responses. In contrast to this, VDR gene expression positively corresponded with RET-induced hypertrophy ($p=0.01$, $R2=0.16$), with the greatest upregulation being observed in high responders to RET (+34±8%, $P<0.05$).
In vivo VDR-OE stimulated myofibre hypertrophy (cross-sectional area (CSA) +17±7%, $P<0.05$)), enhancing muscle protein synthesis (+69±7%, $P<0.05$), matched by an upregulation in key growth related extracellular remodeling and integrin pathway gene-sets. Additionally, multiple muscle hypertrophy crucial genesets (i.e. Pax & Srf) displayed heightened TF binding enrichment. Comparatively, VDR-KD induced myofibre atrophy (CSA -8±2%, $P<0.001$) and induced autophagy related processes (e.g. LC3B-II +84±43%, $P<0.05$). This was further substantiated by an upregulation of multiple lysosome and vesicle biogenesis gene-sets. Moreover, many energy metabolism related genes were downregulated i.e. electron transport, glycolysis and citric acid cycle gene-sets.
CONCLUSION: We conclude that VDR expression, not habitual VitD status, is an important regulator of muscle mass responses to RET such that VitD supplementation or therapeutics targeting the VDR (VitD analogs) may enhance RET-induced muscle growth. The VDR is regulated by RET and should not be discounted as a pro-muscle pharmaceutical target.

ESSA-ECSS EXCHANGE: HIGH-INTENSITY EXERCISE IS ABLE TO MITIGATE THE REDUCED MITOCHONDRIAL FUNCTION AND IMPAIRED GLUCOSE TOLERANCE INDUCED BY SLEEP-LOSS

SANER, N., BISHOP, D., BARTLETT, J.
INSTITUTE FOR HEALTH AND SPORT (IHES), VICTORIA UNIVERSITY

INTRODUCTION: Sleep-loss is emerging as an important risk factor for the development of impaired glucose tolerance, insulin resistance (IR) and, subsequently, type 2 diabetes mellitus. While the mechanisms underlying these changes remain to be fully elucidated, there is evidence that IR may be associated with reduced mitochondrial function (Saner et al., 2018). This raises the possibility that sleep-loss may also impair mitochondrial function, but to our knowledge this hypothesis has not been tested. The possible relationship between reduced mitochondrial function and IR, suggests exercise could be used as a strategy to counteract the detrimental physiological changes induced by sleep-loss; however, again, this has not been investigated. Therefore, the aim of this study was to investigate the effect of sleep-loss, with or without exercise, on skeletal muscle mitochondrial function and glucose tolerance.
METHODS: Twenty-three healthy male participants were allocated to one of three experimental groups: a control group (CON, n=7) (8 h sleep opportunity for 5 nights), a sleep-restricted group (SR, n=8) (4 h sleep opportunity for 5 nights), and a sleep restricted and exercise group (SR+EX, n=8) (4 h sleep opportunity for 5 nights and 3 x high-intensity interval exercise (HIIE) sessions). The HIIE bouts consisted of 10 x 60-s intervals at 90% peak power, interspersed by 75 s of active recovery. Oral glucose tolerance tests (OGTT) and muscle biopsies were performed pre- and post-intervention.
RESULTS: Mean sleep duration per night for CON, SR, and SR+EX was 448+25, 230+13 and 237+5 minutes, respectively. There was a significant reduction in mitochondrial respiratory function (O2 flux – pmol/s/mg tissue) from pre- to post-intervention in the SR group (80 + 16 vs 65 + 24, $p=0.0087$), but this remained unchanged in the CON (70 + 5 vs 64 + 12, $p=0.5837$) and SR+EX (78 + 20 vs 79 + 28, $p=0.9998$) groups. OGTT plasma glucose total area under the curve increased post intervention in the SR group (692 + 89 vs 832 + 57 units, $p=0.0018$), but remained unchanged in the CON (741 + 202 vs 677 + 184, $p=0.2379$) and SR+EX (645 + 51 vs 702 + 83, $p=0.2281$) groups. Further, plasma insulin levels (uIU/mL) were elevated post-intervention at 60 minutes (48 + 32 vs 74 + 33) in the SR group ($P=0.001$), but there was no change in either the CON (57 + 50 vs 50 + 40, $p=0.9870$) or SR+EX (26 + 14 vs 35 + 14, $p=0.4176$) groups.
CONCLUSION: Sleep-loss was associated with reduced mitochondrial respiratory function, decreased glucose tolerance, and increased insulin concentration. However, these changes were mitigated by performing HIIE during the period of sleep restriction. These data provide the first evidence that exercise may be a potent and cost-effective strategy to alleviate some of the negative metabolic effects of sleep loss.

References:
Saner N, Bishop D, Bartlett J. (2018). Sleep Med Rev.37, 60-68
Contact:
nicholas.saner@live.vu.edu.au

MITOCHONDRIAL DERIVED REACTIVE OXYGEN SPECIES INFLUENCE ADP SENSITIVITY, BUT NOT CPT-I SUBSTRATE SENSITIVITY, DURING EXERCISE

HOLLOWAY, G.P., BARBEAU, P.A., MIOTTO, P.M.
UNIVERSITY OF GUELPH

INTRODUCTION: The mechanisms regulating oxidative phosphorylation during exercise remain poorly defined, however, key mitochondrial proteins, including carnitine palmitoyltransferase-I (CPT-I) and adenine-nucleotide translocase have redox sensitive sites. Interestingly, muscle contraction has recently been shown to increase mitochondrial membrane potential and reactive oxygen species (ROS) production. Therefore, we aimed to determine if mitochondrial derived ROS influences the bioenergetic responses to acute exercise.
METHODS: To achieve our aim, we determined the response of acute exercise on mitochondrial substrate sensitivity in WT and transgenic (MCAT) mice possessing attenuated mitochondrial ROS. Specifically, mice were randomly assigned to remain sedentary (n=8/genotype) or completed a 90 min treadmill run (15m/min, and a grade of 5%, n=8/genotype), and the red gastrocnemius muscle was removed for assessments of mitochondrial respiration and rates of mitochondrial hydrogen peroxide (H2O2) emission in saponin permeabilized muscle fibres.
RESULTS: We found that attenuating mitochondrial ROS did not alter mitochondrial protein content, maximal coupled respiration, palmitoyl-CoA (P-CoA) respiratory kinetics or influence the exercise-mediated reductions in malonyl-CoA sensitivity, suggesting mitochondrial ROS does not regulate CPT-I flux during exercise. While attenuating mitochondrial ROS did not alter ADP sensitivity in resting muscle, in contrast, exercise increased the apparent ADP Km (decreased ADP sensitivity) ~30% in WT mice only. Moreover, while the presence of P-CoA decreased ADP sensitivity, it did not influence the basic response to exercise, as the apparent ADP Km was increased only in WT mice. This basic pattern was also mirrored in the ability of ADP to supress mitochondrial H2O2 emission rates, as the attenuation in H2O2 suppression following exercise was absent in MCAT mice.
CONCLUSION: Altogether, these data demonstrate that while mitochondrial derived ROS does not influence CPT-I substrate sensitivity, ADP sensitivity is inhibited during exercise independent of P-CoA. These data implicate mitochondrial redox signalling as a key regulator of oxidative phosphorylation during exercise.

Invited symposia

IS-PM09 Pediatric Exercise Oncology: European Approaches for ActiveOncoKids

EXERCISE DURING ACUTE TREATMENT OF CHILDHOOD CANCER IN GERMANY – STUDY RESULTS AND FUTURE APPROACHES TO IMPROVE MOTOR PERFORMANCE AND ACTIVITIES OF DAILY LIVING

WISKEMANN, J., SOENTHGERATH, R., GOETTE, M., KESTING, S.
NATIONAL CENTER FOR TUMOR DISEASES

Children and adolescents with cancer experience severe physical and psychosocial consequences during treatment that dramatically affect daily life activities and participation in sports.
We conducted prospective studies in pediatric cancer patients to objectively assess levels of physical activity, motor performance, strengths and health related quality of life (QOL) in pediatric patients at three German children's hospitals. Results indicate musculoskeletal impairments and reduced QOL already early after diagnosis, during treatment and persisting problems in the aftercare ($p<.05$). Especially children with brain und bone tumors are physically inactive during treatment and have problems regarding reintegrating into physical education at school and into leisure time sports activities. To address these aspects we have developed evidence-based long-term concepts offering tailored physical activity and exercise during and after the course of treatment in various places. Analysis of more than 2,000 exercise sessions revealed clearly that exercising for childhood cancer patients within those programs is safe during as well as after treatment. Furthermore, we were able to show that physical function can be stabilized during inpatient chemotherapy treatment and quality of life can be improved ($p<.05$). In addition, refinement studies were able to reveal that adding activity trackers to an individual exercise program might help to improve adherence to certain activity goals (e.g. step goals) in the home-based setting and also increases health-related quality of life ($p<.05$). A currently running study is evaluating the capability of incorporating a strength training close to tasks of everyday life (2-3 times/per week). Overall, evaluations show that the implementation of adapted physical activity and exercise for childhood cancer patients during and after treatment is feasible and safe. Studies further revealed that patients benefit from an exercise intervention in a multidimensional manner. Based on these results insurance companies start to refund up to 85% of the cost for certain programs. Therefore, future main goal must be to increase program accessibility with the final goal to provide access for every childhood cancer patients in Germany.

EXERCISE IN CHILDREN WITH SOLID TUMORS

FIUZA-LUCES, C.
UNIVERSIDAD EUROPEA, MADRID

INTRODUCTION: Fiuza-Luces, C.1,2, Padilla, JR.1, Santana-Sosa, E.1, Morales, JS.1, Rincon-Castanedo, C.1, Lucia, A.1,2. 1: European University , 2: "i+12" Research Institute .
Introduction.
Despite major advances in survival rates, children with cancer are still at high risk for mid-long term therapy-related side effects that severely deteriorate their physical capacity . The aim of this randomized controlled trial was to determine the effects of an in-hospital exercise intervention on pediatric patients with solid tumors undergoing neoadjuvant chemotherapy.
Methods.

Participants were allocated to an exercise or control group . Training included 3 sessions/wk for 19±2wks. Each session lasted ~60-70min including both aerobic <~30min, 60-70% of maximum heart rate> and strength training. Participants were assessed at treatment initiation, termination, and 2 months after end-treatment. Primary endpoints included cardiorespiratory fitness, muscle strength <5RM tests>, functional capacity, physical activity, body mass and quality of life. Secondary endpoints were immune cell subpopulations, natural-killer cell cytotoxicity, and blood cytokine profile.
Results.
Most sessions were performed in the hospital´s gymnasium. Adherence to the program averaged 68±4%. A significant interaction effect was found for all 5RM tests . Performance significantly increased after training ; bench press: 24% <95%CI=6-14kg>; lateral row 25% <95% CI=6-15 kg>>, whereas an opposite trend was found in controls. Detraining values tended to be higher than baseline for leg and bench press . No other significant interaction was found.
Discussion.
An in-hospital exercise program for pediatric patients with solid tumors can be safely applied to increase muscle strength, without negatively affect immune function or inflammatory profile. These results represent an important addition to the current body of knowledge given the deleterious effects that high-intensity chemotherapy has on muscle tissue , which can persist into adulthood . Muscle strength is essential for health and growth, and for individual and social development .
References.
Ness KK, Armstrong GT, Kundu M, Wilson CL, Tchkonia T, Kirkland JL. <2015>. Cancer, 121<10>, 1540â "1547.
San Juan AF, Wolin K, Lucia A. <2011>. Recent Results Cancer Res, 186, 319â "347.
Smith JJ, Eather N, Morgan PJ, Plotnikoff RC, Faigenbaum AD, Lubans DR. <2014>. Sports Med, 44<9>, 1209â "1223.
Sontgerath R, Eckert K. <2015>. Pediatr Hematol Oncol, 32<8>, 585â "612.
Contact.
braduxia@hotmail.com

A PARTIALLY SUPERVISED PHYSICAL ACTIVITY PROGRAM FOR ADULT AND ADOLESCENT SURVIVORS OF CHILDHOOD CANCER – SURFIT

RUEEGG, C.S., ZUERCHER, S.J., SCHINDERA, C., JUNG, R., VON DER WEID, N.X., KRIEMLER, S.

PEDIATRIC HEMATOLOGY/ONCOLOGY UNIT, UNIVERSITY CHILDREN'S HOSPITAL BASEL (UKBB), SWITZERLAND & EPIDEMIOLOGY, BIOSTATISTICS AND PREVENTION INSTITUTE (EBPI), UNIVERSITY OF ZURICH, SWITZERLAND

Introduction: Modern childhood cancer treatment strives to preserve long-term health and quality of life (QoL). However, the majority of todays' childhood cancer survivors (CCS) suffers from late effects. Physical activity might mitigate or prevent many of these effects. We therefore started a randomized controlled trial (RCT) to investigate the effect of a 12-month exercise programme on a composite cardiovascular disease risk score in CCS. Secondary outcomes are glycaemic control, bone health, fatigue, physical activity/fitness, QoL, mental health, and adverse effects. We aimed to present the current state of the project as well as results from the baseline assessments accomplished by January 2018.
Methods: In total, 150 CCS aged ≥16y and diagnosed ≥5y prior to the study are recruited from Swiss paediatric oncology clinics. Following baseline assessments CCS are randomized 1:1 into an intervention and control group. Thereafter, they are seen at month 3, 6 and 12 for follow-up assessments. We assess anthropometry, bone health (DXA, pQCT), physical activity (pedometer, accelerometer), fitness (maximal cardiorespiratory exercise test, grip strength), blood parameters, clinical status and self-reported mental health, fatigue and QoL. The intervention group is asked to add ≥2.5h of intense physical activity/week, including 30min of strength and 2h of aerobic exercises. Regular consulting, individual web-based diaries, and pedometer devices are used as motivational tools.
Results: By January 2018, 146 CCS (83 males, median age 28 years, range 17-49) underwent baseline assessment (15% of 950 contacted) and were randomized. Among males and females, 31 and 14% were overweight, 7 and 10% obese, and 25 and 32% had too high waist circumferences, respectively. The median total body bone mineral density standard deviation score (SDS) was -0.8 (range -2.8-2.6); 50 (35%) CCS had a SDS below -1 and 7 (5%) a SDS below -2. Mean age- and sex-stratified relative peak oxygen uptakes (VO2max in ml/min*kg) were 36.9 (standard deviation (SD) 6.4) for males aged 17-29, 34.9 (SD 7.8) for males aged 30-39, and 31.5 (SD 6.1) for males aged 40-49 as well as 30.8 (SD 5.8) for females aged 17-29, 28.8 (SD 7.8) for females aged 30-39 and 25.7 (SD 10.1) for females aged 40-49 which corresponds to 68-73% of predicted. The median number of daily steps was 7356 (range 1351-15106). The recommended amount of 10'000 steps per day was reached on average on 20% of measured days (range 0-100).
Conclusion: SURfit is an efficacy trial that is running according to protocol and finishing in early 2019. The results from our baseline assessments show that the Swiss CCS are a population with unhealthy weight, decreased bone mass, low aerobic fitness and reduced physical activity. We believe that our exercise intervention can improve the cardiovascular health including body composition, bone health, physical activity and fitness and ultimately the well-being of this growing population of CCS

Oral presentations

OP-BN12 Footwear and running performance

COUPLING ANGLE VARIABILITY IS UNAFFECTED BY PERCEIVED COMFORT OF RUNNING SHOES

LINDORFER, J., KROELL, J., SCHWAMEDER, H.

UNIVERSITY OF SALZBURG

INTRODUCTION: One potential contributor to running injuries seems to be the indicator "preference of shoes" (Nigg, Baltich, Hoerzer, & Enders, 2015). From a biomechanical perspective the variability of segment coordination is affected in case of injuries and potentially serves as an injury predictor (Cunningham, Mullineaux, Noehren, Shapiro, & Uhl, 2014; Hamill, van Emmerik, Heiderscheit, & Li, 1999). Therefore, the aim of this study was to analyse the effect of shoe preference on segment couplings, as alterations could serve as a functional explanation of the injury contributor "preference of shoes".
METHODS: Most and least preferred shoes were selected by 15 runners from a set of five shoes by pairwise comparisons. Subsequently, kinematic data were collected during treadmill running in the two conditions at submaximal speed. A dynamical systems approach (Needham, Naemi, & Chockalingam, 2014) served as quantification of segment coupling and coupling angle variability (CAV) between

shank rotation and foot inversion/eversion (SHFO) as well as shank rotation and thigh flexion (SHTH) in five phases of the stride (Q1: 11-30%, Q2: 31-50%, Q3: 51-70%, Q4: 71-90%, Q5: 91-next 10%).
RESULTS: A visual inspection of the angle-angle plots revealed similar SHTH coupling, but differences in SHFO coupling. For both CAVs no statistical differences were found within the considered phases between most and least preferred condition.
CONCLUSION: Preference of shoes does not seem to affect CAV in healthy runners. While an increased injury rate in least preferred shoe inserts was found in long-term use (Nigg et al., 2015), it remains unclear if this is a consequence of varied coordinative variability since the actual data reflect only short term adaptations. A prospective study on shoe preference and potential CAV differences could allow deeper insight to injury susceptibility, as differences in coordinative variability have already been shown in injured participants.
REFERENCES:
Cunningham, T. J., Mullineaux, D. R., Noehren, B., Shapiro, R., & Uhl, T. L. (2014). Coupling angle variability in healthy and patellofemoral pain runners. Clinical Biomechanics, 29(3), 317-322
Hamill, J., van Emmerik, R. E., Heiderscheit, B. C., & Li, L. (1999). A dynamical systems approach to lower extremity running injuries. Clinical biomechanics, 14(5), 297-308
Needham, R., Naemi, R., & Chockalingam, N. (2014). Quantifying lumbar–pelvis coordination during gait using a modified vector coding technique. Journal of biomechanics, 47(5), 1020-1026
Nigg, B. M., Baltich, J., Hoerzer, S., & Enders, H. (2015). Running shoes and running injuries: mythbusting and a proposal for two new paradigms: preferred movement path and comfort filter. British Journal of Sports Medicine, 49(20), 1290-1294. doi: 10.1136/bjsports-2015-095054

SIMPLE METHOD FOR MEASURING EXTERNAL MECHANICAL WORK DURING RUNNING

DEVISE, M., ROSSI, J., BELLI, A.

UNIVERSITY JEAN MONNET

INTRODUCTION: The external mechanical work (Wext) produced during running is an important factor related to the metabolic cost of runners (Bourdin et al., 1993). In order to compute Wext, ground mounted (Cavagna, 1975) or treadmill mounted (Avogadro et al., 2004) force platforms and/or video motion analysis techniques are required but such equipment's are expensive and not practical for field measurements. The purpose of the present study was to propose and validate a simple method for measuring external mechanical work during running, using simple parameters such as contact and flight times, and which could be carried out under field conditions.
METHODS: Twelve male subjects (22.8 ± 1.7 years, 72.3 ± 4.6 kg, 1.80 ± 0.1 m) ran 4 min 30 on a treadmill dynamometer at 3.33 m/s. Vertical and antero-posterior ground reaction forces (GRF) were recorded from 10 consecutive steps at 3 min 30.
In the present method $Wext=1/2*Kleg*\Delta L^2$ where Kleg is the leg stiffness (in N/m) and ΔL the maximum leg spring compression (in m) during contact. Kleg and ΔL were computed using contact and flight times measured with vertical GRF, according to Morin et al. (2007).
Results of the present method were compared to the Wext calculated by reference method developed by Cavagna (1975) based on simple and double integration of respectively antero-posterior and vertical GRF measured by the treadmill.
Absolute bias was calculated for each subject. Statistical significance was accepted at $p<0.05$.
RESULTS: The values of the reference and modeled Wext were 1.73 ± 0.16 and 1.71 ± 0.15 J/kg/step respectively. The proposed method underestimates Wext and the mean error between the two methods was 0.03 ± 0.11 J/kg/step. When analyzing the whole dataset (i.e. 120 individual steps measured with both methods) the bias was 4.61 ± 1.83 %. Correlation coefficient for the relationship between the two methods was 0.82.
CONCLUSION: The aim of this study was to provide a calculation method for Wext, based on few simple parameters as ground contact time, aerial time, body mass, speed and leg length. In this study, the values of Wext were in agreement with literature (Avogadro et al., 2004). The low bias (less than 5%) obtained between the two methods and the high determination coefficients (more than 0.8) show that this method is more accurate than current pedometers (Nelson et al., 2016) which overestimate energy expenditure for jogging by 25-39%. For further studies, it could be interesting to investigate the evolution of Wext with this method at different running speeds and for different step frequencies.
REFERENCES:
Avogadro P, Chaux C, Bourdin M, Dalleau G, Belli A. (2004). Eur J Appl Physiol, 92, 182-185.
Bourdin M, Pastene J, Germain M, Lacour JR. (1993). Eur J Appl Physiol, 66, 439-444.
Cavagna GA. (1975). J Appl Physiol, 39, 174-179.
Morin JB, Samozino P, Zameziati K, Belli A. (2007). J Biomech, 40, 3341-3348.
Nelson B, Kaminsky L, Dickin C, Montoye A. (2016). Med Sci Sports Exerc, 48, 1619-1628.

INFLUENCE OF FOOTWEAR ON THE INJURY RISK IN AEROBICS AND CROSS-TRAINING ACTIVITIES: A ONE-YEAR RETROSPECTIVE STUDY

MORIO, C.1, DEMUYNCK, J.1

DECATHLON SPORTSLAB

INTRODUCTION: Aerobics and cross-training grew fast in the last decade. Injuries associated with aerobics were mainly located at the lower limbs (Malliou et al. 2013). However, the effect of wearing specific shoes on the injury risk in aerobics was reported either harmful (Rothenberger et al. 1988) or beneficial (Malliou et al. 2013) in the only two studies available on this question. Moreover, no information is available for cross-training. Therefore, the aim of the present study was to assess the effect of wearing specific shoes on the injury risk in both aerobics and cross-training.
METHODS: A specific questionnaire on the shoe habits, weekly training hours, and the injury history of the past year was sent to 4112 members of the Domoys™ tester database. 513 complete questionnaires were collected. Odds ratio (OR) and chi-square (X2) statistical analyses were used to compare the differences between aerobics and cross-training participants, between male and female participants, and between regular users of specific shoes and users of other shoes (mainly running shoes).
RESULTS: 83.5% of the responders regularly practice aerobics and 16.5% cross-training. 54% of the responders used specific shoes to practice these activities. 232 injuries were reported for the past year including 143 cases of lower limb injuries. This survey revealed risk ratios of 2.13 injuries per 1000h for aerobics, and 3.00 injuries per 1000h for cross-training (OR=0.71; X2=6.79; p=0.005). No significant difference (X2=2.34; p=0.08) was found in the risk ratio between male and female (1.91 and 2.5 injuries per 1000h respectively) but a moderate effect size (OR=0.76) might be considered as an interesting trend for further analyses. Regarding only the lower limb injuries, a significant protective effect was found on the risk ratio while wearing specific shoes (1.15 injuries per 1000h) compared to other type of

shoes (1.83 injuries per 1000h) (OR=0.63; X2=7.61; p=0.003). The latter result showed that wearing a pair of shoes specifically designed for aerobics or cross-training might prevent from some lower limb injuries. This was in accordance with the OR of 0.3 observed by Malliou et al. (2013). Deeper analyses are needed to find the potential interaction between factors.
CONCLUSION: Aerobics and cross-training presented a relatively low risk ratio compared to other sports (less than 3 per 1000h). Even so, wearing specific shoes was found to significantly reduce this risk ratio.

THE STRYD FOOTPOD: A NOVEL WAY OF PREDICTING AND IMPROVING RUNNING PERFORMANCE

BONGERS, C., VAN DELDEN, M., VAN MEGEN, R., EIJSVOGELS, T., VAN DIJK, H., HOPMAN, M.

RADBOUD UNIVERSITY MEDICAL CENTER

INTRODUCTION: The running economy (RE), which is defined as the amount of oxygen required to run 1 kilometer, is one of the main predictors of running performance and can be measured using a metabolic gas analyzer. Furthermore, the mechanical energy cost of running (ECOR), which can be influenced by running power and running technique, is also important for running performance. It might by suggested that running experience impact on running technique and thereby RE and ECOR. Therefore, the aim of this study was to compare the RE and ECOR of both trained and untrained runners at different running velocities. Furthermore, we want to investigate which factors affects the RE and ECOR.
METHODS: Ten untrained and eleven trained runners participated in this study. Subjects completed a predefined running protocol on a treadmill, which consisted of 3 bouts; I) 4 minutes at a self-selected cadence, II) 3 minutes at a high cadence (+10 steps per minute), and III) 3 minutes at a low cadence (-10 steps per minute less). Subsequently, a 5 minutes rest period was included, followed by a 15 minutes run at a self-selected cadence, in which the running speed was increased every 3 minutes. The RE and ECOR were measured continuously using a metabolic gas analyzer and the Stryd Footpod, respectively.
RESULTS: The RE of trained runners at a running speed of 11 and 12 km/h was significantly lower compared to untrained runners ($p=0.038$ and $p=0.016$, respectively). Furthermore, the trained runners had a lower ECOR at 10 and 11 km/h compared to untrained runners ($p<0.001$ and $p=0.040$). Additionally, the RE and ECOR decreased with increasing running speed in both groups (both p-values <0.05), and the highest RE and ECOR were found at the low cadence for both the trained and the untrained runners ($p<0.05$).
CONCLUSION: In conclusion, the RE and ECOR were significantly lower in trained compared to untrained runners, while a lower RE and ECOR were found at a higher running speed in both groups. These results suggests that trained runners had a better running economy and lower mechanical energy cost of running compared to untrained runners. Moreover, the efficiency of running is better at a self-selected cadence compared to a lower cadence.

IMPACT OF FOOTWEAR TYPE AND WALKING SPEED ON ANKLE PLANTAR FLEXOR FINE-WIRE ELECTROMYOGRAPHIC ACTIVITY

PÉTER, A.1, ARNDT, A.2, ANDERSSON, E.2, FINNI, T.1, CRONIN, N.J.1

1: NMRC , 2: GIH

INTRODUCTION: Ankle plantar flexors substantially contribute to propulsion in human walking, and their relative contributions may be affected by the type of footwear used. In this study, we aimed to examine plantar flexor fine-wire electromyography (wEMG) activity in different footwear types and barefoot walking. We further examined the effect of walking speed on the relative activity of ankle plantar flexors.
METHODS: Nine healthy people volunteered to this study (five males) with two sessions. In session 1, participants were familiarized to the study protocol. In session 2, electrical activity of flexor hallucis longus (FHL), soleus (SOL), medial and lateral gastrocnemius (MG and LG) muscles were measured with wEMG during eight overground walking tasks: preferred speed walking with shoes, barefoot and with flip-flops; with shoes: 30% slower and faster than preferred speed walking with shoes, and maximum walking speed; walking barefoot and with flip-flops at the same speed as preferred speed walking with shoes (matched speed). Then they performed maximal isometric plantar flexion contractions and maximal big toe flexions superimposed on ankle plantar flexion (MVICs) in an isokinetic dynamometer for wEMG normalization. Root mean square activity was calculated in the push-off phase of individual step cycles based on ground reaction force data. The relative contribution of each muscle to propulsion was calculated as: (mean RMS value %MVIC of the given muscle / mean RMS value %MVIC of all muscles) * 100. Cohen's d±90% confidence intervals were calculated to define the magnitude of differences.
RESULTS: In all muscles, wEMG activity increased with speed. With increasing speed the relative contribution to propulsion increased in FHL (from 19 to 22%), did not change in SOL (32%), decreased in MG (from 32 to 25%) and increased in LG (from 18 to 21%). There were no differences between preferred and matched barefoot walking speed or wEMG activity level (d range = 0.06-0.17). wEMG activity for all muscles was lower during matched barefoot walking than preferred speed walking with shoes (7-10% MVIC, d range=0.31-0.47). Flip-flop data are under analysis.
CONCLUSION: We found that relative wEMG activity of the examined muscles was affected by speed and absence or presence of shoes. During barefoot walking, wEMG activity of plantar flexor muscles was lower than during shod walking at the same speed, which presumably means that shod walking limits the contribution of intrinsic foot muscles to propulsion, which should be further examined.
CONTACT:
annamaria.a.peter@jyu.fi

BIOMECHANICAL ANALYSIS OF GAIT WAVEFORM DATA: RACE WALKING VS. KENYAN RUNNERS

GOMEZ-EZEIZA, J., HANLEY, B., TAM, N., SANTOS-CONCEJERO, J.

UNIVERSITY OF THE BASQUE COUNTRY

INTRODUCTION: The aim of this study was to analyse the biomechanical parameters of the gait cycle in world-class Kenyan runners and race walkers in a 3D analysis. It was hypothesised that race walkers' kinetics and kinematics would differ from running at the same speed, because of the need to maintain visible contact with the ground and a straightened knee from initial contact until the vertical upright position.
METHODS: Twenty-One Olympic male race walkers and fifteen elite Kenyan runners were recruited for the study. Kinetic and Kinematics were collected using a 3D motion analysis system race walking and running at 12 km/h. Joint kinetics were calculated using inverse dynamics, analysing each plane with a one-dimensional statistical parametric mapping, represented by a waveform.

RESULTS: Race walkers and runners showed differences in their gait patterns, as whereas the elite race walkers had higher ground contact times (ES=6.47), the endurance runners had longer flight times (ES=7.37) and swing times (ES=6.25). The outcome of these differences was that endurance runners used longer strides (ES=3.94) and lower cadences (ES=8.84). Both running and race walking waveforms were found to be different at heel strike for the ankle, knee and hip. The race walkers' heel-strikes were characterised by a more (fully) extended knee (ES=3.08), more flexed ankle (ES=2.25) and less flexed hip (ES=0.56). In the other planes, higher abduction values were measured in the hip (ES=1.8) with external rotation in the ankle for the race walkers and internal rotation for the runners (ES=1.27). During the midstance phase, race walkers maintained or hyperextended the knee, whereas the runners flexed it (ES=8.55). Race walkers and runners showed similar ground reaction forces patterns during initial contact. However, the normalised initial loading rate was higher in endurance runners (p=0.011, ES=5.22).
CONCLUSION: As the first study comparing elite endurance runners and elite race walkers, this study provides very useful information about the three-dimensional gait dynamics. Many differences were showed between both groups during the entire waveform running and race walking at the same speed. As it was hypothesised, due to the requirements of the rule 230.2, race walkers must adopt and optimise this peculiar gait pattern to excel in their event, thus, missing out on the elastic energy absorbed (and returned) by the knee, for example. By contrast, distance runners have no restrictions on their gait, and can therefore move in whatever way is most economical for them. Thus, these differences in the gait pattern, require race walkers a specific and more complex motor control, in addition to specific technical, strength and conditional training programs.

Invited symposia

IS-MI04 The physical activity continuum and other health-related aspects of lifestyle

SYNERGISTIC HEALTH EFFECTS AND INTERACTIONS OF PHYSICAL ACTIVITY, SEDENTARY BEHAVIOUR, AND OTHER HEALTH-RELATED ASPECTS OF LIFESTYLE

STAMATAKIS, E.
UNIVERSITY OF SYDNEY

Health and risk for chronic disease are heavily influenced by physical activity and other aspects of lifestyle. A synergistic effect exists when the combined health effect of two or more behaviours exceeds the sum of the individual effect of each behaviour alone. This is important for public health and clinical practice because there may be scope for targeting pairs of behaviours with strong synergistic links. In this presentation I will discuss the theoretical basis of looking at multiple aspects of lifestyle concurrently and will present results from our recent epidemiological studies that examine the interactions of different aspects of health related lifestyle (incl. physical activity, sedentary behaviour, sleep, alcohol consumption, and smoking). I will also explore the role of socioeconomic circumstances as moderators of these health effects. Our recent research has shown that physically active lifestyles may offset risks associated with alcohol consumption and lifetime smoking; and that the deleterious effects of physical inactivity are considerably amplified by high levels of sedentary behaviours and unhealthy sleep patterns. Many of our recent studies use new methodological paradigms that better handle the effects of time-dependent behaviours such as sleep and physical activity. For example, using isotemporal substitution modelling we can now estimate effects of replacing a time unit of one activity (e.g. 1 hr of sitting) with one unit of another (e.g. 1 hour of sleep) allowing us to better translate the results of epidemiological studies into public health guidance.
Besides the above established aspects of health related lifestyle I will also discuss the less researched area of dog ownership for human health. With physical inactivity being pervasive in all high income countries and dog ownership exceeding 40% in many countries, there may be a largely missed opportunity to systematically promote more incidental daily walking and less sedentary behaviour through canine-human interactions. My lecture will also present results of our recent epidemiological studies and trials that explore the potential of dog ownership as a means to increase physical activity and improve psychosocial health and reduce mortality risk among dog owners.

THE PHYSICAL ACTIVITY CONTINUUM IN RELATION TO MENTAL HEALTH: EPIDEMIOLOGY AND MECHANISMS

HAMER, M.
LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Several decades of evidence suggests that regular participation in exercise/physical activity promotes positive mood state, has anti-depressive effects, and can have favourable effects on cognitive function. More recently, however, researchers have turned their attention to other aspects of the continuum including sedentary behaviors and light activity.
METHODS: I will present our work on sedentary behavior, depressive symptoms, and cognitive function from a range of epidemiological cohorts in children and adults. I will present some of our recent experimental work that investigates biologically plausible mechanisms. In addition, I will touch on new methodologies in this area including ecological momentary assessments of mood.
RESULTS: Emerging data suggest sedentary behavior in certain contexts may be a risk factor for depression and cognitive decline. For example, in over 6,000 men and women from the English Longitudinal Study of Ageing TV viewing time, but not computer use, was associated with higher depressive symptoms. In contrast, objectively assessed sedentary time was inversely associated with psychological distress in 5000 children from Millennium Cohort Study. It therefore remains unclear if these findings are being driven by the context of the sedentary behavior or simply a lack of physical activity. Plausible biological mechanisms remain unclear.
CONCLUSION: In summary, the area of sedentary behavior and mental health is an emerging area, and data should be interpreted in light of several limitations including the use of poor exposure measures, potential for residual confounding, and lack of gold standard experimental data.

UNDERSTANDING THE CARDIOMETABOLIC HEALTH EFFECTS OF THE 24 MOVEMENT BEHAVIOR (PHYSICAL ACTIVITY, SEDENTARY BEHAVIOR, AND SLEEP) USING AN COMPOSITIONAL INTEGRATED THEORETICAL FRAMEWORK

CHASTIN, S.

GLASGOW CALEDONIAN UNIVERSITY

To date the relationship between health and each daily physical behaviours i.e. moderate to vigorous physical activity, light intensity activity , sedentary behaviour and sleep have only been studied in isolation adjusting only for one other behaviour, because standard statistical methods cannot deal with the whole day (time spent in each behaviour is highly collinear and correlated even when correlation indices are low). There is a dearth of information about the combined effect of allocating time to these different behaviours. During the day time is finite, time spent in one behaviour naturally displace time in others. Time budget data are therefore intrinsically co-dependent compositional in nature and require adopting statistical methodology consistent with this type of data. Compositional data analysis enables to investigate how different allocation of time spent in different activity is associated with health outcomes and adequately adjust model for time spent in all behaviours.
We will present results from four studies showing the association between the composition of the day and health outcomes. The results provide insights about different possible route for promotion of healthy pattern of activity and potential to develop 24 hours guidelines.

Oral presentations

OP-BN11 Neuromuscular testing and interventions

DOES PLAYERLOADTM CORRELATE WITH MAKERS OF EXERCISE INTENSITY OR NEUROMUSCULAR FATIGUE FOLLOWING REPEATED SPRINTS?

TEMPLE, S., BAUMERT, P., HULTON, A., STEWART, C.E., DRUST, B., ERSKINE, R.M.

LIVERPOOL JOHN MOORES

INTRODUCTION: Global Positioning Systems (GPS) are routinely used in team sports to estimate the "external load" [e.g. PlayerloadTM (PL)] experienced by an athlete following a bout of exercise, to inform recovery and aid periodisation of training. Yet there is a lack of evidence for a relationship between PL and exercise intensity or neuromuscular fatigue response to exercise. Additionally, it is not known if PL is sensitive to the demands of different sprinting tasks, such as straight line sprinting or shuttle sprinting, which may elicit different fatigue responses. The aims of this study were to (i) compare differences in PL and indices of neuromuscular fatigue response between two different sprint protocols associated with team sports movements and (ii) examine relationships between PL and different indices of neuromuscular fatigue.
METHODS: Eighteen recreationally active males (age: 20.7 ± 3.0 yr) performed either 15 x 30 m straight line sprints (SP, n=11) or 15 x (3 x 10 m) shuttle sprints (3T, n=7). PL, heart rate (HR) and rate of perceived exertion (RPE) were measured during SP and 3T. Capillary blood lactate (BL) was measured pre and post SP and 3T. The following assessments were made pre, post and 48h post SP and 3T: knee extensor (KE) and knee flexor (KF) maximum isometric voluntary contraction (MVC) torque, muscle soreness (visual analogue scale), voluntary and involuntary KF rate of torque development (RTD) and torque-frequency relationship (TFR) (measured via electrical muscle stimulation), range of motion (ROM), KF voluntary muscle activation (VA), and serum interleukin-6 (IL-6) concentration and creatine kinase (CK) activity.
RESULTS: PL was higher in SP (126.8 ± 13.8 AU) compared to 3T (107.6 ± 12.7 AU; $P<0.01$). PL correlated positively with HR ($R2=0.497$; $P=0.03$) and RPE ($R2=0.570$; $P=0.03$) only. There was a main effect for time regarding MVC, soreness, BL, ROM, involuntary RTD, CK, IL-6, and TFR ($P<0.05$) in SP and 3T, suggesting both protocols induced neuromuscular fatigue/muscle damage. There was a group x time interaction regarding muscle soreness, with SP exhibiting higher post and 48 h post values than 3T ($P=0.04$).
CONCLUSION: This study demonstrated that PL positively correlated with HR and RPE during exercise but not with any index of fatigue following repeated sprints. Straight line sprinting placed a higher external load upon the body than shuttle sprinting. While both straight line sprinting and shuttle sprinting both exhibited significant levels of neuromuscular fatigue post exercise, there was no difference between groups. However, subjective muscle soreness was significantly higher following straight line sprinting for up to 48 h. Our data support the use of PL to measure exercise intensity but not to predict neuromuscular fatigue. Moreover, performing shuttle sprints may be as fatiguing as straight line sprinting but may not elicit as much muscle damage post exercise.

EFFECT OF A WARM-UP ON THE REACTIVITY OF THE BOTTOM LIMB MUSCLES

PAKOSZ, P., MARIUSZ, K.

OPOLE UNIVERSITY OF TECHNOLOGY

INTRODUCTION: In the majority of professional and leisure athletes, a warm-up is performed as preparation for primary training. A warm-up is usually recommended in order to prevent injuries and increase performance in all the activities. Through our tests, we wanted mainly to examine changes in reactivity of muscles measured after a 15-minute warm-up on a cycloergometer, using modern, although already well-known measurement method - tensiomyography (TMG). TMG is a non-invasive measurement method used to detect properties of skeletal muscles. It is used to estimate the size of change in displacement of the muscle belly measured in millimeters (mm) and duration measured in milliseconds (ms) in reply to a single electrical stimulus. TMG measures geometric changes in the muscle belly, collecting data with the help of a digital sensor located perpendicular to the muscle. Several parameters of the muscle response can be measured with each measurement. Time parameters: Td (Delay Time), Tc (Contraction Time), Ts (Sustain Time), Tr (Relaxation Time), are measured in ms, while the muscle belly displacement parameter – Dm (Maximal Displacement) – is measured in mm.
METHODS: TMG examination covered twenty-six female students, with average age 19.7±1.1 years old, body height 167.3±4.8 cm and body mass 59±3.3 kg. The persons who were designated to the test had not had previous conditions within the examined muscles and joints. The test and retest were conducted with TMG system, before and after a 15-minute warm-up on a cycloergometer. The warm-up proceeded according to Bruce's scheme, where the drive was started from load 50 W (5 MET), and after each 3 minutes of the test, the load was increased by 25 W, until 150 W was obtained (15 MET), riding in the rhythm between 60 and 70 rpm. All the TMG parameters in surface muscles of the two bottom limbs were measured: gluteus maximus (GT), vastus medialis (VM), vastus lateralis (VL), rectus femoris (RF), semitendinosus (ST), biceps femoris (BF), tibialis anterior (TA), gastrocnemius medialis (GM), and gastrocnemius lateralis (GL).

RESULTS: The test results can be characterized by reduction in TMG time parameters of the bottom limb muscles. Td decreased from 24.4 (ms), to 23.9 (ms), at p=0.005, Tc from 33.2 to 32 (ms) at p=0.066, Ts from 194 to 157.3 (ms), at p =0.000, Tr from 73.8 to 59.1 (ms), at p=0.000. On the other hand, displacement of the muscle belly Dm increased from 6 to 6.1 (mm), at p=0.36.
CONCLUSION: After applying a 15-minute warm-up on a cycloergometer, reactivity of the bottom limb muscles to stimuli increased. On the contrary, the muscle belly is subject to greater deformations than in the test before the warm-up. The warm-up seems to have a substantial effect on the changed nervous-muscular profile, and the results can also be used as reference data. The TMG system is an effective tool for detecting changes which the muscles are subject to. Testing with the TMG system permits evaluation of sport programs and gives an opportunity to adjust them.

EFFECT OF TWO EXTERNAL COUNTERPULSATION TREATMENT DURATIONS ON NEUROMUSCULAR FUNCTION AND COMFORT IN PHYSICALLY ACTIVE YOUNG MEN

COLLINS, R.1, MCGRATH, D.1, HORNER, K.1, EUSEBI, S.2, DITROILO, M.1

1: UNIVERSITY COLLEGE DUBLIN, IRELAND, 2: UNIVERSITY OF URBINO CARLO BO, ITALY

INTRODUCTION: External Counterpulsation (ECP) has been well established as a treatment for individuals with coronary disease. Its potential as a sports recovery modality has recently been attracting interest. This study examined the effects of an ECP treatment in a rested state on neuromuscular function (NF). Specifically, different durations of ECP were compared in relation to both NF and participant comfort, the results of which could inform optimal administration strategies.
METHODS: Seven physically active male volunteers received two ECP treatments (Renew Sport, Singapore) of differing duration (20 and 40min) in a randomised, repeated measures crossover design. NF testing and subjective response recording was conducted at three separate timepoints: before treatment (PRE), post-treatment (0h), and 24 hours post-treatment (24h). NF testing consisted of countermovement jumps (CMJs) and 6-second sprint cycling. Rate of Perceived Exertion (RPE, 6 to 20) and Bipolar Comfort Scales (10 to -10) quantified the subjective experience of the participants, and each participant highlighted the "more acceptable" ECP duration. Repeated measure ANOVA and effect size (ES: Cohen's d) were used to analyse the NF testing results, and paired t-tests were used to analyse RPE and Comfort ratings.
RESULTS: A significant timepoint x duration interaction was found for CMJ height ($p<0.05$), with the post-hoc test revealing a significantly greater ($p<0.05$) 24h jump height for 20min (38.5cm) compared to 40min (35.9cm) treatment, with a small ES (0.28). CMJ relative peak power (PP/kg) showed no difference, and trivial ES, in both conditions. The ratio of eccentric/concentric contraction during CMJ was also analysed and despite no statistically significant differences, a trend in ratio reduction at 24h, with small ES, was recorded (20min, d=-0.51; 40min, d=-0.20). While the sprint cycling variables did not display significant differences, PP/kg at 24h showed an increase (d=0.45, small ES) for the 20min condition. Paired t-tests revealed a significant difference in comfort between conditions ($p<0.05$), with 20 minutes rated as more comfortable, and no difference in RPE. This corresponds with 6 of the 7 participants classifying the 20min condition as the "more acceptable" ECP duration.
CONCLUSION: These preliminary results indicate that ECP sessions of different duration yield separate effects upon NF, as indicated by a significant difference between conditions in CMJ height at 24h. The increase in PP/kg at 24h in sprint cycling (non-weightbearing) and no change in CMJs (weightbearing), suggests that the effect of ECP may depend upon the performance modality. This will be verified with continued data collection. Additionally, as no detrimental effects on NF were observed for the treatment duration of 20 minutes, ECP should be further explored as a potential recovery modality in both endurance and power-based sports.

NEUROMUSCULAR ELECTRICAL STIMULATION EXERCISE (NMES): A POTENTIAL COUNTERMEASURE IN MICROGRAVITY

CAFELLO, L.1, CAULFIELD, B.1, COBLEY, J.N.2, CROWE, L.1, COUGHLAN, G.1, MALONE, J.K.3

1: UCD , 2: UHI , 3: ABERTAY

INTRODUCTION: Muscle atrophy and reduced aerobic capacity are among a plethora of negative consequences of prolonged spaceflight (Yoshimitsu et al, 2010; Hargens et al., 2013). Countermeasures include bespoke exercise ergometers, bungee-cord assisted treadmills and resistance based devices. However, such bulky equipment in spacecraft where physical space is limited, has obvious limitations. NMES can induce favourable aerobic and strengthening effects across a range of healthy and clinical populations (Crognale et al., 2013; Banerjee et al., 2005), including the preservation of muscle mass during periods of immobilization (Dirks et al., 2014). This modality is portable and cost effective, and requires no additional physical space, however, evidence of its effectiveness in a microgravity environment is lacking. Therefore, the aims of this study were to compare: 1) the acute physiological effects; 2) degree of limb movements, when using NMES during normo-gravity (1G), micro-gravity (0G) and hyper-gravity (1.8G) environments, to assess its potential as an effective countermeasure during prolonged space flight.
METHODS: During a European Space Agency (ESA) Parabolic Flight Campaign, 11 healthy physically active volunteers (8 M; 3 F) underwent continuous sub-tetanic NMES (4Hz) to elicit rapid rhythmical contractions in the large lower extremity muscle groups (quadriceps and hamstrings) @ max tolerable intensity (48±17% VO2peak) for a total of 15 parabolas (Each parabole consisted of 3 periods: 2 x 1.8G (~ 20s); 1 x 0G (~20s), with ~2 min of 1G between paraboles & ~ 5 min between groups of 5 paraboles). Physiological responses were measured using a portable gas analyser, with limb movements using wireless, inertial motion sensors.
RESULTS: There were no significant differences ($P<0.05$) found for VO2 (18.2±5.4; 17.7±5.4; 17.6±5.5 ml.min-1.kg-1), VE (51.9±19.0; 53.3±18.8; 53.0±19.1 L.min-1), and RER (0.82±0.1; 0.81±0.1; 0.81±0.1) at 1G, 1.8G and 0G respectively. There were significant differences in mean variance of total acceleration of the thigh and shank across the gravitational states, with greatest variance found at 0G.
CONCLUSION: Acute physiological responses to NMES were not attenuated in a microgravity compared to normogravity environment. Furthermore, while there were small but significant differences in the degree of lower limb movements at 0G vs 1G, no uncontrolled limb movements that could be considered unsafe were observed. Therefore, findings suggest NMES may be a safe and effective therapeutic cardiovascular countermeasure in a microgravity environment, where aerobic exercise through weightbearing of the lower limbs is not possible.
References:
Banerjee et al. (2005) J Appl Physiol; 99(6):2307-11.
Crognale et al. (2013) J Strength Cond Res; 27(1):208-15.
Dirks et al. (2014) Acta Physiol (Oxf). 2014 Mar;210(3):628-41
Hargens et al. (2013) Eur J Appl Physiol;113(9):2183-92.
Yoshimitsu et al. (2010) Tohoku J Exp Med; 220(1):83-93
Contact: J.Malone@abertay.ac.uk

AXIAL BODY LOADING INDUCES CHANGES IN THE NEURO-MECHANICS OF HUMAN RUNNING

ATTIAS, J., MILEVA, K.N., RUSSOMANO, T., GREEN, D.A.

KINGS COLLEGE LONDON

INTRODUCTION: Bodyweight loading has been shown to increase neuromuscular activity and alter gait patterns during running. The Mk VI 'SkinSuit' developed as a spaceflight countermeasure provides axial body loading (ABL) via graded vertical compression up to 20% 'body weight'. Thus, we investigated the effect of additional 0.2Gz ABL upon lower limb muscle activation and gait kinematics during running.
METHODS: Nine male (29.4 ±5.2yr; 78.6 ± 6.8kg; 176.4 ± 6.7cm) healthy volunteers completed an incremental treadmill test while wearing either the SkinSuit (~1.2Gz; AL) or loose-fitting clothes (1Gz; CONTROL) in two randomised trials separated by at least 24 hours. The protocol consisted of 9km/h running for 2min with speed increases of 1km/h every minute until 13km/h was completed. Knee range of motion (ROM) was quantified using an electrogoniometer attached laterally to the right knee. Surface electromyography (EMG) activity of the right vastus lateralis (VL), biceps femoris (BF), Tibialis Anterior (TA) and Soleus (SOL) muscles were recorded continuously. Muscle activity levels and patterns were quantified by the Root Mean Square (RMS) and temporal characteristics of the EMG signal (onset, offset and duration), respectively. The main and interaction effects of CONDITION (AL vs. CONTROL) and SPEED (5 levels) were investigated with two-way repeated measures ANOVA.
RESULTS: Knee ROM within a stride was unaffected by load (AL: 82.6° vs CONTROL: 83.1° at 13km/h), but at both heelstrike (-5.51±2.1° vs. 8.1±1.5° [F(1,8) = 68.477 p=0.000]) and maximal flexion (77.1±3° vs. 91.2±5.3° [F(1,8) = 13.412 p=0.006], the knee joint was significantly more extended in AL compared to CONTROL. RMS EMG amplitude increased with SPEED similarly in both conditions for the VL, SOL and GL ($p<0.05$), with no observed CONDITION effect, whereas BF RMS amplitude increased to a greater extent in AL vs. CONTROL at faster speeds vs. 9km/h (SPEED*CONDITION interaction; $p<0.05$). SOL onset and offset, as well as VL and BF duration were affected by SPEED ($p<0.05$). In contrast, BF onset was later and SOL duration was longer in AL vs. CONTROL (main CONDITION effect; $p<0.05$).
CONCLUSION: SkinSuit-induced axial body loading (~0.2Gz) significantly altered gait characteristics during incremental running compared to 1Gz, which were not accompanied by concurrent increases in lower limb muscle activities. Nonetheless, SkinSuit-induced ABL prompted alternative activity patterns likely governed by the central nervous system (CNS) to preserve the same movement under differentially-loaded circumstances.

THE 'POST ACTIVATION POTENTIATION' EFFECT OF RESISTED SLED SPRINTING ON SUBSEQUENT SPRINT PERFORMANCE.

MONAHAN, M.

UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: Introduction; Post-activation potentiation (PAP) describes how performance of an activity involving maximal, or near maximal, muscle contraction may increase the strength/power produced in activities performed shortly afterwards. Previous research has established that various maximal, or near maximal resistance exercise can enhance subsequent sprint performance. However, the potentiating effect of resisted sled sprints (RSS) on subsequent sprint performance is equivocal and has yet to be trailed when using individually prescribed loads. The primary aim of this study was to assess the PAP effect of individually prescribed RSS stimuli, of 'high' (60%) and 'low' (20%) velocity decrement (vdec) loads on subsequent sprint performance.
METHODS: Methods; To compare the PAP effect of a high and low velocity decrement RSS stimulus; 28 field sport athletes (15M, 12 F; age, 22 ± 3 y; body mass, 74.1 ± 16.4 kg) took part in 3 testing sessions for which all took place on an indoor tartan track. To establish loads/vdec profile for each participant, the first testing session measured 0-10m(10m) & 0-20m(20m), unresisted sprint (URS) performance and RSS performance at various loads. Then to assess and compare the PAP effect of low & high vdec RSS on subsequent URS's, trials 2 and 3 measured 10m & 20m URS time (s) & velocity (m/s) prior to (13, 9 & 5 minutes) and post (30 secs, 5, 9, 13, 17, 21 & 25 min) 3 x 20m RSS's (of either a 20% or 60% vdec load). The best 10m & 20m performance pre and post were used to access effect of RSS.
RESULTS: Results; Post 20% vdec, best 10m time and velocity showed significant improvements -0.03(s) ± .06; 0.09(m/s) ± .21 ($p= \leq 0.04$, $d = 0.2$, mag = small) compared to best pre. While post 60% vdec, best 10m and 20m velocity significantly improved -0.06(m/s) ± .15; 1.0(m/s) ± .20 ($p= \leq 0.046$, $d = 0.2$, mag = small; $p= <0.001$, $d = 2.8$, mag = very large) respectively, when compared to best pre. Gender based evaluation showed, post 60% PAP best 20m velocity demonstrated large significant improvements -0.95(m/s) ± .15; 1.04(m/s) ± .23 ($p= <0.001$, $d = 0.-4.9$, mag = near perfect; $p= <0.001$, $d = 5.0$, mag = very large) for females and males respectively.
CONCLUSION: Discussion; Mean sprint velocities over 10m and 20m were similar between trials at pre. Following 3x20m RSS sprints at 60% vdec, subsequent sprint velocity improves at 10m and 20m. With the largest improvement 15% ±3% observed in best 20m velocity. Best time and velocity post 20% vdec at 10m also improved but these were of a smaller magnitude (d=0.2) that may be attributed to inter-day or inter-repetition variability. These improvements were not apparent when males and females were assessed separately.
Conclusion; RSS can acutely enhance subsequent acceleration and 3x20m RSS at 60% vdec can be successfully used to provide a large acute improvement in 0-20m sprint velocity, providing adequate recovery is given.
References: Turner, A et al. (2015).

Oral presentations

OP-BN10 Cognitive and motor functions in the elderly

INVESTIGATING THE INTERPLAY BETWEEN COGNITIVE AND LOCOMOTOR ADAPTIVE CAPACITIES USING A DUAL-TASKING PARADIGM

EGAN, S., MCGRATH, D.

UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: Many activities of daily living require concurrent performance in cognitive and gait domains, termed dual-tasking (DT). DT has been widely researched to determine the adaptive capacity of cognitive and locomotor systems in ageing and disease. Nonlinear gait metrics such as local dynamic stability and predictability of gait time series are also thought to capture adaptive capacity of the locomotor system [1]. The purpose of this study was to understand if different measures of adaptive capacity map to each other. This

research sought to a) determine the effect of DT on cognitive performance in older and younger adults, and b) investigate the relationship between nonlinear gait parameters and cognitive performance in DT.
METHODS: Steady-state gait data were collected from 14 healthy older (70.4 ± 5.4 years; 8M,6F) and 27 young adults (21.4 ± 1.7 years 12M,15F) treadmill walking, using an accelerometer attached to the shank and lumbar spine. The largest Lyapunov exponent and sample entropy of the acceleration signal were calculated over a period of 3 minutes per person. A test of verbal fluency - the controlled word association test (COWAT) - was performed, in sitting and then while treadmill walking. Participants completed two dual tasks i.e. two COWAT tests of increasing difficulty while walking (DT1 and DT2). The COWAT was scored by the number of correct words recalled in each condition; the difference in conditions were used for correlation with nonlinear gait variables. A mixed Anova examined potential interaction effects between group and COWAT conditions (seated, DT1 and DT2). Correlation analysis investigated the relationship between nonlinear gait metrics and change in DT performance.
RESULTS: The mixed Anova determined that COWAT performance differentiated between older and younger participants (p=0.048). Participants performed better while walking compared to the seated control (p=0.001). No interaction effect was observed suggesting that DT performance was not different between young and old. A weak relationship existed between DT performance and nonlinear gait metrics.
CONCLUSION: The goal of this work was to empirically examine the theoretical basis for framing nonlinear gait metrics as indices of functional adaptive capacity. Previous studies have shown an interplay between cognitive flexibility, and gait speed - but no other gait variables - in DT [2]. We investigated this from the inverse perspective: locomotor flexibility in steady-state and cognitive flexibility in DT, and similarly found only weak correlations suggesting that these gait variables do not map to adaptive cognitive performance in DT. It is likely that participants employed a 'posture second strategy [3], commonly seen in healthy populations, facilitating preservation of cognitive performance during DT.
[1] Cavanaugh JT et al (2017) J Neurol Phys Ther 245-251
[2] Hobert MA et al (2017) Front Aging Neurosci 9:154
[3] Decker LT et al (2016) Age 1-13

INFLUENCE OF COGNITIVE FUNCTIONS ON STAIR ASCENT AND DESCENT IN YOUNG AND OLDER ADULTS

GAILLARDIN, F., BAUDRY, S.
UNIVERSITÉ LIBRE DE BRUXELLES

INTRODUCTION: Stair ascent and descent are among the most complex and hazardous everyday life activity. Due to the age-related decrease in maximal force capacity (1), older adults operated closer to their maximal capacities during stair ascent and descent than young adults (2). As a consequence, stair locomotion is more challenging with advancing age, likely leading to increase the attentional demand of this motor task, as probed by dual-task paradigm (3). However, there is a lack of consensus on cognitive-motor interaction that may reflect, at least in part, the nature of the cognitive process (working memory and executive function) involved by the cognitive task. The purpose was to determine the impact of attention division, working memory and executive function on the cognitive-motor interaction when young and older adults ascend and descend stairs.
METHODS: 20 young and 20 older adults ascended and descended a 3-step staircase with no simultaneous cognitive task (single motor task) or while performing one of the three following cognitive tasks (dual-task): 1/SPAN-2 consisted of recalling a list of words with a number that corresponded to subject's word-span minus 2 words (attention division effects); 2/SPAN-O required to recall a list of words corresponded to subject's word-span (working memory effects) and; 3/SPAN-A was similar to SPAN-O but subjects had to recall the list in alphabetical order (executive function effects). Performance in motor and cognitive tasks was measured as the duration of the ascent or descent, and the number of words recalled, respectively.
RESULTS: Regarding cognitive performance, number of words recalled during stair descent did not differ between young and older adults ($p>0.05$) but was significantly lesser in SPAN-A than SPAN-O ($p < 0.001$). Ascent and descent duration did not differ between age groups in single task, and was similar between single motor task and SPAN-2 for both groups ($p>0.05$). In contrast, ascent and descent duration increased in SPAN-O compared with SPAN-2 for both groups ($p<0.01$). Stair ascent ($p=0.017$) and descent ($p=0.008$) were longer in SPAN-A than SPAN-O only in older adults.
CONCLUSION: This study highlights that healthy ageing was not associated with a decrease in dual-task performance that involve ascending and descending when cognitive task mainly requires working memory. In contrast, a decrease in dual-task performance was observed only in older adults when cognitive task requires executive function. This could reflect a subclinical decline of executive function with ageing.
REFERENCES:
1. Vandervoort, McComas (1986). J Appl Physiol 61:361-7.
2. Reeves et al. (2008). J Electromyo Kinesiol,18,218-27.
3. Ojha et al. (2009). Phys Ther,89,1080-8.
This study is supported by a grant of the King Baudouin Foundation (Belgium)

THE EFFICACY OF THE SQUARE-STEPPING EXERCISE IN IMPROVING COGNITION AND MOBILITY IN OLDER ADULTS WITH MULTIPLE SCLEROSIS: PRELIMINARY RESULTS.

SEBASTIÃO, E.1, ADAMSON, B.2, BOLLAERT, R.1, MCAULEY, E.2, SHIGEMATSU, R.3, ROBERT, W.
1: NIU , 2: UIUC , 3: MU , 4: UAB

INTRODUCTION: There is an increased prevalence of older adults living with multiple sclerosis (MS). Aging with MS as a disabling disease presents a number of consequences such as poor health status and cognitive and walking difficulty [1,2]. This study examined the efficacy of a home-based, square-stepping exercise (SSE) program in improving cognition and mobility in older adults with MS.
METHODS: We conducted a pilot randomized controlled trial involving 25 older adults with MS that were assigned into one of the following conditions: intervention (n=15) or control (n=10). The intervention group participated in the SSE program and the control group participated in a stretching and toning program (STT). Both programs used a hybrid approach and lasted 12-weeks. Participants were assessed at baseline and post-intervention period. Cognition was assessed using the California Verbal Learning Test (CVLT), which is a measure of verbal learning. Mobility was assessed using the Timed 25-foot Walking Test (T25FW), which is a measure of walking speed. Data were analyzed using mixed factor ANOVA and percent delta (%Δ). Statistical significance was set at $p <.05$.
RESULTS: The overall average age of participants was 64.3 (SD 4.5) years and disability level was found to be moderate (Expanded Disability Status Scale; EDSS = 4.0 [IQR = 2.5]) with over 90% of participants having the relapsing-remitting type of MS. ANOVA revealed no

group x time interaction for CVLT [F(1,23)= 0.764; p= .39] or T25FW [F(1,23)= 0.398; p= .53]. A marginal main effect for time was observed for CVLT [F(1,23)= 3.994; p= .06] but no main effect for time was observed for T25FW [F(1,23)= 2.393; p= .14]. Percent delta analysis revealed that participants in the SSE group on average improved verbal learning (i.e., CVLT) by 8.4% (d=.39) compared with 3.4% (d=.12) of the STT group; walking speed (i.e., T25FW) by 13% (d=-.34) compared with 3.4% (d=-.07).
CONCLUSION: Aging with MS has detrimental health consequences. Although no statistical significance was observed in the intervention group (i.e., SSE) regarding the outcome measures, SSE showed potential to improve aspects of cognition and mobility in older adults with MS.

EFFECTS OF COGNITIVELY DEMANDING ACUTE AEROBIC EXERCISE ON WORKING MEMORY

KAMIJO, K.1, ABE, R.2

1: WASEDA UNIVERSITY , 2: SHIMANO INC.

INTRODUCTION: An increasing number of studies conducted over several decades have shown the beneficial effects of chronic and acute aerobic exercise on higher-order cognitive function . Several recent chronic exercise studies have suggested that cognitively demanding exercise has a greater impact on executive function than simple exercise . The chronic effect is seemingly based on the assumption that the beneficial effects of acute aerobic exercise on executive function are greater for cognitively demanding than for simpler exercise. However, little is known about whether the effects of acute aerobic exercise differ depending on the cognitive demands that are made during exercise. This study was designed to examine the post-exercise effects of cognitively demanding acute aerobic exercise on working memory, which is one of the key aspects of the executive function.
METHODS: Three conditions were investigated: <1> the exercise-only condition in which participants only exercised on a bicycle ergometer; <2> the exercise-cognition condition in which participants simultaneously performed cycling exercise and a cognitive task; and <3> the rest-cognition condition in which participants performed a cognitive task on a bicycle ergometer without exercising. Using a within-participants design, middle-aged participants performed a 2-back task that required updating working memory information before and after each intervention.
RESULTS: In the exercise-only condition, a higher hit rate and shorter correct rejection reaction times were observed after acute aerobic exercise compared to pre-exercise baseline, whereas no such effects were observed in the exercise-cognition or the rest-cognition conditions.
CONCLUSION: The results of cognitive performance in the exercise-only condition supported existing evidence indicating acute improvements in working memory following aerobic exercise. By contrast, working memory performance did not change in the exercise-cognition condition or the rest-cognition condition, which may seem counterintuitive. However, several studies have suggested that exercising in environments requiring a high degree of cognitive resources could cause cognitive fatigue , which in turn might result in deduced working memory performance. Therefore, it is suggested that cognitive fatigue caused by additional cognitive demands during acute aerobic exercise might cancel the beneficial post-exercise effects on working memory.
References: Barcelos N, Shah N, Cohen K, Hogan MJ, Mulkerrin E, Arciero PJ, Cohen BD, Kramer AF, Anderson-Hanley C. <2015>. J Int Neuropsychol Soc, 21, 768-779.
Berman MG, Jonides J, Kaplan S. <2008>. Psychol Sci, 19, 1207-1212.
Contact: k-kamijo@aoni.waseda.jp

ASSOCIATION BETWEEN COGNITIVE FUNCTION AND PHYSICAL FRAILTY IN OLDER INDIVIDUALS WITH MILD COGNITIVE IMPAIRMENT

RUEDIGER, S., STUCKENSCHNEIDER, T., SCHNEIDER, S.

(A) GERMAN SPORT UNIVERSITY; (B) UNIVERSITY OF THE SUNSHINE COAST, AUSTRALIA

INTRODUCTION: To enable early interventions for dementia patients and to prevent a more rapid rate of cognitive decline, recent research focuses on prodromal stages such as mild cognitive impairment (MCI). Previous studies assessed the functional capacity of older persons and first results suggested that physical frailty is associated with an increased risk of MCI and a further cognitive decline [1]. In order to provide a better insight into the potential utility of frailty measurements as early markers and treatment recommendations in pre-dementia, the aim of this study was to analyse this relationship in an amnestic MCI (aMCI) sample.
METHODS: 85 persons between the age of 61–84 years (74.7±5.6 years) with diagnosed aMCI were included in this cross sectional study. Cognitive function was assessed using the Montreal Cognitive Assessment Battery (MOCA) [2]. The participants were divided into early (EMCI) and late MCI (LMCI), based on their MOCA scores (MOCA 19-22; 23-25). Measures of physical frailty (handgrip strength, lower body strength, and walking speed) were performed using a dynamometer [3] the 30s chair stand [4] and the Timed Up and Go test (TUG) [5].
RESULTS: Participants with LMCI performed significantly worse during the chair stand (p= .03) and the TUG (p= .02), but did not show differences in handgrip strength compared to individuals with EMCI (p= .65). The performance of the TUG and the chair stand test was related to cognitive impairment, whereas higher MOCA scores indicated faster walking speeds (p= .003, r = -.352) and a better performance in the chair stand (p= .02, r= .275).
CONCLUSION: The results show a link between physical frailty and cognitive impairment. However, the cause and response question- does physical inactivity leads to frailty and thus determines cognitive impairment, or does cognitive impairment limits physical activity, which leads to physical frailty- remains unanswered and should be addressed in future longitudinal studies. For now, caretakers should promote regular physical activity for individuals with MCI, as walking speed and leg strength are important factors to perform activities of daily living and live independently as long as possible.
References:
1. Robertson DA, Savva GM, Kenny RA. Frailty and cognitive impairment-A review of the evidence and causal mechanisms. Ageing Res Rev. 2013;12(4):840-851.
2. Nasreddine ZS, Phillips NA, Bédirian V, et al. The Montreal Cognitive Assessment, MoCA: A Brief Screening Tool For Mild Cognitive Impairment. J Am Geriatr Soc. 2005;53(4):695-699
3. Bohannon RW. Hand-grip dynamometry predicts future outcomes in aging adults. J Geriatr Phys Ther. 2008;31(1):3-10.
4. Jones CJ, Rikli RE, Beam WC. A 30-s Chair-Stand Test as a Measure of Lower Body Strength in Community-Residing Older Adults. Res Q Exerc Sport. 1999;70(2):113-119.
5. Podsiadlo D, Richardson S. The Timed "Up & Go": A Test of Basic Functional Mobility for Frail Elderly Persons. J Am Geriatr Soc. 1991;39(2):142-148
Contact: S.Ruediger@dshs-koeln.de

Oral presentations

IS-EX03 CSSS-ECSS EXCHANGE SYMPOSIUM - OPTIMISING PARTICIPATION IN PHYSICAL ACTIVITY

CHINESE FITNESS AND HEALTH PROMOTION STRATEGIES: THE ROLE OF EXERCISE SCIENCE

FENG, L.

CHINA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: The rapid development of economy and science and technology in China has brought great changes in lifestyle of Chinese people, consequently increasing non-communicable chronic diseases (NCDs) during the past 2 decades. In 2016, the word bank reported that more than 580 million Chinese adults were estimated to have at least one NCD, which account for more than 80% of China's 10.3 million annual deaths. There were 290 million adults aged 18 years and older suffered from cardiovascular diseases. The reported prevalence for hypertension was 25.2%, diabetes 9.7%, overweight 30.1%, and obesity 11.9% in 2012, respectively. The costs for chronic diseases accounted for more than 70% in total medical care. The proportion of people who regularly take part in physical exercise is 33.9%.The increased NCDs were largely due to steadily decreased physical activity and increased poor diet quality, which resulted in "the Healthy China 2030 Plan" to call for increasing public health efforts to expedite the promotion of physical activity and health among Chinese people.
"The Healthy China 2030 Plan" aims to enhance the combination of physical activity and medical care, and to strengthen non-medical care intervention, and to improve the overall population fitness and health. The ultimate goal is to insure that the Chinese average life expectancy reaches to the age of 79.0 years, the premature death rate caused by chronic diseases decreases by 30%, to insure that 92.2% of Chinese urban and rural residents meet the National Physical Fitness Evaluation Standard, and to insure that Chinese exercise population reaches 530 million. The plan addresses the urgent need to promote population-level fitness and health, which is increasingly adversely affected by the unprecedented economic development of China.

SELF-CONTROL RESEARCH AND ITS APPLICATION UNDER HIGH PRESSURE

ZHANG, L.

BEIJING SPORT UNIVERSITY

SELF-CONTROL RESEARCH AND ITS APPLICATION UNDER HIGH PRESSURE
Li-Wei Zhang (Psychology School, Beijing Sport University)
Introduction: In athletic competitions, we often see that some athletes achieve fantastic performance while others show unbelievable choking. All of these phenomena are closely related to their self-control. Self-control refers to abilities of restraining, adjusting and changing impulse, desire and habitual responses, which lies at the center of volition, motivation and emotion and has great impact on cognition. Self control embodies executive function and is a precondition of good social adaptation. Good self-control helps people cope with problems of impulse such as aggressive behaviors, crime, eating disorders, and addictive behaviors. Good self-control can also help people get better academic achievement and work accomplishment, have harmonious interpersonal relationship and increase the level of mental health. With the same logic, athletes' tough training and peak performance in big competitions also require good self-control.
Method
This study uses the method of research evaluation.
Results: This presentation will introduce the concepts, researches and implications that are closely related to self-control in athletic training and competition, focusing on the strength model of self-control (Baumeister, Vohs & Tice, 2007) and the attentional control theory (Eysenck, Derakshan, Santos, & Calvo, 2007) in a microscopic perspective and the model of integrated psychological construction (Liu, 1998, 2001) and the system of Chinese athletes psychological construction (Zhang & Zhang, 2011) in a macroscopic perspective. This presentation will also discuss the unique ways Chinese sport psychologists used to help athletes do mental preparation before Olympic Games.
Conclusion
It is believed that athletes' self-control in very tough training and competitions and related studies could be used as an important reference to people working under high pressure such as students in classroom examinations, doctors in operation rooms, soldiers in battle fields, and pilots in planes.
References: Baumeister, R. F., Vohs, K. D., & Tice, D. M. (2007). The strength model of self-control. Current Directions in P011sychological Science, 16, 3651-355.
Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: Attentional control theory. Emotion, 7(2), 336-353.
Liu, S. (1998). Psychological service to elite sport teams: Theory and practice for 10 years. Journal of Capital Institute of Physical Education, 10(4), 13-19. (in Chinese)
Zhang, K., & Zhang, L. (2011). Doctrin vs. technique: Inspiration of Chinese culture to athletes' psychological consultation and psychological training. Journal of Tianjin Sport Institute, 26(3), 196-199. (in Chinese)
liweizhang@hotmail.com

A MOTIVATION THEORY APPROACH TO INTERVENTIONS FOR SUSTAINED, HEALTH CONDUCIVE ENGAGEMENT IN PHYSICAL ACTIVITY

DUDA, J.

UNIVERSITY OF BIRMINGHAM

Introduction: Besides all of the well documented physical and mental health benefits of regular physical activity (PA), a concerning number of children and adults do not engage in a sufficient level of PA to realise such positive outcomes. With an overarching aspiration to facilitate the adoption and maintenance of an active lifestyle and contribute to population health, it is important that we: (1) sustain engagement in exercise programmes and sport, i.e., settings in which physical activity can be accrued and promoted, and (2) make it more likely that individuals participating in such settings experience well being and optimal functioning. Both aims are more likely to be realised when participation is autonomously motivated and the motivational climate manifested is more empowering/less disempowering

(Duda & Appleton, 2016). In this presentation, a brief overview will be provided of work pulling from contemporary theories of motivation and optimal engagement (such as Self Determination Theory or SDT; Ryan & Deci, 2017). This research has focused on an examination of the interplay between social environmental factors, motivational processes, and relevant outcomes in diverse groups such as: (a) patient groups/people w/ risk factors for disease onset, and (b) children involved in youth sport (Fenton et al, 2016).
Method
Cross-sectional and longitudinal designs including use of mixed methods; intervention.
Results and Conclusion
All in all, this work indicates that more empowering environments (which are more autonomy and socially supportive and task involving) are predictive of greater autonomous motivation, which is positively linked to greater well being and maintained participation. Evidence for the relevance and effectiveness of our theory-grounded interventions (e.g., Empowering Coaching™) is also provided.
References: Duda, J. L. & Appleton, P. R. (2016). Empowering and disempowering coaching behaviour: Conceptualization, measurement considerations, and intervention implications. In M. Raab, P. Wylleman, R. Seiler, A-M. Elbe, & A. Harzigeorgiadis, A. (Eds.), Sport and Exercise Psychology Research: From Theory to Practice. Elsevier.
Duda, J. L., Williams, G.C., Ntoumanis, N., Daley, A., Eves, F. F., Mutrie, N., Rouse, P. C., Lodhia, R., Blamey, R. V., & Jolly, K. (2014). Effects of a standard provision versus an autonomy supportive exercise referral programme on physical activity, quality of life and well-being indicators: A cluster randomised controlled trial. International Journal of Behavioral Nutrition and Physical Activity, 11(1):10.
Fenton, S.A.M, Duda, J.L., Appelton, P.R., & Barrett, T.G. (2016). Empowering youth sport environments: Implications for daily moderate-to-vigorous physical activity and adiposity. Journal of Sport and Health Sciences, 6(4).
Ryan, R.M., & Dei, E.L. (2017). Self Determination Theory: Basic Psychological Needs in Motivation, Development and Wellness. New York: Guilford.

Oral presentations

OP-PM83 Sports specific training

ASSESSING CHANGES IN AEROBIC FITNESS MEASURES OVER THE PRESEASON TRAINING PHASE IN PROFESSIONAL FOOTBALL PLAYERS

MICHAELIDES, M., PARPA, K., ZACHARIA, A., PETUSIS, C.

UCLAN CYPRUS

INTRODUCTION: The pre-season period in football develops the physical requisites for competition and usually consists of a high volume of aerobic and anaerobic conditioning training including friendly games. The purpose of the study was to determine the effects of pre-season training on aerobic fitness indices on professional football players of division one Cyprus football league.
METHODS: Fifty-four professional male football players (age =26.72 ± 4.12 years) performed an incremental cardiopulmonary exercise testing (CPET) on a treadmill before and after the eight weeks of pre-season preparation. Furthermore, the anthropometric measurements were recorded.
RESULTS: The results were analyzed using paired t-tests revealed significant differences on several indices. The participants improved significantly on maximal oxygen consumption (VO2 max) and lasted significantly longer on the treadmill ($p<0.05$). Heart rate response (Hr) decreased significantly at ventilatory thresholds (VT1, VT2), and at maximum (Hr max). The running velocity at ventilatory thresholds (Vvt1, vVT2) and at VO2 max (vVO2max) increased significantly ($p<0.05$). The VO2 at VT1 and VT2 also increased significantly ($p<0.05$). Furthermore, the body weight (BW) and percent body fat (%BF) decreased significantly ($p<0.05$).
CONCLUSION: The findings of this study clearly demonstrated that eight weeks of pre-season training have a significant impact on the body composition and cardiovascular fitness of professional football players. The study confirms the beneficial changes in the process of adaptations that occurs with this type of training.

PRESEASON TRAINING: THE EFFECT OF A 14-DAY HIGH-INTENSITY SHOCK MICROCYCLE IN HIGH-LEVEL ICE HOCKEY PLAYERS

BROCHERIE, F., PEREZ, J., GUILHEM, G.

FRENCH INSTITUTE OF SPORT

INTRODUCTION: This study aimed to investigate the effects of adding a high-intensity training (HIT) shock microcycle to the usual training content of the preseason preparation of high-level male ice hockey players.
METHODS: Over 14 days, 14 players (age: 23.4±7.2yr) were randomly assigned to HIT (n = 7) or usual preseason on-ice and off-ice training (control, n = 7). For HIT group, additional off-ice training content included two sessions of repeated-maximal resistance training, two sessions of repeated-sprint training and two sessions of high-intensity intermittent training. Control group performed equal number of off-ice sessions using traditional strength and conditioning training. Off-ice Yo-Yo intermittent recovery test level 2 (YYIR2) test and on-ice repeated-sprint ability test (RSA; 8 × 20 m – 20 s of passive recovery) were conducted before (pre-test) and 3 days after the intervention (post-test). A two-way repeated measures ANOVA (group × time) was used for comparison.
RESULTS: After the shock microcycle, significant group × time interactions were found for off-ice YYIR2 performance ($P<0.05$) and on-ice RSA cumulated skating time (RSATT) ($P<0.05$). Compared to pre-test, HIT group significantly improved their fitness level [i.e., increase in off-ice YYIR2 distance covered ($P < 0.01$) and decrease in on-ice RSATT ($p < 0.05$)], while no significant changes were observable in other RSA-related parameters (best time and percentage decrement). No significant pre-to-post-test changes were found for the control group.
CONCLUSION: A 14-day shock microcycle (i.e., including six additional HIT sessions) added to the regular on-ice and off-ice training significantly improved fitness performance in high-level male ice hockey players. Such HIT block periodization offers a promising way to deal with strong schedules constraints (few available time, short pre-competition preparation).

EFFECTS OF A 5-WEEK PLYOMETRIC EXERCISE PROGRAM ON VERTICAL JUMP PERFORMANCE ON RIGID AND SAND SURFACE

SZWAJCA, S., STELZER, L., ZENTGRAF, K., EILS, E.

INSTITUTE OF SPORT AND EXERCISE SCIENCES, UNIVERSITY OF MÜNSTER

INTRODUCTION: Plyometric training has demonstrated to be efficient in improving power-related measurements in athletic performance and muscle-tendon behaviour during stretch shortening cycle (SSC) exercise (Markovic, 2007; Hirayama et al., 2017). In handball, many actions require such attributes. Recently, beach handball was announced to be included into the Olympic Games and is currently, played by indoor handball players during their summer break. Although there are pronounced differences in playing on either rigid or sand ground, information regarding training to optimize performance for each format remains relatively unknown. Therefore, the aim of this study was to examine the effect of a 5-week plyometric exercise program on vertical jump performance on rigid and sand surface.
METHODS: 22 participants (24±3yrs, 177.8±9.1cm, 77.7±11.6kg) were assigned into control (CON, n=9) or plyometric training (PT, n=13) group. While CON proceeded with their normal training routines, PT participated in a 5-week PT regime (2 sessions/week each 45 min) consisting of plyometric exercises on firm ground with a progressive increase in the number of jumps (from 80 to 180). Testing was conducted 48h before (pre) and after (post) PT regime on sand (s) and rigid (r) ground. Jump performance was investigated via vertical displacement of a back marker attached to the body (CMJ, DJ) and reactive strength index (DJ). Surface electromyography (sEMG) evaluation examined preactivation (PA) and short latency response (SLR) of tibialis anterior (TA), gastrocnemius medialis (GM), vastus medialis (VM) and biceps femoris (BF), and ratio of root-mean-square (rRMS) of (TA/GM) and (BF/VM) during DJ only. Magnitude-based inferences (MBI) were used to describe probabilities of substantial differences between conditions.
RESULTS: There were observed improvements of 4.2%, 5.5% and 6.2% for CMJ (PT r), DJ (PT r) and RSI (PT s), respectively. However, no meaningful changes (possibly positive) were perceived in other performance variables. For sEMG, PA and SRL of TA, GM, BF and VM were deemed predominantly unclear pre to post. rRMS (BF/VM) was found likely and very likely positive for both groups and conditions (ES 0.66 to 1.71), whereas rRMS (TA/GM) was observed to be likely (ES -0.46) and very likely negative (ES -0.61) for PT on both conditions.
CONCLUSION: A 5-week PT program on firm ground was not sufficient to markedly enhance vertical jump performance on sand surface in the PT group. Although co-activation of agonist/antagonist muscles was optimized, it remains unclear whether a PT performed on firm ground is practically relevant for indoor team handball players preparation due to negligible improvements in CMJ, DJ and RSI performance. In accordance with Binnie et al. (2014) we suggest that preparation on sand should be preferred as greater training adaptions to be achieved.
References: Binnie et al. (2014). J Sports Sci, 32(1), 8-15.
Hirayama et al. (2017). Front Physiol, 8:16, 1-9.
Markovic G. (2007). BJSM, 41(6), 349-355.

THE EFFECT OF IN-SEASON VELOCITY-BASED SLED TOWING ON ACCELERATION IN SEMI-PROFESSIONAL RUGBY LEAGUE PLAYERS

BENTLEY, I.1, SINCLAIR, J.K.1, ATKINS, S.J.2, METCALFE, J.1, EDMUNDSON, C.J.1

1: UNIVERSITY OF CENTRAL LANCASHIRE , 2: UNIVERSITY OF SALFORD

INTRODUCTION: Coaches often employ sprint-specific training methods to improve acceleration. Sled towing provides an external load in the form of a weighted sled towed via a shoulder or waist harness and cord, behind the athlete. Sled loadings can be determined in different ways; however, the velocity-based approach is preferred as it accounts for strength/power and technical ability (Petrakos et al., 2016). This investigation looked to compare velocity-based sled towing (ST) and un-resisted sprint training (URS) as part of a concurrent in-season training programme in order to determine which training modality best enhanced acceleration and explosive power.
METHODS: Twenty-six male (18.8 ± 0.58 years; 87.62 ± 11.41kg; 182.17 ± 5.49cm) semi-professional Rugby League players were randomly assigned to either ST or an URS group. Baseline testing consisting of 5, 10, 20m sprints as well as counter movement jumps (CMJ) was undertaken before, during (week 4) and after an 8-week training intervention consisting of 16 sessions (3x3 20m sprints). The ST or URS intervention sessions were incorporated into the training programme, which also consisted of gym-based resistance training, technical field sessions and competitive games. Sled loadings were adjusted so that sprint time over 10m was reduced by 20%; loadings were re-calculated 4 weeks into the intervention.
RESULTS: Both interventions significantly reduced sprint time over 5, 10 and 20m ($p < 0.01$). CMJ height was increased significantly in the ST group (6.52% increase; $p = 0.012$), there were no significant changes in CMJ height in the URS group (0.79% increase; $p>0.05$). Performance improvements between the ST and URS groups over 5m, 10m and 20m were non-significant ($p > 0.05$), however, the ST group had greater percentage improvements at all distances (5m: ST = 5.59%, URS = 2.50% ; 10m: ST = 3.94%, URS = 1.24%; 20m: ST = 3.20%, URS = 1.22%).
CONCLUSION: The results indicate that the inclusion of ST in an 8-week training programme improves explosive power, but these adaptations did not transfer through to acceleration as distinctly as they did to executing a CMJ. This is likely to be because of the difference between tasks, as CMJ demands are principally force-based, whereas increasing sprint distances tend more towards velocity based demands. Though not statistically significant, the 5.59% greater improvement reported in the ST group over the initial 5m of the sprint is expected to be an important enhancement for game performance. In conclusion, for semi-professional Rugby League players, ST appears to provide marginal benefits over URS when combined with a concurrent training programme.
REFERENCES:
Petrakos G, Morin JB, and Egan B. (2016) Sports Med, 46 (3): 381-400.

EFFECT OF HANDBALL SPECIFIC ENDURANCE CIRCUIT TRAINING ON AEROBIC CAPACITY OF MALE HANDBALL PLAYERS

BALASUBRAMANIAN, C.

ANNAMALAI UNIVERSITY

INTRODUCTION: Handball is a fast intermittent sport demands greater amount of aerobic and anaerobic endurance during the match. Today handball coaches acknowledge the importance of sports specific training and employ during training (Kraemer et al. 2002). Sports specific training aims to show adaptation to fitness by replicating playing environment or conditions (Stone et al. 2000). Therefore, the aim

of our study is to assess the effect of handball specific endurance circuit training (HSECT) on aerobic capacity of male handball players at the end of the preparatory phase.
METHODS: We selected thirty trained male handball players who took part in this study. These players were classified into two groups as Handball Specific Endurance Circuit Training Group (HSECTG = 15) and Control Group (CG = 15). Thirty handball players were tested on aerobic capacity before the start and after eight weeks of training. Handball specific endurance circuit training was performed on specifically designed handball circuit 3 days a week for 8 weeks. To assess the training effect 2 × 2 repeated measure ANOVA on last factor repeated was performed.
RESULTS: Repeated measure ANOVA showed significant interaction effect for aerobic capacity ($F = 88.41$, $p < 0.05$) and simple effect displayed significant improvement in HSECTG from pre to post ($F = 173.6$, $p < 0.05$; MD = 4.02 & Cohen's d = 1.95).
CONCLUSION: Our study showed that HSECT has elicited 8.21% of improvement in aerobic capacity. Earlier it was established that game based training improves fitness (Coutts et al. 2010; Chittibabu 2013) and skill. In our study players performed at 90 to 95% of maximal heart rate in the specifically designed handball circuit which resulted in improvement of aerobic capacity. Previous studies confirmed the existence of linear and positive relationship exists between exercise duration spent at high intensity and changes in aerobic capacity (Castagna et al. 2013). We concluded that 8 weeks of HSECT at high intensity is effective enough in improving aerobic capacity of male handball players at the end of the preparatory phase.

PHYSIOLOGICAL PREDICTORS OF AN ON-COURT, SQUASH-SPECIFIC FITNESS TEST

FARRA, S.D., JAMES, C.A.
INSTITUT SUKAN NEGARA

INTRODUCTION: As elite-level squash play simultaneously imposes diverse physiological demands on the body (Murray, 2016), our laboratory developed and validated a novel on-court assessment of squash-specific fitness (James et al, under review). The purpose of this project was to examine the relationship between performance on this assessment and various fitness parameters to identify those critical for squash play and inform training prescription.
METHODS: Nine healthy members of the Malaysian National Squash Program (age = 18.2 ± 1.2 yr; Weight = 64.0 ± 3.1 kg; Height = 171.6 ± 7.9 cm) completed a battery of tests to determine body fat (BF), lean body mass (LBM), time to complete a change of direction (COD) course (Wilkinson et al, 2009), repeated sprint ability (RSA; Wilkinson et al, 2010), and the running stage that elicited a blood lactate of 4 mmol (OBLA) as well as final stage (FS) during the on-court squash test previously developed (James et al, under review). The on-court test was designed for subjects to undergo repeated, multi-directional shuttle runs around a predetermined pattern on the squash court in accordance to audio beeps until volitional exhaustion. Each stage consisted of 5-10 laps, with the audio beeps becoming progressively faster with each stage. The relationship between these variables and FS were examined using a Pearson's correlation.
RESULTS: There were statistically significant correlations between FS (76 ± 11 laps) during the on-court assessment and both COD (9.4 ± 0.7 s; $r = -.726$; $p = 0.027$) and RSA (221.2 ± 12.1 s; $r = -.671$; $p = 0.048$). There was a trend toward significance with OBLA (59 ± 7; $r = .663$; $p = 0.073$). No significant correlations between FS and BF (11 ± 5 %$r = -.570$; $p = 0.140$) or LBM (57 ± 2; $r = .329$; $p = 0.426$) were demonstrated.
CONCLUSION: These provisional findings are part of an ongoing project to identify the critical physiological attributes that are necessary for elite-level Squash. Of the measures studied, these data suggest that training the physical qualities that enhance change of direction ability, repeated sprint ability and OBLA are important to squash performance. Further research investigating the impact of strength, speed, and jumping characteristics on FS will help to extend these findings and facilitate the development of a multifactorial model of squash performance.

Oral presentations

OP-PM61 Nutrition

THE EFFECTS OF CAFFEINATED COFFEE INGESTION ON REPEATED SPRINT RUNNING PERFORMANCE: A DOSE RESPONSE STUDY

KARAYIGIT, R., YASLI, B.C., ERSOZ, G.
ANKARA UNIVERSITY

INTRODUCTION: The ergogenic effects of caffeine on various sports performance are now well established. Recently, most commonly supplemented form by athletes, caffeinated coffee has been shown to increase performance also in low doses (1). This study investigated for the first time that effects of different doses of caffeinated coffee (3-6 mg/kg) ingestion on sprint running performance in male team players.
METHODS: Thirteen male team players (mean ± SD: age, 22,0±1,9 yr; height, 176,1±5,5 cm; weight, 76,2±4,3 kg; VO2max, 60,9±5,7 ml/kg/dk) took part in this study. Following familiarization, in a randomized, crossover, counterbalanced research design, subjects were submitted to three experimental conditions: decaffeinated coffee (PLA), low dose (3 mg/kg) of caffeinated coffee (LOWCOF), moderate dose (6 mg/kg) of caffeinated coffee (MODCOF). Following 10 hour overnight fasting, subjects ingested coffee dissolved in 500 mL of hot water 1 hour before test and completed 12x30 meters repeated sprint running test protocol with 35 seconds passive recovery between sprints. Heart rate(HR) and rating of perceived exertion (RPE) were measured before begining of the test and after 6. and 12. sprints. Blood lactate(LAC) and blood glucose(GLU) were measured at immediately before and after test.
RESULTS: No significant differences were found in sprint running times, HR, RPE, GLU between any trials. Further, MODCAF and LOWCAF significantly increased blood lactate after test when compared to PLA ($p<0.05$).
CONCLUSION: This study demonstrated that neither moderate nor low doses of caffeinated coffee significantly increases repeated sprint running performance. Despite non significant effect, low and moderate doses of caffeinated coffee showed a trend to increase first three sprint running performance compared to placebo similar to Glaister's study (2).
References: 1. Clarke ND, Richardson DL, Thie J, Taylor R. Coffee Ingestion Enhances One-Mile Running Race Performance. International Journal of Sport Physiology and Performance. 2017, Ahead of print.
2-) Glaister M, Howatson G, et al. Caffeine Supplementation and Multiple Sprint Running Performance. Medicine and Science in Sport and Exercise. 2008; 40:1835-1840.

Contact racikarayigit@hotmail.com

THE EFFECT OF CAFFEINE INGESTION AND FATIGUING EXERCISE ON LEVELS OF BRAIN-DERIVED NEUROTROPHIC FACTOR IN HEALTHY MEN

MESQUITA, R.N.O., AVELA, J., CRONIN, N., HINTIKKA, J., KYRÖLÄINEN, H.

EDITH COWAN UNIVERSITY; UNIVERSITY OF JYVÄSKYLÄ

INTRODUCTION: Exercise induces mental health benefits. A member of the neurotrophin family, brain-derived neurotrophic factor (BDNF), plays a crucial role in these exercise-induced effects (Huang et al., 2014). In mice, BDNF synthesis and its modulation of synaptic transmission in the hippocampus are facilitated by the activation of adenosine receptors (Tebano et al., 2008). Caffeine is the most widely consumed drug worldwide, and several studies have documented its ergogenic effects. Caffeine's main mechanism of action is the reversal of inhibitory effects of adenosine by blocking its receptors in the central nervous system (Fredholm et al., 1995). Animal studies have demonstrated that chronic administration of caffeine reduces BDNF synthesis (Costa et al., 2008). However, an effect of this drug on BDNF tone has not been investigated in humans. Thus, this study examined the effects of caffeine ingestion on the exercise-induced production of BDNF.
METHODS: Sixteen males participated in this randomised, double-blind, placebo-controlled crossover trial. Blood draws to analyse serum BDNF (sBDNF) were conducted at three time-points: before administration of caffeine (6 mg•kg-1) or placebo, after a 1-hour rest and post-exercise. Participants performed a fatigue protocol that consisted of stretch-shortening cycle exercise until task failure on a sledge apparatus by repeating series of 40 bilateral rebound jumps, with resting periods of 3 min.
RESULTS: At the group level, caffeine did not increase the number of sets completed during the fatiguing task. Nevertheless, 9 responders and 7 non-responders could be identified. Prior to exercise, caffeine ingestion did not significantly alter the levels of sBDNF. In the fatiguing task there was considerable inter-individual variability in exercise duration, with 8 participants completing 7 or more sets of jumps. In the placebo condition, physical exercise caused a significant ($p = 0.001$) increase in sBDNF (pre-exercise: 9.72 ± 7.49; post-exercise: 15.29 ± 7.53 ng•ml-1), but only in the group of participants with greater fatigue resistance. This exercise-induced increase was not seen in the caffeine condition.
CONCLUSION: These results suggest that BDNF production is dependent on exercise duration. Moreover, the present study appears to provide evidence for a caffeine-related suppression of exercise-induced BDNF synthesis. This study lays the groundwork for future research into the possible negative effects of caffeine on the association between exercise and mental health.
References: 1. Huang , T. et al., Scand J Med Sci Sports (2014); 2. Tebano, M. T. et al., J Neurochem (2008); 3. Fredholm, B. B., Basic Clin Pharmacol Toxicol (1995). 4. Costa, M. S., et al., Neurosci (2008)
r.mesquita@ecu.edu.au

PEA PROTEIN ASCORBIC ACID MICROCAPSULES ARE MORE EFFECTIVE THAN ACORBIC ACID-FREE IN THE ATTENUATION OF OXIDATIVE STRESS BIOMARKERS AFTER SIMULATED SOCCER GAME EXERCISE PROTOCOL AMONG YOUNG PROFESSION

LOUREIRO, L.L., OLIVEIRA, T.M., COSTA, C.S.C., CITELLI, M., PEDROSA, C.M.P., PIERUCCI, A.P.T.R.

FEDERAL UNIVERSITY OF RIO DE JANEIRO

INTRODUCTION: Soccer players reach high intensity effort during competitive games and deleterious body symptoms can occur as consequence of oxidative stress (OS). Depending on metabolic adaptation to OS body hormesis can be delayed, compromising performance. Rapid recovery is relevant during competitive season, when games occur at small intervals. Nutritional interventions with ascorbic acid (AA) were proposed by many researchers aiming attenuation of OS blood biomarkers, however, literature is controversial as concerns its effectiveness. This might be due to the saturation mechanism that occurs in the enteric absorption sites of AA. Thus, we proposed microencapsulation of AA with a matrix of pea protein isolate (PPI) as an alternative to improve AA bioavailability. In this study, our aim was to evaluate the effect of PPI-AA microcapsules over OS biomarkers and AA bioavailability after a simulated game exercise protocol.
METHODS: A duble-blind crossover placebo controlled study was undertaken with 10 young players from a Brazilian elite sport club. Players were submitted to three nutritional treatments: PPI-AA; AA-free and placebo (P); AA doses were 1g. Blood parameters (catalase CAT, AA, total antioxidant capacity TAC, hydroperoxide HP, malondialdehyde MDH and creatine quinase CK) were monitored over time-course analysis up to 60 min after exercise.
RESULTS: PPI-AA had earlier decreasing effect than AA-free ($p<0.05$) on HP levels (20min vs 40mins), while MDH was not attenuated by any AA treatment. Enhancement in TAC was significantly higher ($p<0.05$) in PPI-AA than in AA-free (845.54 ± 56.66 vs 766.53 ± 64.44 µmol.AAeq-1). CAT had no variation. Absorption kinetics of AA from PPI-AA had typical profile of sustained release system, promoted by microencapsulation. All AA-free parameters were not statistically different from P, except for AA blood concentration.
CONCLUSION: Exercise protocol induced a rise on oxidative molecules and PPI-AA microcapsules were more effective than AA-free on their attenuation. Further analyses regarding player's physical performance will furnish more information about microcapsules functionality on body recovery.

DOES LOW-CARBOHYDRATE AVAILABILITY TRAINING INCREASE PROTEIN REQUIREMENTS OF ENDURANCE ATHLETES?

GILLEN, J.B.

UNIVERSITY OF TORONTO

INTRODUCTION: Increased protein requirements in endurance athletes are due in part to the need to replenish exercise-induced amino acid oxidative losses, which may be increased when exercising with low muscle glycogen. Low-carbohydrate (CHO) availability training can enhance markers of aerobic adaptation and has become popular to periodize throughout an endurance-training program. Given the importance of dietary protein to support post-exercise recovery, we aimed to determine the impact of low-CHO availability training on protein requirements. Using the minimally invasive indicator amino acid oxidation technique, we hypothesized that the excretion of our indicator amino acid would be greater after training with low as compared to high-CHO availability, reflecting a heightened protein requirement.
METHODS: Eight endurance-trained males (27±4y, 75±10kg, 67±10ml O2/kg/min) completed two trials matched for energy and macronutrient composition but with differing CHO periodization. In the low-CHO trial (LOW), participants consumed 7.8g CHO/kg during the day,

prior to an evening session of high-intensity interval training (HIIT; 10x5 min run intervals at ~90% HRmax, 1 min recovery) designed to lower muscle glycogen stores. Immediately after exercise 0.3g protein/kg was consumed and CHO intake was restricted for the remainder of the evening (0.2g CHO/kg). In the high-CHO trial (HIGH), participants consumed 3g CHO/kg during the day before HIIT, and subsequently consumed 0.3g protein/kg and 5g CHO/kg that evening to promote muscle glycogen resynthesis. The following morning, participants performed a 10km treadmill run (~80% HRmax) while fasted (LOW) or 1h after consuming 1.2g CHO/kg (HIGH). Following exercise, participants consumed eight hourly meals containing sufficient energy and 0.93g protein/kg/d as a crystalline amino acid mixture. Phenylalanine and tyrosine were consumed in excess to ensure the indicator amino acid ([1-13C]phenylalanine, consumed over the final 4h) was directed towards excretion after maximization of whole body protein synthesis. Breath 13CO2 enrichment (IRMS) and CO2 production (indirect calorimetry) were measured at metabolic and isotopic plateau for determination of 13CO2 excretion (F13CO2).
RESULTS: Fat oxidation (indirect calorimetry) was higher in LOW compared to HIGH (0.94±0.3g/min vs. 0.60±0.2g/min; p<0.05) during the 10km run. Preliminary analyses (n=7) revealed similar F13CO2 after the 10-km run in LOW and HIGH (0.89±0.10 vs. 0.84±0.16 umol/kg/h, respectively; p=0.36), suggesting similar rates of whole body protein synthesis.
CONCLUSION: Protein requirements of endurance-trained athletes appear similar after a 10-km run performed with low- or high-carbohydrate availability. Ongoing urinary analysis will determine if protein flux and oxidation are also similar in order to confirm/refute the observation that contemporary low-CHO availability training does not increase endurance athlete protein requirements above current guidelines.

EFFECTS OF CAFFEINE AND ACUTE EXERCISE ON COGNITIVE PERFORMANCE IN YOUNG ADULTS

LI, L., FENG, L.S., XU, J.F.

CHINA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: As a psychoactive stimulant, caffeine is a common ingredient in drinks that are consumed wildly in the world. The consumption of caffeine-containing drinks is reported to increase alertness, concentration, and memory. Recent years, some studies found that the acute exercise also have positive effects on cognitive function. However, inconsistent findings were also reported in previous research. Therefore, this study aimed to examine the different effects of caffeine and acute exercise on cognitive performance.
METHODS: Eighteen young volunteers (6 females; 21.3±2.4 yr; 68.5±7.0 kg) completed three experimental trials in a randomized crossover design. A 2-h standard examination was conducted firstly to induce brain fatigue, then the participants were instructed to consume either a caffeine-containing drink (Caffeine trial) or a flavored placebo drink (Placebo trial), or performed 20 min moderate-intensity cycling exercise (Exercise trial) followed by 120 min recovery. 100 mg caffeine was contained in the caffeine drink, and all drinks were consumed within 20 min in Caffeine and Placebo trials. During recovery, the heart rate (HR), blood pressure and blood samples were obtained. Reaction Time Test, Letter Cancellation Test (LCT) and Continuous Calculation Test (CCT) were used to measure the participants' cognitive performance.
RESULTS: At 60 min during recovery, the HR was higher in the Exercise trial (71±1 b/min) than the Caffeine (63±2 b/min) and Placebo (60±2 b/min) trials (p<0.01), but the systolic pressure was lower in the Exercise trial than the two other trials (112±11 mmHg vs. 119±11 mmHg vs. 117±14 mmHg, p<0.05). The reaction performance was better in the Caffeine trial (360±56 ms) compared with the Placebo trial (386±76 ms) at the end of recovery (p<0.05). The completion time was not different between trials in the LCT and CCT tests, but a higher accuracy of CCT test was observed in the Caffeine (63±32%) and Exercise (60±24%) trials than the Placebo trial (44±21%, p<0.05) at 120 min of recovery. There was no difference between trials in the serum serotonin, adrenaline, and brain-derived neurotrophic factor levels.
CONCLUSION: The effects of caffeine-containing drink or acute exercise on cognitive performance are generally small when comparing with a placebo drink. Moreover, the low-dose caffeine and acute exercise have similar effects on cognitive performance in the situations of current study.

RESTRICTING CARBOHYDRATE DURING RECOVERY FROM PROLONGED EXERCISE DOES NOT EFFECT INTRAMUSCULAR TRIGLYCERIDE RESYNTHESIS.

JEVONS, E.F.P.1, GEJL, K.D.2, HVID, L.G.2, FRANDSEN, U.2, JENSEN, K.2, SAHLIN, K.2, STRAUSS, J.A.1, ORTENBLAD, N.2, SHEPHERD, S.O.1

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Intramuscular triglycerides are an important substrate during prolonged moderate-intensity exercise, and therefore post-exercise IMTG resynthesis is an important part of recovery. Nutritional guidelines advise the consumption of carbohydrate following prolonged exercise in order to support glycogen resynthesis, but a high CHO diet impairs IMTG resynthesis. More recent evidence suggests that actually restricting CHO in the post-exercise period may maximise the adaptive response to exercise, but how this strategy effects post-exercise IMTG resynthesis has not been investigated. To address this, this study aimed to examine IMTG resynthesis when acutely restricting CHO in the post-exercise period following prolonged exercise.
METHODS: 14 male elite triathletes <27 ± 1y, 66.5 ± 1.3 mL.kg-1.min-1> were recruited as part of a previous study . Muscle samples were collected pre, post, 4h post and 24h post 4h of glycogen depleting cycling exercise. In the 4h period immediately following exercise 7 participants consumed a high CHO diet while the other 7 consumed only water. For the remaining recovery period <20h> all participants received the same CHO-enriched diet. Muscle samples were analysed using confocal immunofluorescence microscopy to determine muscle fibre type and subcellular-specific IMTG content and LD morphology.
RESULTS: Exercise reduced IMTG content by 53% in type I muscle fibres , and specifically in the central region of the fibre , which was driven by a 47% decrease in LD number . In recovery, IMTG content in type I fibres increased from post-exercise to 24h post in the water condition only . Specifically, IMTG content increased in the central region , with a trend for increases in LD number from post to post 24hr <58%, P=0.084>. However, no significant differences in IMTG content were observed between groups by 24h post .
CONCLUSION: IMTG utilisation during exercise was evident in the central region of type I fibres only, and a corresponding increase in IMTG content was only apparent in the water condition. Although IMTG resynthesis was significantly greater when restricting CHO immediately post-exercise, IMTG content was similar between groups at 24h post-exercise. Together, these results suggest that IMTG resynthesis following prolonged exercise is unaffected when acutely restricting CHO in the post-exercise period. Future studies will investigate the role of lipid droplet proteins in mediating this response.
References: Gejl KD, Hvid LG, Frandsen U, Jensen K, Sahlin K, Ortenblad N. <2014>. Med Sci Sports Exerc, 46<3>, 496-505.
e.jevons@2013.ljmu.ac.uk

Oral presentations

OP-PM49 Sedentary behaviour

A SYSTEMATIC REVIEW AND META-ANALYSIS OF THE EFFECTS OF INTERRUPTING PROLONGED SITTING WITH PHYSICAL ACTIVITY BREAKS ON BLOOD GLUCOSE, INSULIN, TRIACYLGLYCEROL

LOH, R., STAMATAKIS, E., FOLKERS, D., ALLGROVE, J., MOIR, H.

KINGSTON UNIVERSITY

INTRODUCTION: Sedentary behaviour has been associated with all-cause mortality independent of leisure time physical activity (PA), although such findings have been disputed. The primary aim was to systematically review and meta-analyse experimental trials breaking up prolonged sitting with intermittent bouts of PA throughout the day (INT) compared with sitting (SIT) on glycaemia, insulinaemia and triacylglycerol (TAG). A secondary aim was comparing the effects of INT against continuous exercise (EX), on glucose, insulin and TAG.
METHODS: PRISMA recommendations were followed. PROSPERO Registration: CRD42017080982
PubMed, OvidSP: Journals@Ovid and PsychINFO, Science Direct, SPORTDiscus were systematically searched on 04/03/2017.
Eligibility Criteria: control trials comparing INT vs SIT or INT vs one bout of EX prior to sitting, in participants aged 18 or above, healthy, or with type 2 diabetes, but not with other health conditions such as chronic obstructive pulmonary disease or peripheral arterial disease.
Risk of Bias (RoB) assessed with Cochrane RoB tool
RESULTS: INT vs SIT:
16 trial comparisons, 618 participants for TAG, 30 trial comparisons ,1036 participants for glucose, and 896 participants,24 trial comparisons for insulin, were meta-analysed.
INT vs EX:
6 trial comparisons,62 men, 75 women for TAG, 7 studies,90 men and 60 women for insulin, whereas 160 men and women, 8 studies for glucose, were meta-analysed.
Synthesis:
INT vs SIT: For glucose, SMD of -0.60 [-0.81, -0.39] in favour of INT. For insulin, SMD of -0.69 [-0.98, -0.41] in favour of INT. For TAG, SMD of -0.27 [-0.44, -0.09] in favour of INT. BMI was associated with glucose responses (β= -.064, 95% CI: -0.123, -0.005, p= .034), but not insulin (β= -.066, -0.152, 0.02, p=.122), nor TAG (β= .010, -.048, .067, p= .722)
INT vs EX: For glucose, SMD was -0.24 [-0.56, 0.08] in favour of INT, but not statistically significant (p=0.15). For TAG, SMD of 0.21 [-0.16, 0.57] in favour of EX vs INT, and not statistically significant (p=0.27). SMD for insulin was -0.08 [-0.31, 0.16] in favour of INT, and not statistically significant (p=0.53). When energy expenditure was matched, there was an effect in favour of INT, -0.36 [-0.65, -0.06] (p=0.02) on glucose, but not insulin, -0.16 [-0.40, 0.08] (p=0.20).
CONCLUSION: Most trials did not report randomisation or allocation methods, nor attempted blinding, nor handling of data attrition. There was possible publication bias for TAG. BMI moderates glycaemic response to PA breaks, but insufficient studies reported cardiorespiratory fitness or quantitative PA status, to allow regression.
PA breaks in sitting moderately attenuate post-prandial glucose, insulin, and TAG, with greater glycaemic attenuation in people with higher BMI, but any differences compared to one continuous bout of exercise are small, for glucose when exercise protocols are energy matched, or non-existent for insulin and TAG.
Therefore, PA breaks can attenuate standard markers of metabolic health.

DO THE ASSOCIATIONS OF SITTING TIME AND TV-VIEWING TIME WITH MORTALITY FROM CARDIOVASCULAR DISEASE AND CANCER DIFFER BY DIFFERENT LEVELS OF PHYSICAL ACTIVITY?

EKELUND, U., BROWN, W.J., STEENE-JOHANNESSEN, J, FAGERLAND, M.W., OWEN, N., POWELL, K.E., BAUMAN, A., LEE, I.M.

NORWEGIAN SCHOLL OF SPORT SCIENCES

INTRODUCTION: Sedentary behaviours, usually assessed as daily sitting and TV-viewing time, are highly prevalent and have been considered potentially detrimental to health. Using a harmonized meta-analytical approach we recently reported that moderate and vigorous intensity physical activity (MVPA) of at least 60 minutes per day appears to eliminate the detrimental association between sitting time and all-cause mortality. We here examine whether the associations between sitting/TV-viewing time and mortality from cardiovascular disease (CVD) and cancer differ by different levels of physical activity.
METHODS: Harmonised meta-analysis of prospective cohort studies. Data on exposure variables were harmonised according to a predefined protocol and categorised into four groups for sitting/TV time and into quartiles of physical activity (MET-h per week). Individual studies reported harmonised data on both daily sitting or TV-viewing time across quartiles of physical activity (PA), and effect estimates (Hazard ratio HR and 95% CIs) for CVD or cancer mortality. We then estimated summary HRs with 95% CIs across studies in separate meta-analyses for each outcome with a fixed-effect inverse variance method for sitting time and . TV-viewing time. We tested the trend for the probability of mortality within each stratum of physical activity with a Wald test in a logit model for the numbers of deaths and survivals.
RESULTS: Nine studies (N=850,060; Deaths=25,730) and eight studies (N=777,696; Deaths=30,851) provided data on sitting time and CVD and cancer mortality, respectively. Five studies had data on TV-viewing time, and CVD (N=458,127; Deaths=13,230) and cancer (N=458,091; Deaths=16,430) mortality. A dose-response association between sitting time (9% to 32% higher risk; P for trend<0.001) and TV time (3% to 59% higher risk; P for trend<0.001) with CVD mortality was observed in the 'inactive', lowest quartile of PA. There was no increased risk for CVD mortality with increasing sitting/TV-time in the most active quartile. Associations between sitting/TV-time and cancer mortality were generally weaker; 6% to 21% higher risk with longer sitting time observed only in the lowest quartile of PA.
CONCLUSION: PA modifies the associations between sitting/TV-viewing time and CVD and cancer mortality. These findings emphasize the importance of higher volumes of moderate and vigorous activity to reduce, or even eliminate these risks, especially for those who sit a lot in their daily lives.

METHODS: RESULTS: CONCLUSION: SEDENTARY BEHAVIOR: A REAL THREAT TO A LONG LIFE. THE ELDERLY EXERNET MULTI-CENTRE STUDY

NAVARRETE-VILLANUEVA, D.1,2, GÓMEZ-CABELLO, A.1,2,3,4,5, VILA, S.5,6, PEDRERO-CHAMIZO, R.7, VILLA, G.8, GUSI, N.5,9, GONZÁLEZ-GROSS, M.4,7, VICENTE-RODRIGUEZ, G.1,2,4, CASAJÚS, J.A.1,2,4, ARA, I.3,5

1:GENUD UNIZAR , 2:IA2 , 3:CUD , 4:CIBEROBN, 5:CIBERFES, 6: GENUDTOLEDO UCLM . 7:IMFINEUPM . 8:IBIOMEDUL 9:UE

INTRODUCTION: Nowadays, sedentary behavior (SB), defined as sitting (nonexercising), reclining, and lying down posture with a low energy expenditure (< 1,5 MET), is a public health risk due to its deletereous consequences [Harvey JA et al, 2015]. The aim of this study was to analyze the influence of SB (hours sitting per day) on ten-year mortality in community-dwelling older people.
METHODS: Between June 2008 and November 2009, self-reported sitting time was measured in 2313 Spanish non-institutionalized seniors aged 65 years or over (1131 women), using a validated questionnaire [López-Rodríguez C et al., 2017]. All participants were members of the cohort of the multi-center EXERNET Study [Gómez-Cabello A et al., 2011]. Sedentary behavior was recorded through the following question: "How many hours do you usually spend sitting per day?". Similarly, walking time was recorded through the following question: "How many hours do you usually spend walking per day?". For both questions, each participant had to choose one of the following answers: <1 h/day, 1–2 h/day, 2–3 h/day, 3–4 h/day, 4–5 h/day or ≥5 h/day. Ten years later, the mortality was identified by the Spanish National Death Index (INDEF). Logistic regression models were used to estimate the associations between sitting duration levels and mortality by sex. Models were adjusted for age as possible confounder. To test if walking time could influence on the associations mentioned above, all the analyses were repeated adding this variable into the model.
RESULTS: During the 10-year follow-up, 9.8% of the participants died (172 women, 49 men). Multiple logistic regression model showed a significative relationship between SB (more than 4 hours sitting per day) and mortality [X2(2, N=2313) =99.8; p<0.01] in women. Specifically, sitting more than 4 hours is related with an increase of a 44% of mortality risk in the 10-years follow-up (OR=1.44, 95% CI: 1.03-2.03, p≤0.05). Nevertheless, results become non-significant when including time spent walking as covariable (OR=1.27, 95% CI: 0.88-1.85, p>0.05). In men, no significant associations between sitting time and mortality were found.
CONCLUSION: In women, sitting 4 or more hours per day increases the risk of death, but it seems that walking can stop the premature mortality risk. This results support the benefits of a non-sedentary lifestyle as prevention of morbimortality in elder women.
References: Harvey JA, Chastin SF, Skelton DA. (2015). J Aging Phys Act, 23, 471–87.
López-Rodríguez C, Laguna M, Gómez-Cabello A, Gusi N, Espino L, Villa G, Pedrero-Chamizo R, et al. (2017). Arch Gerontol Geriatr. 69, 156-161.
Gómez-Cabello A, Pedrero-Chamizo R, Olivares PR, Luzardo L, Juez-Bengoechea A, Mata E, et al. (2011). Obes Rev. 12(8), 583-92.
dnavarrete@unizar.es

SEDENTARY BEHAVIORS ARE ASSOCIATED WITH A LATENT MODEL OF METABOLIC SYNDROME, INDEPENDENT OF PHYSICAL ACTIVITY, IN US ADULTS

TAYLOR, K.

EASTERN WASHINGTON UNIVERSITY

INTRODUCTION: Sedentary behaviors have been recognized as contributing to the declining cardiometabolic health of US adults. Traditional research investigates metabolic syndrome (MetS) risk factors as dichotomous variables, which can reduce statistical power. However, advanced statistical techniques, such as structural equation modeling (SEM), present the possibility for researchers to understand MetS as a latent variable and the relationship it has with lifestyle factors. Currently, there is no research investigating the use of SEM in the MetS literature in adults or with lifestyle factors such as sedentary behavior or physical activity (PA). The purpose of these analyses was to determine whether a latent model of MetS was valid in US adults and further, whether sedentary behaviors or PA were associated with this model of MetS.
METHODS: Data from the 2015-16 National Health and Nutrition Examination Survey (NHANES) was collected from 5,991 US adults (age 48.1±18.5 years, BMI 29.4±7.1 kg.m-2). Sedentary behaviors including time spent sitting and screen time (TV and computer) were collected via self-report as were levels of PA. MetS risk factors measured were waist circumference, blood pressure, and fasting glucose, triglycerides and high-density lipoprotein cholesterol. Confirmatory factor analysis (CFA) was used to construct a latent model for MetS and individual indicator variables. SEM was used to assess associations among sedentary behaviors, PA and MetS. Goodness-of-fit indices were used to determine model fit for CFA and standardized estimates with an alpha level of 0.05 were used for SEM models.
RESULTS: The latent MetS model was a valid model in this cohort ($\chi2$=295.39, p<.05; CFI=.92; RMSEA=.08) with all indicator variables significantly contributing to the model (p<.001). On average, participants self-reported engaging in 959.7 minutes/week of moderate PA and 571.0 minutes/week of non-leisure time PA. Further, participants self-reported an average of 449.6 minutes/week of sedentary activities and an average of 6.8 hours per month of screen time. SEM analyses showed that PA variables were not associated with MetS (β=-.01, p>.05). Sedentary behavior as a latent variable of sedentary activity (i.e., sitting) and screen time, was positively associated with MetS (β=.07, p=.002). This association was independent of moderate, vigorous, and non-leisure time PA (β range .07 to .08, p=.002).
CONCLUSION: These findings suggest that MetS may be studied as a latent variable using advanced statistical techniques. Further, sedentary behavior is associated with a latent model of MetS and this relationship is independent of PA levels in US adults. Our analyses suggest that PA may not be strongly associated with a latent model of MetS in this cohort. These findings support recent public health efforts to decrease the time spent in sedentary behavior by US adults and suggest that sedentary behavior may play an important role in cardiometabolic health independent of PA.

PHYSICAL ACTIVITY BUT NOT SEDENTARY TIME IS ASSOCIATED WITH CARDIOMETABOLIC HEALTH MARKERS IN OVERWEIGHT ADULTS

SJÖROS, T.1, VÄHÄ-YPYÄ, H.2, SAVOLAINEN, A.3, SIEVÄNEN, H.2, VASANKARI, T.2, KNUUTI, J.3, KALLIOKOSKI, K.K.1, HEINONEN, I.H.A.1

1: TURKU PET CENTRE, UNIVERSITY OF TURKU 2: UKK INSTITUTE 3: TURKU PET CENTRE, TUH,

INTRODUCTION: A low level of physical activity (PA) has been identified as an important predictor of poor health and all-cause mortality. Recently, there has been a growing interest in assessing sedentary behaviour (SB) instead of moderate-to-vigorous physical activity (MVPA) in the prevention of obesity and metabolic diseases.

METHODS: We examined the associations between cardiometabolic health markers and SB and PA in an overweight (BMI 31.2, SD 4) working aged population (n = 70, 15 men; age 56, SD 7) with high risk for metabolic syndrome and low self-reported PA levels. SB and PA were measured for 4 weeks (mean 25 days SD 5) with hip-worn accelerometers (UKK AM30) using validated mean amplitude deviation (MAD) and angle for postural estimation (APE) algorithms. Fasting plasma glucose, insulin, triglycerides, total, LDL and HDL cholesterol and HbA1c from venous blood samples were analysed using standard assays. Body mass index, waist circumference and blood pressure were measured prior to accelerometry. The associations were examined by Pearson's correlation analysis adjusted for age and sex.
RESULTS: Our analysis shows no association between cardiometabolic health markers and sedentary time. MVPA was significantly associated with lower fasting insulin levels (r = -0.28, p = 0.029) and plasma triglycerides (r = -0.27, p = 0.034) as well as smaller waist circumference (r = -0.29, p = 0.024). In consistency, daily step count was similarly associated with insulin (r= -0.29, p = 0.022), triglycerides (r = -0.27, p = 0.035) and waist (r = -0.29, p = 0.022). Breaks in sedentary time were associated with lower fasting insulin (r= -0.25, p=0.048) and waist circumference (r = -0.41, p = 0.0012). Both breaks and standing time as well as light activity were associated with resting heart rate (r = -0.36, -0.26 and -0.28, p = 0.005, 0.036 and 0.032, respectively).
CONCLUSION: In conclusion, it seems that in overweight adults at high risk for metabolic syndrome MVPA and daily steps, but not objectively measured sedentary time are associated with cardiometabolic health indicators. However, interruptions in sedentary time may also contribute to better metabolic health, overall suggesting that muscle activity is crucially important in cardiometabolic health promotion.

PATTERNS AND GEOGRAPHIC DISTRIBUTION OF OBJECTIVELY MEASURED SEDENTARY BEHAVIOUR IN EARLY YEARS: SYSTEMATIC REVIEW AND META-ANALYSIS.

PEREIRA, J.R., CLIFF, D.P., SOUSA-SÁ, E., ZHANG, Z., SANTOS, R.

UNIVERSITY OF WOLLONGONG

Background
Some studies in children indicate that the excessive sitting time may have harmful effects on children's health. However, the amount of time that young children spent in sedentary behaviour as well as the patterns of this behaviour is largely unknown.
Objective
This systematic review and meta-analysis summarises the current literature that used objective devices to capture patterns of sedentary behaviour on young children, in particular, differences between weekdays and weekend days, between childcare and non-childcare hours, and between indoors and outdoors, in young children. Prevalence of Sedentary behaviour according to geographic location was also assessed.
Methods: Five databases (Sport Discus, MEDLINE, SCOPUS, CINAHL and psycINFO) were searched until 26.10.2017 and meta-analyses were conducted.
Results: Fourty three studies representing 13, 364 children (aged 2 to 5.99 yr) were included. No significant differences on the time spent in sedentary behaviour were found between weekdays/weekend days (estimate difference=-0.4;95%CI=-2.0:1.2;p=0.61) or between childcare hours/non-childcare hours (estimate difference:2.9%;95%CI -0.9to 6.6%;p=0.136).While attending childcare centres, children spent more time in sedentary behaviour indoors than outdoors (estimate difference=14.4%;95%CI=11.8:16.9;p<0.001). When the studies were sorted by continent, prevalence of total Sedentary Behaviour seemed to be higher in North America (59.1%; 95%CI: 55.9 to 62.4) than in Europe (51.1%; 95% CI: 43.5 to 58.7), and in Oceania (47.5%; 95% CI: 22.2 to 73.7).
Conclusions
There is a need for higher-quality studies with strong designs, using age and device appropriate cut-off points, to raise the level of evidence-base and to better establish the prevalence of sedentary behaviour. As some data indicates that excessive sedentary behaviour may be detrimental to children's health and development, and knowing that this behaviour seems to be established at young ages and tracks throughout life, there is an urgent need to tackle sedentariness in early childhood, particularly while young children are indoors at childcare.

Oral presentations

OP-BN49 Lower limb injuries

ARE PATELLAR TENDON PROPERTIES ALTERED IN PATIENTS WITH CHRONIC PATELLAR TENDINOPATHY?

WIESINGER, H.P.1, KÖSTERS, A.1, MÜLLER, E.1, SEYNNES, O.R.2, HERFERT, J.3, RIEDER, F.1,3

1: PLUS , 2: NSSS , 3: PMU

INTRODUCTION: The mismatch between tendon functional demand and adaptational rate often ends in chronic pathological conditions (Riley 2004). Subsequently, affected athletes continue their daily routines in pain, although the impact of this pathology on tendon mechanics remains debated. Hence, the present study aimed to compare patellar tendon stiffness and, for the first time, hysteresis (i.e. the capacity to recoil elastically stored energy) between patients suffering from patellar tendinopathy and healthy controls.
METHODS: Ten adults with chronic (>3 months) patellar tendinopathy (25±5 yrs; male=7, female=3) were matched to ten healthy controls (29±4 yrs; male=7, female=3) in this pilot cohort comparison study. The clinical examination indicated persistent pain and palpation tenderness at the inferior pole of the patella, impaired functional performance (VISA-P≤80), ultrasonically verified tendon thickening and hypo-echoic area with some cases of neovascularization. Individual knee extension strength capacity, patellar tendon stiffness and hysteresis were obtained by combining isometric dynamometry, ultrasonography and electromyography.
RESULTS: Anthropometric parameters (age, height, body mass) did not differ between groups. There were no differences in maximal voluntary isometric knee extension torque (p=.34; η^2<.05), patellar tendon stiffness (p=.11; η^2<.13) and hysteresis (p=.53; η^2<.02). However, after normalization to body mass^2/3, patellar tendon stiffness was significantly lower in tendinopathy patients compared to healthy controls (-20%.; p=.03; η^2<.24).
CONCLUSION: In this study we observed lower stiffness in affected tendons, however, despite the substantial structural and histological changes occurring with tendinopathy (Magnusson et al. 2010), energy dissipation remains unchanged. The decreased stiffness of the impaired tendon could have important implications for athlete's performance and likely results in an increased strain in response to loading, increasing the risk of further tendon damage.

REFERENCES: Magnusson SP, Langberg H & Kjaer M. The pathogenesis of tendinopathy: balancing the response to loading. Nat Rev Rheumatol, 2010.
Riley GP. The pathogenesis of tendinopathy. A molecular perspective. Rheumatology (Oxford), 2004.
Funded by the AUSTRIAN SCIENCE FUND (FWF) – Austria's central funding organization for basic research.
Contact:
hans-peter.wiesinger@sbg.ac.at

THE EXTENDED VIEW OF THE PATELLOFEMORAL JOINT

HAEHNI, M.1, TAEYMANS, J.1, CLIJSEN, R.2, ROGAN, S.1

1 BERN UNIVERSITY OF APPLIED SCIENCES, BERN, SWITZERLAND; 2UNIVERSITY OF APPLIED SCIENCES AND ARTS OF SOUTHERN SWITZERLAND, LANDQUART, SWITZERLAND

INTRODUCTION: The prevalence of patellofemoral pain in physically active individuals ranges from 21% to 45%. In adults PFP prevalence rate ranges from 15% to 33% [1]. While in previous years the treatment of PFP focused on the neuromuscular control of the knee [2], the focus is now shifting towards a more functional-anatomical and biomechanical interaction of the hip, knee and ankle alignment. Recent research projects focus on the functional-anatomical circumstances such as lower leg alignment and the resulting biomechanical effects on the PFJ [3]. The main reason of PFP has been described as a chronic overload of the soft tissues with a misalignment of the patella or excessive patellar strain [4].
The prerequisite of an evidence-based physiotherapy to treat PFJ-pain patients is the knowledge of the interacting risk factors and PFJ pathogenesis. In addition, the knowledge of the clinical examination method and possible diagnostic imaging are also needed to establish adequate physiotherapy treatment strategy to tackle PFJ-pain in patients.
METHODS: The aim of this rapid review was to present the status quo of the diagnostic methods and physiotherapy treatment of PFJ-pain. The observed effect-sizes of the included studies were analyzed and discussed.
RESULTS: The diagnostic method of PFJ-pain in patients should include an anamnesis, a visual inspection of the lower leg alignment, a passive examination of the knee as well as a specific test of the PFJ with PFJ imaging. The diagnosis should examine the three anatomical risk factors: the bone, capsule-ligaments and skeletal muscle components.
CONCLUSION: The findings of this rapid review showed that a structured medical history and examination form the basis to prescribe an adequate physiotherapeutic intervention. To verify or falsify PFJ-pain, the anamnesis and visual findings should be made at first. Subsequently, passive examination and specific investigation tests of the PFJ should be performed. Finally, diagnostic imaging should be used for verification or falsification.
References: 1. Lindberg U, Lysholm J, Gillquist J: The correlation between arthroscopic findings and the patellofemoral pain syndrome. Arthroscopy 1986, 2:103-107.
2. Clijsen R, Fuchs J, Taeymans J: Effectiveness of exercise therapy in treatment of patients with patellofemoral pain syndrome: systematic review and meta-analysis. Physical therapy 2014, 94<12>:1697-1708.
3. Dey S: The pathophysiology of patellofemoral pain: a tissue homeostasis perspective. Clinical orthopaedics and related research 2005, 436:100-110.
4. Sanchis-Alfonso V: Patellofemorale schmerzen. Der Orthopäde 2008, 37:835-840.

SINGLE-LEG HOP FOR DISTANCE AS A PREDICTOR OF PATIENT-REPORTED OUTCOMES FOLLOWING A LOWER EXTREMITY INJURY

SIMON, J.E., YOM, J., GROOMS, D.R.

OHIO UNIVERSITY

INTRODUCTION: The single-leg hop for distance (SLHOP) is a commonly used functional performance measure to determine return-to-play readiness. However, it is unknown if functional performance at return-to-play can predict future patient outcomes. Therefore, the purpose of this study was to determine if SLHOP performance and symmetry at return-to-play following a lower extremity injury would predict lower extremity patient-reported outcomes six months post-injury.
METHODS: Two-hundred thirty-six adolescent athletes (15.7±1.4 years, 171.1±7.6 cm, 70.3±15.3 kg) were recruited for this study. If an individual sustained a non-surgical lower extremity injury during their sports season and missed three days of sports participation they were eligible for follow-up functional and patient outcome assessment Thirty-two adolescent athletes were eligible and completed the follow-up testing (15.0±1.1 years, 166.5±4.9 cm, 67.3±10.4 kg; 14 American football, 8 volleyball, 4 girls' basketball, 6 boys' basketball athletes). The SLHOP was completed by affixing a tape measure to the ground and instructing the participant to hop on one leg as far as possible. Each participant performed three trials per leg at return-to-play (alternating legs). To be counted as a successful trial the participant maintained postural stability for 2 seconds after the landing and the contralateral leg was not allowed to touch the ground. The Pediatric Patient-Reported Outcomes Measurement Information System (PROMIS) Lower Extremity scale was completed six months after return-to-play as the patient-reported outcome measure. A stepwise multiple linear regression was conducted to predict PROMIS Lower Extremity scale score from SLHOP distance on the injured and uninjured leg (cm), and limb symmetry (%).
RESULTS: At step one of the analysis, injured limb SLHOP distance was entered into the regression equation and was significantly related to the PROMIS Lower Extremity scale $F<1,31>=20.8$, $p<.001$. The multiple correlation coefficient was 0.79, indicating approximately 62% of the variance of the PROMIS Lower Extremity scale scores could be accounted for by the injured limb SLHOP distance. Specifically, for every increase in one cm of SLHOP performance there would be an increase of 0.6 points on the PROMIS Lower Extremity scale. Uninjured limb SLHOP distance and limb symmetry did not enter into the equation at step two of the analysis ($p>.05$).
CONCLUSION: The SLHOP conducted at time of return-to-play following a lower extremity injury can predict lower extremity patient-reported outcomes six months later. This indicates that clinicians may be able to use the SLHOP following an injury to not only determine return-to-play readiness but a successful long-term outcome.

PLANTAR FASCIITIS LEVELS IN RUNNERS WITH THE USAGE OF BALANCED SCORECARD

PAZETTI, J.A.T.1, MANCINI, F.1, MARTINEZ, B.R.1, BUCK, I.1, YI, L.C.1
FEDERAL UNIVERSITY OF SÃO PAULO ; UNIVERSITY PAULISTA-UNIP

INTRODUCTION: The way of business management has undergone changes and has impacted in business fields. Fasciitis Plantar (FP) is one of the most common injuries among runners, and the treatment is time-consuming and expensive (WHO,2015). Using a management tool such as the Balanced ScoreCard (BSC), could help Plantar Fasciitis treatment management (BSI,2017).Objective:The aim of the study was to identify the Fasciíte Plantar levels in runners.
METHODS: Thirty four runners, 24 men (70,59%) and 10 women (29,41%) between 30 50 years old (40.03±5.55), Body Mass Index (21.46 ±2.28 Kg/m²), with Plantar Fasciitis (PF), were enrolled in the study. They ran for at least 6 months, with the training volume of at least 20 km weekly and the pain visual analogue scale (EVA) of at least 3 (0-10). To construct the Balance Scored Card (BSC) model to obtain FP levels, indicators and goals were defined from four perspectives: (i) the results; (ii) the patient; (iii) internal process; (iv) learning and growth. The BSC indicators were determined from lower limb clinical assessment tools, as follows: Sports Athlete Foot and Ankle Score (SAFAS), Hop test, Core test, assessment of the feet intrinsic muscles, Jack test, Navicular Drop Test; Visual Analogue Scale Star Excursion Balance Test, Step Down; Range of motion of foot and ankle, and Lunge Test.
RESULTS: From a constructed model from BSC, 4 levels of plantar fasciitis were obtained for the runners, in which the level I subjects have the mild PF and the level IV the worst symptoms, as follows: level I (20.58%); level II (76.47%); level III (2.94%); level IV (0.00%). It was found that 97.06% of the runners concentrate on the first and two levels (I-IV) of the injury.
CONCLUSION: Through a BSC strategic management tool, the levels of plantar fasciitis were identified. The levels I and II composed almost 97% of the runners, probably because they were recruited from the runners club, and still active for running practice, with no symptoms of functional limitation. BSC has shown to be a tool that could help clinicians to guide the treatment of PF, that could give precision in the choice of treatment according to the stage and disease characteristic (Rummler,1994).
Balance Scored Card management tool is useful to identify the Plantar Fasciitis level in runners, in order to assist clinicians to the better treatment, according to the found level.
References: BALANCED SCORECARD INSTITUTE(BSI) 2017 [internet] [Access 2017may 01].Available at
RUMMLER,G.A;Brache,A.P.Better performance of companies.São Paulo: Makron Books,1994.
World Health Organization(WHO).2015[internet] [Access2015 may 28].Available at
Contact: josepazetti@gmail.com

KINEMATICAL DIFFERENCES BETWEEN POSTERIOR STABILIZED AND CRUCIATE RETAINING PROSTHESIS IN TOTAL KNEE REPLACEMENT USING DYNAMIC RSA

BRAGONZONI, L., BONTEMPI, M., CARDINALE, U., PIZZA, N., ZAFFAGNINI, S., MARCHEGGIANI MUCCIOLI, G., MARCACCI, M.
UNIVERSITY OF BOLOGNA

INTRODUCTION: The purpose of this work is to compare the kinematics of CR and PS TKA prosthesis design during a daily life activity.
Those two models show different features: asimmetrical condyles and lower lateral posterior condyle for the CR and simmetric condyles, frontal geometry and cam kinematics for the PS.
The motor task of the sit-to-stand was analyzed. This motor task is very common and allows to analyze the motion of the prosthesis with active muscle contraction and high stress inside the joint.
METHODS: The used RSA device was BiSTAND DRX (ASSING Group, Rome, Italy). The patients were asked to perform a sit-to-stand task: from the sitting position, the patient stands up.
The kinematic was analyzed using custom dedicated software. The motion parameters were evaluated using the Grood and Suntay decomposition and the Low-point kinematics. The time was normalized in percentage (0% begin, 100% end of the motor tasks). A random cohort of 16 randomly selected patients was operated and evaluated after 9 month follow up. The mean age of the patients was 69 years (95%CI, 64-82).
RESULTS: The kinematical data of the examined motor task were analyzed. The IE and VV rotations did not show any significative difference trend of the femur with respect to the tibia as the flexion angle increase. Otherwise the low point kinematics show a faster anterior traslation in the range between from the 55% to 80% of the movement. PS design show a wider anterior displacement respect to the CR. These two trends are in accordance with the screw-home mechanism. Moreover, the low point show a typical medial pivot during flexion.
CONCLUSION: Results using Dynamic RSA confirm different kinematic patterns between CR and PS. Particularly, the PS prosthesis has a range of displacement larger than the CR and the effect on the quality of life of patients deserves further studies.

KINEMATIC COMARISON OF PRE- AND POST- ACL RECONSTRUCTION DURING SINGLE-LEG-SQUAT USING DYNAMIC RSA

BONTEMPI, M., BRAGONZONI, L., CARDINALE, U., ZAFFAGNINI, S.
UNIVERSITÀ DI BOLOGNA

INTRODUCTION: The aim of this work is to compare, the kinematics of the knee of a cohort of patients with complete and isolated lesion of the Anterior Cruciate Ligament (ACL). The injured knee was evaluated using dynamic RSA pre-operatively and then were re-evaluated after 18 months of follow up. The ACL were reconstructed using the "Non Anathomical Double Bundle" (NADB), or the "Single Bundle with Lateral Plasty" (SBLP) techniques. The patients were asked to perform a single leg squat using the injured leg.
METHODS: A cohort of 27 patients (5 women, 22 men) with an isolated anterior cruciate ligament injury were recruited. The average age was 26 ± 8 years old. The analyzed knees were 16 right and 11 left. The patients were divided in two different groups: 13 were reconstructed using the SBLP, and 14 were reconstructed using the NADB technique. The Dynamic RSA device (BiSTAND DRX, ASSING Group, Rome, Italy) was used to evaluate patients the day before surgery (PRE group) and 18 months post-operatively. The patients were asked to perform a single leg squat using the injured leg: from standing to maximal allowed flexion (forward phase), to standing (return phase). The motion parameters were evaluated using the Grood and Suntay. The quantitative data were then statistically evaluated using the 1-way ANOVA ($p < 0.05$), to find significant differences during the movements.
RESULTS: The maximal flexion was the same in the injured and reconstructed knees. All the groups flexed at a mean angle of 67 degrees. The most important differences concerned the internal/external rotations (IE). The three pattern are very different and statistically signifi-

cant. The IE rotational pattern of the PRE group shows a forward phase values from -2 (external rotation), to +6 (internal rotation), to +4 degrees of rotation at the full flexion. The return phase ranges from +4 to +8 degrees. This pattern highlight a general instability of the knee. On the contrary the reconstructed knees show very different patterns. The NADB is divided in two stable sections. The forward phase has a IE rotation from +2, to 0, to +4 degrees. The return phase ranges from +4, to +8, to +5 degrees. The shape denotes that the patient has a stable rotation during the forward phase, then at the maximal flexion changes the knee rotation and start the return phase. The SBLP show a different, stable trend during the whole motor task. The IE rotations ranges from +5, to +8, to +5 degrees in both the forward and return phases, i.e. the knee maintains the same rotation during the motor task.
CONCLUSION: The analysis of the results, show that PRE group had a chaotic rotation pattern, while the NADB and SBLP are very different and the stabilization of the joint is strongly affected by these techniques. The SBLP demonstrated to be more effective to stabilize the rotations with respect to the NADB. Future studies will include a comparison with non-pathological kinematics of the knee.

Oral presentations

OP-SH03 Sociology 1

RE-ENGAGING LOCAL YOUTH FOR SUSTAINABLE SPORT-FOR-DEVELOPMENT

SCHULENKORF, N., HOEKMAN, J., WELTY PEACHEY, J.

UNIVERSITY OF TECHNOLOGY SYDNEY

Despite increasing evidence that sport-for-development programs can contribute to community development, there remains a lack of empirical inquiry into different socio-managerial aspects of SFD. For example, in attempts to achieve locally sustained SFD programs, the roles, responsibilities and potential impact of re-engaged youth need further investigation. We define re-engaged youth as previous program participants who have maintained strong links with the organization and who return to the program at a later stage as volunteers, casual staff, or full-time employees. In this presentation, we examine ways in which re-engaged youth of the Blue Dragon Children Foundation's SFD program contribute to sustainable management and community development within a disadvantaged community setting in Hanoi, Vietnam. Following an interpretive mode of inquiry, we conducted and analyzed 12 in-depth interviews and two focus group discussions with re-engaged youth and key program stakeholders. Based on our thematic analysis, re-engaged youth were recognized as key drivers for organizational success; they were identified as program culture experts, role models, leaders and mentors, and creators of a family feel in SFD and beyond. We argue that re-engaged youth are demonstrating a number of important change agent capabilities that enable them to uniquely gauge and best respond to the needs of program participants and local communities in complex sociocultural environments.
Reference
Schulenkorf, N. <2010>. The roles and responsibilities of a change agent in sport event development projects. Sport Management Review, 13<2>, 118-128

A FULLY-INTEGRATED MULTIDISCIPLINARY INVESTIGATION INTO THE TALENT DEVELOPMENT PROCESS IN AN ENGLISH FOOTBALL ACADEMY

KELLY, A.1,2, WILLIAMS, C.2, WILSON, M.2

1. BIRMINGHAM CITY UNIVERSITY, 2. UNIVERSITY OF EXETER

INTRODUCTION: The ultimate purpose of a player development pathway is to realise the most effective methods to support young individuals to maximise their potential (MacNamara & Collins, 2015). Within a modern football academy setting, the essential developmental characteristics are often termed environmental, psychological, sociological, physiological, technical, and tactical attributes (Sarmento et al., 2018). Although these factors have been explained to independently facilitate the acquisition of expert performance, fully-integrated multidisciplinary evidence from an English context is unknown. Therefore, the aim of this study was to combine these features and to determine, over two football seasons, what outcomes support greater age-specific development within the Foundation Development Phase (FDP; under-9 to 11s) and Youth Development Phase (YDP; under-12 to 16s) at an English professional football academy.
METHODS: A total of 87 players (aged 8 to 17 years) were analysed within their respective phase; FDP (n=36) and YDP (n=51). A combination of 34 holistic factors from the Participation History Questionnaire, Psychological Characteristics for Developing Excellence Questionnaire, socio-economic status, growth and maturation data, physical performance, technical tests, match analysis statistics, perceptual-cognitive expertise (PCE), and game test situations were measured at two time points across two football seasons. Development was measured by comparing the delta change between the overall player profile scores from two seasonal reports. Stepwise regression analyses were conducted to assess the predictive capability of these variables on overall development.
RESULTS: Within the FDP, total touches change (p=0.023), taking advantage of openings quality (p=0.003), and PCE 'post' score change (p=0.029) explained a combined 11.5% of the variance. Within the YDP, PCE 'at' score (p=0.21), total sports played change (p=0.008), and total match-play hours (p=0.009) explained a combined 34.1% of the variance.
CONCLUSION: Results from the FDP support the importance of technical and tactical development during middle childhood compared to other influential factors. From a YDP perspective, results support the significance of the environment players are exposed to, whilst also illustrating the importance of PCE as a key ingredient within adolescence, to support greater overall development. Therefore, professional football academies are encouraged to deliver technical and tactical specific developmental activities within the FDP, whilst offering a substantial games programme alongside providing opportunities to participate in multi-sport activities across both age phases, to support superior development.
REFERENCES:
MacNamara, A., & Collins, D. (2015). Sport Psychol, 29(1), 73–81.
Sarmento, H., et al. (2018). Sports Med, [Epub ahead of print] 1–25.
CONTACT:
Adam.Kelly@bcu.ac.uk

PSYCHOSOCIAL ASPECTS OF ASTHMA RELATED EXERCISE LIMITATION IN THE LITERATURE

WESTERGREN, T., BERNTSEN, S., FEGRAN, L.

UNIVERSITY OF AGDER

INTRODUCTION: Perceived exercise limitation in children with asthma is associated with markers of asthma severity and overweight (Westergren et al. 2017), and participation in physical activity (PA) may be avoided for various reasons. We aimed to identify psychosocial aspects of exercise limitation in children with asthma reported in the research literature.
METHODS: In a larger study described elsewhere (Westergren et al. 2017), we systematically searched 9 databases for sport and health science, and 5 databases for unpublished studies in January 2016. We included quantitative primary studies reporting about the relationship between PA and psychosocial factors, and qualitative primary studies reporting about experiences with PA in children and adolescents with asthma. Descriptive qualitative data about limiting aspects of PA participation, and quantitative questionnaire-/instrument-data of the relationship between PA level and psychosocial factors were extracted and sorted in distinct aspects possibly causing perceived exercise limitation.
RESULTS: Records identified were 3633. After removing 1314 duplicates, 2319 records were screened. Thirteen qualitative studies, and 20 quantitative studies were identified and included. Five distinct aspects possibly causing perceived exercise limitation were identified; (a) positive and negative feelings, attitudes, beliefs, and perceptions about PA and health, (b) the perception of self and one´s abilities, (c) perceived psychological distress, (d) perception of one´s social role and interplay, and (e) perception of health service and neighborhood.
CONCLUSION: Aspects reported in this study should be further explored in a meta-synthesis of qualitative literature to reveal more in-depth understanding of perceived exercise limitation. Original research combining an exploration of pathophysiological mechanisms, cardiorespiratory fitness, and subjective experiences should also be conducted, as well as intervention studies to determine causal relationships and to reveal factors worth manipulating to increase level of PA. Instrument development to assess level of, and distinct dimensions of perceived exercise limitation in children with asthma is also needed.

LONG-TERM DEFERMENT POLICY OF NATIONAL SERVICE FOR ELITE MALE ATHLETES – AN AVENUE FOR SPORTING SUCCESS? (A SOCIOLOGICAL PERSPECTIVE)

CHAN, C.

REPUBLIC POLYTECHNIC

ABSTRACT
This study aimed to use a sociological lens to evaluate the long-term deferment policy of military conscription, otherwise known as National Service (NS), for elite male athletes in Singapore. A functionalist perspective will be used to consider the impact of the policy; whether this policy has helped elite male athletes achieve sporting success.
Two cases of long-term deferment from NS for elite sports endeavour are examined. These two cases were for swimmers Joseph Schooling and Quah Zheng Wen.
As mentioned earlier, this study took on a functionalist perspective to consider the impact of the policy. The functionalist perspective is based on the assumption that society is an organized system of interrelated parts, held together by established social arrangements that maintain the system in a state of balance and equilibrium. Therefore it is apt that the Ministry of Defence (MINDEF) has such principles for a long-term deferment to maintain equilibrium in Singapore society.
The results of their long-term NS deferments bore fruit. For the RIO Olympics 2016, Schooling made history as he won the gold medal in the 100m butterfly and became Singapore's first-ever Olympic gold medallist. Quah Zheng Wen clocked personal bests to qualify for the semi-finals of both the 100m and 200m butterfly. Due to these achievements, both swimmers were allowed to extend their deferments for a further four years till after the 2020 Tokyo Olympics.
This study suggested that the continued support from the general public to the policy will hinge on the outcome of whether the deferments from NS, will help elite male athletes concerned, achieve the desired outcome in the sport. While the results from Joseph Schooling and Quah Zheng Wen have been positive thus far, the perception study with the empirical evidence from two cases alone will not be sufficient to form a conclusion on the success of the policy. As this is only a preliminary study, it will only serve as a pilot test because the information collected is only exploratory. It is intended only to assist in the design of a subsequent study (Zikmund, Babin, Carr, & Griffin, 2010). It is therefore recommended that this study is tracked longitudinally with more case studies in the future. Over time, this will provide a more robust basis to inform further policy development.
References: Zikmund, W. G., Babin, B. J., Carr, J. C., & Griffin, M. (2010). Business research methods (8th ed.). South Western, Ohio: Cengage Learning.

MOTIVATIONAL FACTORS AND PROFILE OF ROAD RUNNERS IN THE BRAZILIAN CAPITAL

MORAIS, L.1, COSTA, A.2, JUSTE, J.2, RAMOS, L.2, RUSSOMANNO, T.2, SOUSA, A.2

1:UNIEURO , 2:UNB

INTRODUCTION: Road race is a world sport phenomenon, and it also has many kind of products and service involved on it. Some investigations are interested about what factors of motivation are related to the runners. The motivations can be differentiated between those that begin into the race and those remain in the modality. Therefore, the aim of this study was analyze which are motivational factors related to those who joining and those who staying in the sport.
METHODS: A descriptive quantitative research was made, by applying an electronic survey that approached sociodemographic issues, race practice profile and motivational factors related to join (Salgado, 2006) and stay of the runners (Costa, 2016). The survey was sent by web link, through social networks and e-mails of runners that accepted to take part on the survey. For the motivations factors, it was used a scale of 4 points that ranged from 0- did not motivate to 4- motivated a lot. To analyze the results was used a descriptive statistic with cross tables and analysis of the Pearson chi-square test ($p \leq 0.05$). The SPSS software was used to analyze the results.
RESULTS: A total of 361 questionnaires were considered valid. Among the respondents, 51.8% were men. The predominant age group was 31 to 40 years (36.6%). The main schooling was higher education (78.7%). Regarding the profile of practice, 73.4% of respondents have been training for over 2 years, 15.8% six months ago and 10.8% a year ago. As concerns distance ran, 41.6% ran 21km, 26.3% ran 10km and 19.1% ran 42.195km.
The motivations to join, which have scored points, in descending order, are Health; Quality of life and Physical Fitness. The motivation factors to permanence stood out: Overcome limits; Physiological benefits and Plan and achieve news goals. The cross tables of these

variables did not present significant association of trends with the sociodemographic variables. However, the variables of practice profile indicate positives associations between Training time and distance ran with Plan and achieve news goals.
CONCLUSION: The research data suggest that the search for improvements in the objective and subjective aspects related to well-being and body leads the practitioner to start the races. However, the permanence factors seem to be more associated to the establishment of incremental goals and the search for the achievement of these objectives. It is suggested that new studies be done, due to the great demand for practice and to evaluate the profile of these practitioners consumption.
References: Costa, Américo Pierangeli. Comportamento de consumo de corredores de rua: uma abordagem baseada na teoria da prática / Américo Pierangeli Costa. – Lavras : UFLA, 2016. 229 p. : il.
SALGADO, José Vítor Vieira; CHACON-MIKAHIL, Mara Patrícia Traina. Corrida de rua: análise do crescimento do número de provas e praticantes. Conexões, Campinas, São Paulo, v. 4, n. 1, p. 100-109, 2006.
Contact: lemannuell@gmail.com

IN SOCIO-ECONOMICALLY HIGHER DEVELOPED COUNTRIES, SPORT PLAYS A MORE IMPORTANT ROLE: CROSS-NATIONAL RELATIONS BETWEEN THE EUROPEAN SPORT INDEX AND SELECTED SOCIO-ECONOMIC INDICATORS IN THE EU.

NADER, M.
UNIVERSITY OF VIENNA

Introduction: Previous research has shown that sport has a major impact on different aspects of European societies. To operationalize the social significance of sport in the 28 member states of the European Union, Weiß et al. (2016) developed an indicator-based statistical benchmarking model: the European Sport Index. Based on this index, the present study analyses the correlations between the social significance of sport and socio-economic development in the 28 members of the EU. Methods: To indicate the socio-economic development of the countries, a set of important indicators was selected (e.g. Human Development Index, All-Cause-Mortality). Beside content-related considerations, the availability, actuality and comparability of the data were crucial criteria for the selection of the indicators. In a next step, a hierarchical cluster analyses (Ward-Method) was applied to group the nations concerning their data structure. Finally, the Pearson's correlation coefficient (r) was calculated to examine the relations between the selected indicators and the European Sport Index. Results: Strong positive correlations (r>0,7) were found between the European Sport Index and the socio-economic indicators. In particular, northern and western European countries (e.g. Denmark, Netherlands) reach higher scores on the European Sport Index and the socio-economic indicators. Countries from southern and eastern Europe (e.g. Bulgaria, Romania), on the other hand, score lower on all observed indicators. The results of the cluster analysis support the northwest-southeast trend. Discussion:
The identified macro-level correlations highlight that in socio-economically higher developed countries, sport plays a more important role. However, deeper research needs to be conducted to analyze causality and robustness of these correlations. References: Weiss, O., Norden, G., Nader, M. & Arnusch, F. (2016). European Sport Index: The social significance of sport in 28 European countries. European Journal for Sport and Society, 13(2), 167-182.

09:45 - 11:15

Invited symposia

IS-SH03 Is Exercise Medicine?

A CRITICAL SOCIOLOGICAL EXAMINATION OF EXERCISE IS MEDICINE

MALCOLM, D.
LOUGHBOROUGH UNIVERSITY

This paper provides a critical sociological review of the Exercise is Medicine initiative, focussing particularly on the literal extrapolation that: a) exercise is the equivalent of a pharmaceutical; and b) that exercise and medicine as professional practices are becoming synonymous. It argues that the former, narrower, sense of this claim is problematic due to its generalized and open-ended prescription and disregard for potential side-effects. Consequently, exercise is very different to, and subject to different regulations from, medicine as conventionally conceived. The paper further argues that the latter, wider claim, raises questions of jurisdictional legitimacy, the disempowerment of citizens and the obfuscation of what it means to be healthy or unwell. In so doing, Exercise is Medicine raises some key conceptual and medical ethical questions

THE BIOMEDICAL PERSPECTIVE ON EXERCISE - A SOCIOLOGICAL ANALYSIS

MICHELINI, E.
TU DORTMUND

Exercise can be considered as medicine, if the perspective is a biomedical one. Indeed, it has been proven that it can prevent, cure, and rehabilitate diseases, which are the leading causes of death worldwide. However, there are other reasons for exercising which lead to the question: How socially dominant is the biomedical perspective on exercise?
This topic is assessed here by analysing the content of a catalogue of national strategies for promotion of PA issued by national sport and health systems. These documents are selected within a set of countries which are prototypes of differing welfare typologies (Leibfried, 1993): USA (Anglo-Saxon); Germany (Bismarckian); Sweden (Scandinavian); and Italy (Latin Rim). The catalogue has been analysed through a triangulation of systems theory (Luhmann, 1995), medicalisation studies (Conrad & Schneider, 1980), and critical theory (Habermas, 1984) and the qualitative technique of thematic analysis (Braun & Clarke, 2012).
These analyses uncover different systemic perspectives on exercise and the biomedical one's dominance. This logic appears largely dominant even in programmes issued by sport system organisations. Within the health system, a fundamental discrepancy between broad goals of health promotion and narrow biomedical objectives was revealed. As a consequence, the health system ignores its

utopic goals here and ends up focussing 'merely [on] the absence of disease or infirmity' (WHO, 1948, p. 1). Generally, the area of physical activity promotion undergoes a process of medicalisation, which tends to rationalise natural human behaviours for biomedical scopes. While this process is not per se problematic, it raises questions about the chance of disadvantaged population segments to follow guidelines on healthy PA and exercise and on the consequences of not following them.

Bibliography
Braun, V., & Clarke, V. (2012). Thematic Analysis. In H. Cooper & American Psychological Association (Eds.), APA Handbook of Research Methods in Psychology (pp. 57-71). Washington, DC: Magination Press.
Conrad, P., & Schneider, J. W. (1980). Deviance and Medicalization: From Badness to Sickness. Philadelphia: Temple University Press.
Habermas, J. (1984). The Theory of Communicative Action. Reason and the Rationalization of Society. (T. McCarthy, Trans. Vol. 1). Boston: Beacon Press.
Leibfried, S. (1993). Towards a European Welfare State. In C. Jones (Ed.), New perspectives on the welfare state in Europe (pp. 133-156). London; New York: Routledge.
Luhmann, N. (1995). Social Systems. (J. J. Bednarz & D. Baecker, Trans.). Stanford: Stanford University Press.
WHO. (1948). Preamble to the Constitution of the World Health Organization; signed on 22 July 1946 by the representatives of 61 States (Official Records of the World Health Organization, no. 2, p. 100) and entered into force on 7 April 1948. Retrieved from http://apps.who.int/gb/bd/PDF/bd47/EN/

'SPORT AS MEDICINE' AND OTHER MEANINGS OF SPORT AND PHYSICAL ACTIVITY AMONG PEOPLE WITH CHRONIC CONDITIONS

ELLING, A., STUIJ, M., ABMA, T.
MULIER INSTITUUT

In the research project Sport in Times of Illness, we analyse the construction and negotiations of sport-illness narratives among people with different chronic conditions and the perceptions of and interactions with medical/sport professionals. We used both quantitative and qualitative methods with a main focus on narrative methodology.
The meaning of sport showed less clear patterns than overall illness narratives, although aspects of restitution , quest and chaos could be identified among all groups. The outcomes present an interesting contradiction between an overall positive meaning of sport in managing illness and a rather negative overall evaluation of acquired guidance from health professionals with respect to sport and physical activity in the treatment trajectories.
We discuss meaningful differences related to illness conditions, social determinants and experienced well being, as well as the significance of our findings with respect to mainstream health-physical activity discourses and primarily medically based intervention programmes and guidance.

Oral presentations

OP-PM24 Cardiovascular physiology 3

INTER-INDIVIDUAL DIFFERENCES IN ACUTE BLOOD PRESSURE RESPONSE TO HIGH INTENSITY EXERCISE: A REPLICATE CROSSOVER DESIGN

WILLIAMSON, P., ATKINSON, G., BATTERHAM, A.
TEESSIDE UNIVERSITY

INTRODUCTION: Acute blood pressure responses to physical activity predict hypertension and other cardiovascular-related comorbidities . Robust quantification of individual differences in this blood pressure reactivity requires a controlled replicate crossover design to isolate the participant x condition response variance . Our aim was to conduct the first appropriately designed experiment on individual differences in acute blood pressure reactivity to exercise.
METHODS: After baseline assessment of peak oxygen uptake, twelve normotensive adults <4 women> with mean age: 29.7 <4.9> y, height: 173.9 <10.1> cm, body mass: 72.5 <12.5> kg were randomised in blocks of 2 to one of 6 possible sequences of 2 control and 2 exercise replicates over 4 periods. The exercise comprised two 10-min bouts of cycling at 70% of the power output exhibited at peak oxygen uptake, separated by a 5-min recovery period. In the control condition, participants rested on the cycle ergometer for the equivalent time. Blood pressure was measured at rest and immediately after the last exercise bout . Data were analysed using a linear mixed model, allowing for sex differences in the mean effect of acute exercise and differential period effects between conditions . We included random effects for the participant x treatment interaction to partition the variance and derive the true SD for individual responses.
RESULTS: The mean effect of acute exercise on systolic blood pressure was an increase of 49 <95% CI, 33 to 66> mmHg <67 mmHg in women vs. 32 mmHg in men>. The SD for individual responses - the typical difference between participants in the mean change between a control trial and an exercise trial - was 17 <-18 to 30> mmHg.
CONCLUSION: In the first replicate crossover study quantifying inter-individual variability in response to exercise, we have shown a very large typical difference between participants in the mean effect of acute exercise on systolic blood pressure. We emphasise that although individual response variance was substantial, such a finding does not imply, necessarily, that there are responders and non-responders - in the current study all participants were responders to acute exercise. This model can be applied to future replicate crossover trials to quantify the presence of inter-individual variation in response to acute exercise.
References: Atkinson G, Batterham AM, Kario K, et al. Eur J Appl Physiol. et al. 2014;114:521-9.
Goltz FR, Thackray AE, King JA, et al. Med Sci Sports Exerc. 2018. Ahead of Press. DOI: 10.1249/MSS.0000000000001504
Senn S. Stat Med. 2015;35:966-77
Contact: P.Williamson@tees.ac.uk

HEART RATE VARIABILITY, MAXIMAL OXIGEN UPTAKE AND ANAEROBIC THRESHOLD

PÉREZ-LASIERRA, J.L.1,2,4, GARATACHEA, N.1,3,4, BAILÓN, R.5,6, HERNANDO, D.5,6, CASAJÚS, J.A.1,2,4
UNIVERSITY OF ZARAGOZA

INTRODUCTION: The VO2max and the Anaerobic Threshold (AT) are two parameters widely known and used in the field of physical exercise either from a focus on sports performance or health (Scribbans et al., 2016), but to know them objectively, complex and expensive techniques are required. Heart Rate Variability (HRV), represented by several indicators, is an easy and inexpensive method to assess the sympathetic and parasympathetic activity of our autonomic nervous system (ANS), which is responsible for controlling variables like heart rate (HR) (Draghici et al., 2016). Therefore, the aim of this study is to estimate the VO2max and the HR at AT from mathematical models that include HRV parameters.
METHODS: In our study we used 25 volunteers trained men (25-45 years). To assess VO2max and HR at AT we used the Gold Standard (GS) method, a maximum stress test on treadmill with gas analyzer; and to assess HRV parameters (HRM, PLF, PHF, LF/HF, FR) we used a spectral analysis of R-R intervals recorded in a resting phase of 5 minutes with a commercial HR monitor.
We use regression analysis to elaborate two models that can predict the VO2max and the HR at AT, and finally we analyse the reliability and heteroscedasticity of the models with Bland Altman plots.
RESULTS: The results show that in our sample it´s possible to estimate the HR at AT from the HRV using a mathematical model that explains 69.6% ($p<0.05$) of the variability, but it is not possible to estimate the VO2max because the mathematical model resultant is not statistically significant ($p>0.05$). Both mathematical models present a significant heteroscedasticity.
CONCLUSION: The possible results could have innumerable and innovative practical applications, but we are aware that in this case they are subject to certain bias and limitations that will have to be solved in future investigations before using those results in a real application.
REFERENCES:
Draghici AE, Taylor JA. (2016). J Physiol Anthropol, 35(22), 1-8.
Scribbans TD, Vecsey S, Hankinson PB, Foster WS, Grund BJ. (2016). Int J Exerc Sci, 9(2), 230-247.
CONTACT:
jlperez@unizar.es

THE DYNAMICS OF NOCTURNAL HEART RATE (VARIABILITY) IN TRAINING LOAD MONITORING

HYNYNEN, E., VESTERINEN, V., NUMMELA, A.
RESEARCH INSTITUTE FOR OLYMPIC SPORTS

INTRODUCTION: Heart rate (HR) and heart rate variability (HRV) measurements are used in monitoring athlete's recovery status (Buchheit 2014). Theoretically, recordings during night sleep may represent the best disturbance-free condition for this. The effects of training load of the preceding day may be seen especially in the early hours of sleep. As the nocturnal sleep is not just a stable period of recovery, the aim of this study was to identify the underlying relationships between nocturnal HR and HRV in different segments of the night sleep.
METHODS: Nocturnal RR-interval (RRI) recordings of 60 recreational endurance runners after two consecutive "stress-free" days were included in this study. RRI recordings were started when going to bed to sleep and stopped after waking up in the morning. First six hours of the RRI recordings were analyzed as 45-min periods (T1-T8) by using the Firstbeat Sports software. Sample correlation coefficients were calculated among the periods of HR and high frequency power (HFP). Exploratory factor analysis was used to study whether there are unobserved dimensions (factors, latent variables) underlying the observed periods of HR and HFP (factor indicators). Based on the results of the exploratory factor analysis, confirmatory factor model was specified for nocturnal HR and HFP at both measurement points (night 1 and night 2).
RESULTS: Correlations among periods of HR ranged from 0.655 to 0.946 and among periods of HFP from 0.720 to 0.912. The highest correlations were observed between the adjacent measurement periods and the correlations were lower between early and late periods of nocturnal sleep. In exploratory factor analysis the two-factor model showed the best fit to the data. According to the estimation results of the model, the four earliest periods of HR (T1-T4) and the two earliest periods of HFP (T1-T2) loaded on the Factor 1, while the six latest periods of HR (T3-T8) and the five latest periods of HFP (T4-T8) loaded on the Factor 2. Confirmatory factor model for early (T1-T2) and late periods (T5-T8) fitted the data well at both measurement points (two consecutive nights).
CONCLUSION: The results suggest that nocturnal HR and HRV indices should not be analyzed as one period, but separately for early and late periods of the night sleep. First 90 min contains different information than later periods of the night sleep. Previous studies have shown that early hours of nocturnal HRV are reflecting the training load (Buchheit 2014), but further research is needed to confirm the value of the HRV during the late hours of nocturnal sleep.
REFERENCE:
Buchheit M. (2014) Monitoring training status with HR measures: do all roads lead to Rome? Front Physiol 5, 73.

POST-EXERCISE HYPOTENSION AFTER SIMULATED VOLLEYBALL TRAINING

MANOLAKI, N.1, BARZOUKA, K.2, KARTEROLIOTIS, K.3, GEORGAKOPOULOS, A., BERGELES, N.2, KOSKOLOU, M.1
NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

INTRODUCTION: Post-exercise hypotension (PEH) is the reduction in systolic (SBP) and/or diastolic blood pressure (DBP) below control levels and is usually observed after a single bout of continuous exercise of submaximal intensity (50-70% VO2max) and prolonged duration (30-60 min) (1). There are few studies in the literature comparing PEH between interval and continuous exercise (2), but none for a team sport. The aim of the present study was to investigate whether volleyball, as a type of interval exercise, causes PEH. Thus, arterial pressure values measured during recovery after simulated volleyball training (VT) were compared with those measured after a continuous cycling exercise protocol (CC).
METHODS: Ten female, normotensive, experienced volleyball players, 23.6±3.89 yrs, performed a 60-min volleyball training (30 min active time) with continuous monitoring of heart rate (HR) and, on a separate day, a 30-min protocol of continuous cycling at the same intensity (as judged by HR) as the VT. Baseline and post-exercise values of BP and other cardiovascular parameters [HR, cardiac output (CO), stroke volume (SV), total peripheral resistance (TPR)] were monitored noninvasively (Finometer) for 30 min before and 60 min after the exercise protocols.
RESULTS: SBP was lower during the first minutes of recovery compared to baseline in both conditions, but the drop was larger (-16±4 vs. -8±4 mmHg) and longer (10 vs. 5 min) following VT than after CC ($p<0.01$). DBP remained at baseline values in recovery from CC, but after

VT it remained unchanged only for 10 min; afterwards, it was elevated compared to rest and CC (p<0.01). A slight decline (7% from baseline values; p>0.05), similar for both protocols, was observed in TPR at the start of recovery. CO was lower at the first 5 min of recovery after VT compared to CC (p<0.05). SV values were lower during recovery compared to pre-exercise (p<0.01) exhibiting more profound and prolonged decrease after VT than after CC (p<0.01). HR during VT recovery was higher compared to baseline and CC recovery (p<0.01). Both protocols were performed at 78±6% of HRmax or 67±9% of VO2max.
CONCLUSION: The results of the present study suggest that PEH, as judged from the drop in SBP, is more profound among young volleyball players after a single bout of volleyball training, compared to equal time and intensity continuous exercise which elicited the typical phenomenon of PEH as reported in the related literature (3). The steadily elevated values of DBP and HR throughout the 60-min recovery period after VT suggest that sympathetic nervous system activation remained at high levels after volleyball training, as this type of exercise involves the participation of more muscle mass, motor units and fast twitch fibers compared to cycling.
REFERENCES:
1. Kenney M, Seals D. (1993). Hypertension, 22, 653-664.
2. Jones H, Taylor C, Lewis N, George K, Atkinson, G. (2009). Chronobiol Int, 26, 293-306.
3. Halliwill J, Tashiba M, Lacewlell A, Romero, S (2013). Exp Physiol, 98, 7-18.

HEMATOLOGICAL ADAPTATIONS DOES NOT EXPLAIN THE INCREASE IN MAXIMAL OXYGEN UPTAKE INDUCED BY 10-WEEKS OF ENDURANCE TRAINING

SKATTEBO, Ø.1, AUENSEN, M.1, CAPELLI, C.1, BJERRING, A.W.2, SARVARI, S.2, HALLÉN, J.1
1: NORWEGIAN SCHOOL OF SPORT SCIENCES 2: OSLO UNIVERSITY HOSPITAL

INTRODUCTION: It is still debated whether improvements in VO2max are mainly dictated by central or by a combination of central-peripheral adaptations. In two recent studies, increased blood (BV) or erythrocyte (EV) volumes (1; 2) induced by endurance training (ET) were removed and it was found that maximal cardiac output (Qmax) and VO2max recovered to pre-ET level. However, hypovolemia due to phlebotomy (Phle) may reduce venous return, increase sympathetic tone, potentially masking the ET induced drop in vascular resistance, and therefore decrease Qmax and O2-delivery. The present study investigated cardiovascular adaptations to ET in upright (UC) and supine (SC) cycling, where venous return is enhanced, before and after normalizing hemoglobin mass (HbM) to pre-ET level.
METHODS: Eleven untrained subjects completed 10-weeks of supervised ET (3 sessions/week) with cardiac morphology (echocardiography) and HbM (CO-rebreathing; CV: 1.1%) assessed pre and post. VO2max and Qmax (Physioflow) were determined pre-ET, post-ET and after Phle in UC and SC in randomized order. Repeated-measures and two-factor within-subject ANOVAs (time x modality) were used for analyses.
RESULTS: ET increased HbM by 25±14 grams (mean±95% CI; P<0.01) and BV by 180±175mL (P=0.04). After Phle, BV was unchanged (9±119mL) compared with pre-ET. VO2max in UC increased from 3.3±0.5 to 3.7±0.5 L/min (11±4%; P<0.01) and remained elevated after Phle (3.7±0.5 L/min). In SC, it was 13±2% lower than in UC (P<0.01), increased 9±5% after ET and remained elevated after Phle (P<0.01). Qmax in UC increased from 20.2±2.6 to 21.9±2.5 L/min (10±6%; P<0.01) after ET and remained elevated after Phle (21.9±2.8 L/min). In SC, Qmax tended to increase (20.9±3.1 to 21.6±2.6 L/min; P=0.23) and significantly so only after Phle (22.5±2.8 L/min; P=0.01). SVmax increased by 12±8% in UC (P<0.01) and 9±8% in SC (P=0.03) and remained elevated after Phle. Arteriovenous O2 difference changed in neither UC (166±16 to 169±17 mL/L) nor SC (142±19 to 149±20 mL/L) after ET. Left ventricular mass increased (123±25 to 137±25 grams; P=0.03) with no change in end-diastolic volume (122±24 to 125±27mL).
CONCLUSION: The present study challenge the previous findings (1; 2) that increased BV is the main factor responsible for improvements in Qmax, but supports that increased Qmax, via elevated SV, is the main factor responsible for improvements in VO2max by short-term ET. In addition, the hypothesis of initial concentric remodeling in early commencement of ET (3) is supported.
Ref:
1: Bonne, TC. et al (2014). Phlebotomy eliminates the maximal cardiac output response to six weeks of exercise training. Am J Physiol Regul Integr Comp Physiol, 306:752-60
2: Montero, D. et al. (2015). Haematological rather than skeletal muscle adaptations contribute to the increase in peak oxygen uptake induced by moderate endurance training. J Physiol, 593:4677-88
3: Arab-Zadeh et al. (2014). Cardiac remodeling in response to 1 year of intensive endurance training. Circulation, 130:2152-61

IMPACT OF A BLOOD DONATION ON HEMOGLOBIN MASS, IRON STORES AND PERFORMANCE IN WOMEN

WACHSMUTH, N., HAUPT, S., BAUER, P., TREFF, G., STEINACKER, J., SCHMIDT, W.
INSTITUTE OF SPORTS SCIENCE

INTRODUCTION: During a blood donation, about 500 ml of blood are taken regardless of body proportions and sex of the donor. This amount corresponds to a haemoglobin loss of 60-80g. Because of generally lower haemoglobin mass (Hbmass) and lower iron stores in women the blood donation may have a stronger impact in female donors and it might take a longer period of time for them to recover from the blood loss than the suggested 8 to 12 weeks until the next possible blood donation. Therefore, the aim of the study was to determine total haemoglobin mass, iron status and performance (VO2max) in women before and after a blood donation (BD) and to monitor the recovery of these parameters for the following 12 weeks.
METHODS: In total, 10 women (age: 24.6±1.5years, body mass: 63.5±6.6kg, BMI: 22.5±1.9, [Hb]:13.8±0.8g/dl) who fulfilled the criteria to donate blood participated at the study. Hbmass was measured using the optimized CO-rebreathing method before, directly after the BD and periodically until 12 weeks thereafter. Simultaneously venous blood samples were drawn to analyse erythrocyte parameters (e.g. [Hb], Hct, MCV, MCH, and MCHC) and iron status (e.g. Ferritin, CRP, Transferrin, and Transferrin saturation). Before and regular up to 12 weeks after the BD 7 VO2max -Tests were performed.
RESULTS: Hbmass dropped from 562.1±69.5g to 499.0±64.0g (p<0.001) after the BD and increased continuously in the following weeks. For the first time, 8 weeks after the blood donation no significant differences to baseline values were found. Only 3 out of the 10 subjects achieved the baseline values after 12 weeks. Ferritin declined from 40.9±34.2ng/ml to 12.1±6.9ng/ml (p<0.05) in week 6. Even after 12 weeks, iron stores were not refilled (Ferritin: 18.4±12.7ng/ml, p<0.05) and 6 out of 10 subjects showed an iron deficiency (Ferritin <15ng/ml). Immediately after BD, VO2max was reduced by 213±47ml (7.2±1.2%; p<0.001) and remained 3.2±1.4% (p<0.01) below baseline values after 12 weeks.
CONCLUSION: For many women, 12 weeks are not sufficient to recover from a blood donation and to achieve baseline Hbmass and iron stores. A subsequent blood donation might lead to a severe anaemia. It should be evaluated whether an iron supplementation could accelerate the time of recovery.

Oral presentations

OP-PM25 Sports Medicine and orthopedics

PREVALENCE OF THE DEGRADATION CARTILAGE MARKER, OLIGOMERIC MATRIX PROTEIN (COMP), IN MALES CROSS-TRAINING AND ULTRA TRAIL RUNNERS

RAMA, L., COELHO E SILVA, M.J., DUARTE, J., COSTA, D., MARTINHO, D., SILVA, P., TEIXEIRA, A.M.

FACULTY OF SPORT SCIENCES AND PHYSICAL EDUCATION OF COIMBRA

INTRODUCTION: Cartilage oligomeric matrix protein (COMP) is a well-known marker of cartilage degradation namely in inflammatory arthritis, rheumatoid arthritis and other. The produced protein fragments diffuse out into the joint fluid, appearing in the bloodstream, making them useful to predict the cartilage degradation in inflammatory joint diseases. An association has been shown between the concentrations of COMP in serum and cartilage degradation. To our knowledge, few studies were conducted to analyze the impact of training on COMP appearance in the serum in healthy athletes. Serum COMP values could be elevated, after exercise, however, tend to return to basal levels upon 36hours of rest. We aim to compare the values of serum COMP in athletes of two sports of distinct exercise demand: Cross training (XFIT) and ultra trail runners (UTR), the former sustained in the high-intensity workouts, the later, by large volumes of training.
METHODS: 19 cross-training(XFIT) and 20 ultra trail runners (UTR), males, of 30,2±9,0 and 39,3±7,6 years old, 175,9±4,8 and 173,8±6,2(cm) height; 85,2±14,8 and 75,8±10,3Kg weight, for XFIT and UTR respectively, volunteered to participate in this study, approved by the Scientific Board of the Faculty of Sports Sciences & Physical Education of University Coimbra. The subjects were informed about the objectives and procedures of the study and gave their written informed consent. 10mL of peripheral blood samples were collected (8:00-9:00h) by venipuncture of the antecubital vein, after 48 hours of rest from the last training session. Blood samples were centrifuged, and the serum was reserved and frozen (-20º) into Eppendorf tubes until analysis. The serum values of COMP were determined ELISA (COMP-ELISA®AnaMar AB, Gothenburg, Sweden). The reference values used to assess ongoing cartilage turnover estimating the risk for joint destruction in the future was as follows: < 12 U/L lower risk of aggressive joint destruction; 12-15 U/L increasing risk of aggressive joint destruction; > 15 U/L high risk of aggressive joint destruction.
RESULTS: No differences were found in the COMP mean values between XFIT (8,7±2,5 U/L) and UTR (8,8±2,4 U/L). Nevertheless, the proportions of athletes that presented an increased risk for future development of joint destruction was higher in XFIT(25%) than in the UTR (4%).
CONCLUSION: The results showed a high proportion of Cross-training athletes with elevated COMP serum values, identified with a higher risk for future cartilage damage. Further research must be done with athletes of other sports and follow-up studies aiming to analyze the temporal effect of the specific sports practice over the risk of cartilage damage.

THE ROLE OF INFLAMMATION IN ACHILLES TENDINOPATHY: INTERLEUKIN-6 LEVELS DROP AFTER PHYSIOTHERAPEUTIC INTERVENTION

LEGERLOTZ, K., RADOVANOVIC, G.

HUMBOLDT-UNIVERSITÄT ZU BERLIN

INTRODUCTION: Tendinopathies are a commonly occurring clinical problem in sports. They are characterized by chronic tendon pain and impaired functionality. Effective treatment options are difficult to develop, because aetiology and progression of this disorder are still poorly understood. The role of inflammation in chronic tendinopathies is highly debated. For many years, the disease was considered to be mainly degenerative. However, recent research indicates that chronic inflammation may be a feature of Achilles tendinopathy . Thus, the aim of this study was to investigate, if plasma levels of the inflammatory cytokine Interleukin-6 are elevated in patients with chronic Achilles tendinopathy and if IL6 levels are affected by treatment, duration of symptoms or anatomical localization.
METHODS: 22 male patients with chronic insertional or mid-portion Achilles tendinopathy were subjected to a physiotherapeutic intervention for 12 weeks. VISA-A scores and blood plasma IL6 levels were determined before and after the intervention phase. Exercise activity was recorded daily in a training diary.
RESULTS: The physiotherapeutic intervention led to improved pain and functionality. This is represented by a significant VISA-A score increase from 56±14 points at baseline to 75±19 points after the intervention. Plasma IL6 levels decreased significantly from 2.7±1.7 ng/l at baseline to 2.0±0.7 ng/l after the intervention period. IL6 levels decreased from 3.7±2.1 to 2.0±0.9 ng/l in 10 patients <7 insertional and 3 mid-portion>, did not change <1.8±0.6 ng/l> in 7 patients <3 insertional and 4 mid-portion>, and increased from 1.8±0.5 to 2.2±0.6 ng/l in 5 patients <1 insertional and 4 mid-portion>. Pre and post IL6 levels did not correlate with any of the other measured parameters. Patients with insertional Achilles tendinopathy did not differ significantly in any of the investigated parameters when compared with patients having mid-portion Achilles tendinopathy.
CONCLUSION: At baseline, IL6 levels were elevated in some but not all patients with Achilles tendinopathy. The anatomical location may contribute to elevated IL6 levels. Inflammation appears to play a role in the progression of Achilles tendinopathies in some patients, making IL6 a potential target for therapeutic interventions in this subgroup.
REFERENCES:
Dakin et al. <2017> Br J Sports Med, Nov 8. [ahead of print]
Legerlotz et al. <2012> Rheumatology, 51<7>:1161-5
CONTACT:
Prof. Dr. Kirsten Legerlotz
email: kirsten.legerlotz@hu-berlin.de

INFLUENCE OF TART CHERRY JUICE ON AIRWAY BIOMARKERS OF INFLAMMATION AND OXIDATIVE STRESS FOLLOWING A 42.2KM TRAIL RUN

DIMITRIOU, L.1, YAGNIK, D.R.2, WOOD, A.1,3, SINCLAIR, S.1,4, PAICE, K.1, WILSON, L.1, HILLS, F.A.2, GONDEK, M.B.2, KWAN XUE BIN, K.1, HOWATSON, G.5, COCKBURN, E.1,6

MIDDLESEX UNIVERSITY

INTRODUCTION: Tart cherry juice (CJ) has been shown to alleviate the development of respiratory symptoms following a Marathon (Dimitriou et al., 2015) by possibly reducing exercise-induced airway inflammation (Verges et al., 2005). Therefore, this study examined the effects of CJ supplementation before and following a 42.2km trail run on biomarkers of airway inflammation and oxidative stress.
METHODS: Nineteen recreational runners were randomly assigned to either consumption of CJ or placebo (PL) (age 39 +/- 8 years; height 1.75 +/- 0.7 m; mass 71.9 +/- 8.2 kg; completion time 210 +/- 25 min), from 4 days prior to 48h following a 42.2km trail run. Fractional exhaled nitric oxide (FeNO) and hypertonic inhalation-induced sputum (IS) samples were measured immediately before and after the run and then 24h and 48h post run. Both, FeNO and IS are non-invasive methods that can determine the type and severity of airway inflammation. Induced sputum samples were analysed for biomarkers of: a) inflammation (CD163; CD3E; CD44; CD62E; CD66E; Elastase and Interleukin-6 (IL-6)) and b) oxidative stress (protein carbonyls (PC) and superoxide dismutases (SOD)). The percentage of markers expressed on the surface of activated cells was determined using flow cytometry and the remaining biomarkers (IL-6; PC and SOD) were analysed using enzyme-linked immunosorbent assays (ELISA). Data were analysed using magnitude based inferences and results are reported as factor changes.
RESULTS: Compared to PL, CJ was beneficial for changes in CD163 (B-post 1.11 v 0.60, likely moderate; B-48h 1.60 v 0.75, very likely moderate), CD44 (B-48h 1.18 v 0.59, likely moderate), CD62E (B-post 1.08 v 0.69, likely small), CD66E (B-post 0.91 v 0.52, likely moderate; B-48h 1.03 v 0.67, likely small), IL-6 (B-48h 1.32 v 0.83, possible small) and SOD (B-post 1.01 v 0.77, likely small; B-24h 1.14 v 0.80, likely small; B-48h 0.96 v 0.70, likely small). However, CJ was harmful for changes in FENO (B-post 1.09 v 1.28, possible trivial; B-24h 1.04 v 1.21, possible small; B-48h 1.11 v 1.25, possible small) and PC (B-post 1.07 v 1.41, possible small; B-24h 0.99 v 1.22, possible small; B-48h 1.11 v 1.43, possible small). All other effects were unclear.
CONCLUSION: Airway inflammation biomarkers were decreased in the cherry juice group, whereas an increase was observed in the placebo group. However, cherry juice led to greater increases in FENO and PC compared to placebo. Cherry juice was beneficial for limiting exercise-induced airway inflammation.
REFERENCES:
Dimitriou L, Hill J, Jehnali A, et al., (2015). J of the Intern Soc of Sport Nutr., 12(22); DOI 10.1186/s12970-015-0085-8.
Verges S, Devouassoux G, Flore P, et al., (2005). CHEST J., 127(6):1935–41.
CONTACT:
l.dimitriou@mdx.ac.uk

LIMB-SPECIFIC TRAINING ADAPTATIONS AND A REDUCED ACTIVE MUSCLE MASS CAN ATTENUATE THE ACUTE INFLAMMATORY RESPONSE TO INTERVAL EXERCISE

HOEKSTRA, S.P., WESTERMAN, W., BEKE, F., BISHOP, N.C., LEICHT, A.C.

LOUGHBOROUGH UNIVERSITY

INTRODUCTION: While adaptations to a short-term training program can dampen the acute inflammatory response to exercise (Pedersen & Febbraio, 2008), less is known about the influence of chronic training. This study compares the inflammatory response to upper- and lower-body interval exercise in individuals chronically trained in these respective modalities to investigate the influence of limb-specific training status as well as the amount of active muscle mass on the inflammatory response to exercise.
METHODS: 90 min of interval exercise on an arm-crank (ARM) as well as a cycle ergometer (LEG) was performed by 8 trained paddlers (peak oxygen uptake (ύO2peak) ARM: 3.38±0.57 L/min, 0ΌO2peak LEG: 3.57±0.41 L/min) and 8 trained cyclists (0ΌO2peak ARM: 2.65±0.29 L/min, L·O2peak LEG: 4.13±0.41 L/min). Exercise intensities were matched for percentage of peak power output (POpeak) between modalities (10 blocks of 9 min consisting of 40%, 60% and 90%POpeak). Core temperature and heart rate were monitored throughout. Blood samples were taken pre- and post-exercise. Interleukin-6 (IL-6) and extracellular heat shock protein 72 (eHsp72) concentrations were analysed in plasma, while the expression of intracellular Hsp72 in monocytes (iHsp72) was assessed by flow cytometry.
RESULTS: The increase in IL-6 was significantly smaller in ARM compared to LEG (fold change ARM: 7.23±3.56, p<0.001; LEG: 9.03±4.82 p<0.001, Time x Modality p<0.001). The significant increase in IL-6 following ARM as well as LEG was present in both groups (cyclists p<0.001; paddlers p<0.001). ARM induced a significantly smaller iHsp72 response compared to LEG (fold change ARM: 1.07±0.14, p = 0.10; LEG: 1.18±0.14, p<0.001, Time x Modality p = 0.05). Following ARM, only the cyclists increased iHsp72 expression (fold change cyclists: 1.12±0.11, p = 0.02; paddlers: 1.03±0.17, p = 0.64), while iHsp72 expression following LEG increased in both groups (fold change cyclists: 1.14±0.15, p = 0.027; paddlers: 1.22±0.13, p< 0.001). Neither of the exercise modalities induced a significant increase in eHsp72 concentrations (p>0.15). Mean heart rate and peak core temperature were higher for LEG compared to ARM (p<0.001), the pattern being similar between groups (Modality x Group p>0.39).
CONCLUSION: The IL-6 response to lower-body interval exercise was larger when compared with work-matched upper-body interval exercise and, moreover, adaptations to upper-body exercise training dampened the iHsp72 response to this modality. Augmented core temperature increases during cycling might explain the first finding. The latter finding implies that regular exercise training can attenuate the stress response in an exercise modality specific manner. Therefore, exercise might be less effective in reducing chronic low-grade inflammation in individuals relying on their upper body.
References: Pedersen BK, Febbraio MA. (2008) Physiol Rev 4:1379-406

POSITIVE IMMUNOMODULATORY AND NEUROPROTECTIVE EFFECTS OF HIGH INTENSITY TRAINING IN AN ANIMAL MODEL OF MULTIPLE SCLEROSIS

EINSTEIN, O.1, FAINSTEIN, N.2, TYK, R.1, TOULOUMIM, O.3, LAGOUDAKI, R.3, HANYA, E.1, GRIGORIADIS, N.3, KATZ, A.1, BEN-HUR, T.2

1: ARIEL UNIVERSITY , 2: HADASSAH HOSPITAL , 3: AHEPA HOSPITAL

INTRODUCTION: Exercise training has beneficial effects in Multiple Sclerosis patients and in experimental autoimmune encephalomyelitis , the animal model of MS. However, optimal training protocols and the underlying mechanisms whereby ET affects systemic immune

responses and/or the central nervous system remain undefined. Recently, we showed that moderate intensity training suppressed peripheral immune responses but did not protect the CNS from encephalitogenic T cells . Still, it is unknown whether higher intensity training may induce both systemic immune-modulation and/or direct protective effects on the CNS. Here we examined the effects of different ET protocols on a clinically relevant model of MS.
METHODS: Healthy mice were subjected to moderate or high intensity running protocols. Performance tests of trained and sedentary mice were performed. Proteolipid protein -induced transfer EAE was used to enable differentiation between effects of ET on systemic autoimmunity vs. direct effects on the CNS. Regarding neuroprotection, we transferred PLP-reactive, encephalitogenic T cells into recipient mice that underwent the training program prior to EAE transfer, and compared the disease severity to that in recipient sedentary mice. Regarding systemic immunomodulation, characteristics of encephalitogenic T cells derived from PLP-immunized trained vs. sedentary mice were evaluated in vitro using proliferation assays.
RESULTS: Moderate intensity ET induced a significant increase in maximal speed and exercise tolerance. High intensity ET increased maximal speed similarly and more than doubled exercise tolerance. Whereas moderate intensity ET did not have direct neuroprotective effects, transfer of PLP-reactive, encephalitogenic LN-T cells resulted in less severe EAE in recipient mice that were subjected to high intensity training program prior to EAE transfer. High intensity ET also had greater suppressive effects on PLP-reactive T cells proliferation than did moderate intensity. High intensity ET inhibited proliferation of PLP-reactive T cells in response to CNS-derived autoantigen, but strongly enhanced their proliferation in response to concanavalin A, a non-specific stimulus.
CONCLUSION: Our data, obtained by using a unique experimental design, indicate positive effects of high intensity training on both systemic immune-modulation and direct neuroprotection in EAE. This study is of clinical significance and may provide a basis for defining exercise recommendations for MS patients.

THE EFFECTS OF AN 8-WEEK STRUCTURED EXERCISE INTERVENTION ON FUNCTION, SYMPTOMS AND QUALITY OF LIFE IN CANCER SURVIVORS WITH CHEMOTHERAPY-INDUCED PERIPHERAL NEUROPATHY: A PILOT STUDY.

SANDLER, C.X.1,2,3, MCCRARY, J.M.1, GOLDSTEIN, D.1, BATTAGLINI, E.1, BARRY, B.K.1,3, MURRAY, J.1, PARK, S.1,4

1 UNIVERSITY OF NEW SOUTH WALES, SYDNEY, AUSTRALIA. 2 QUEENSLAND UNIVERSITY OF TECHNOLOGY, BRISBANE, AUSTRALIA. 3 UNIVERSITY OF QUEENSLAND, BRISBANE, AUSTRALIA. 4 THE UNIVERSITY OF SYDNEY, AUSTRALIA.

INTRODUCTION: Chemotherapy-induced peripheral neuropathy (CIPN) is a significant consequence of chemotherapy, affecting up to 40% of cancer survivors. The symptoms can include dysaesthesia, tingling, and numbness in the hands and feet. Patients may also report alterations in proprioception, perception of touch or vibration and a sense of instability. Exercise interventions have been shown to improve function, balance and quality of life for patients with neuropathy of various aetiologies. Yet the evidence for the benefit of exercise on symptoms and gait in CIPN is limited.
METHODS: Fifteen cancer survivors, 12 female mean age 64.6±10.5 years, who were at least three months post-treatment and displayed National Cancer Institute CIPN grade of ≥2, completed an 8-week exercise intervention. Self-reported symptoms, functional capacity and neurophysiological assessments were conducted at baseline, after an 8-week wait period, and following the 8-week exercise intervention. Outcome measures included the Total Neuropathy Score (TNS, objective assessment), postural sway and balance (Swaymeter), patient-reported symptoms (CIPN-20), quality of life (SF-36), grooved pegboard test (fine motor function), five times sit-to-stand test (lower limb strength and dynamic balance), and six-minute walk test (6MWT, walking function). The intervention involved three one-hour sessions per week, which included components of aerobic, resistance, and balance exercises at a moderate to hard intensity (rating of perceived exertion 13-15/20). Half of the exercise sessions (12 sessions) were supervised by an exercise physiologist, while the other half were home-based.
RESULTS: There was good adherence to both supervised (mean 11.7±0.6, 98%) and unsupervised (9.1±3.5, 76%) sessions. From baseline to the end of the wait period there were no significant changes in outcome measures. The exercise intervention elicited improvements in quality of life (mean difference 9.5±11.5 95%CI: 3.1-15.9, p<0.01), TNS (2.2±3.1,95%CI:0.6-4.0), patient-reported neuropathy symptoms (9.9±12.9, 95%CI: 2.8-17.1, p<0.01) and postural sway (116.6±41.5, 95%CI: 26.8-206.3, p<0.05), but no statistically significant change in 6MWT distance (19.9±55.4 metre increase, 95%CI:-10.8-50.6, p=0.19) or five times sit-to-stand (-1.2±3.5, 95%CI: -0.7-3.2, p=0.19).
CONCLUSION: This study provides preliminary evidence for the effectiveness of exercise to improve symptoms of CIPN, quality of life and function. However, walking function (6MWT) and dynamic balance (five time sit-to-stand) did not improve. Given associations between gait and dynamic balance deficit and increasing symptom severity (Winters-Stone et al, 2017), it seems likely that 6MWT and five time sit-to-stand are not sensitive measures of gait and dynamic balance for people with CIPN. Further studies are needed to examine the exercise benefits related to gait and dynamic balance using CIPN-specific functional measures.
Reference: Winters-Stone et al.(2017) J Clin Oncol 35(23):2604-2612.

PHYSICAL ACTIVITY REDUCES DYSREGULATION OF THE INFLAMMATORY MEDIATORS IN THE MULTIFIDUS MUSCLE AFTER SPONTANEOUS INTERVERTEBRAL DISC DEGENERATION IN SPARC-NULL MICE

HODGES, P.1, JAMES, G.1, MILLECAMPS, M.2, STONE, L.2

1: THE UNIVERSITY OF QUEENSLAND ; 2: MCGILL UNIVERSITY

INTRODUCTION: A pro-inflammatory response is present in the deep back muscle multifidus after an intervertebral disc lesion. This occurs despite no injury to the muscle and has been proposed to drive structural changes in back muscle fat and connective tissue that are present in low back pain (1) and have been purported to contribute to persistence and worsening of the condition. Exercise and physical activity produce a strong anti-inflammatory response but the effectiveness in ameliorating inflammation in the multifidus muscle is unknown. We assessed whether the inflammatory profile of the multifidus was modified by intervertebral disc degeneration (IDD) using SPARC-null mice that develop this process spontaneous, and whether these changes could be prevented/reduced by physical activity.
METHODS: Wild-type and SPARC null mice that were sedentary or housed with a running wheel. Multifidus muscle segments were harvested from L2-L6 from the mice at 9 months of age after they had undergone an MRI scan to determine levels with IDD. The inflammatory profile of the multifidus was examined using real time PCR assays. Inflammatory cytokine expression was considered with respect to proximity to levels with IDD and compared between wild-type and SPARC-null mice and those that had and had not been exposed to physical activity.
RESULTS: Spontaneous IDD in the SPARC-null mice caused a dysregulation of interleukin-1beta (IL-1β), interleukin 6 (IL6), Transforming growth factor beta1 (TGFβ1) and adiponectin expression. The proximity and degree of IDD was related to levels of IL-1β expression. Physi-

cal activity reduced the pro-inflammatory response to IDD in the multifidus. IL-1β, tumor necrosis factor (TNF), interleukin-10 (IL-10), adiponectin, and leptin levels were lower in the physically active group.
CONCLUSION: These results reveal that spontaneous IDD causes dysregulation of the inflammatory pathways active in the multifidus muscle. These alterations were related to the severity of IDD and were prevented by physical activity.
REFERENCES:
(1) Hodges PW, James G, Blomster L, Hall L, Schmid A, Shu C, Little C, Melrose J (2014) Spine, 39(13), 1010-7.
CONTACT:
p.hodges@uq.edu.au

Oral presentations

OP-PM26 Amino acids and proteins

IMPROVEMENTS IN PHYSICAL FUNCTION AFTER CONCURRENT EXERCISE TRAINING IN OLDER ADULTS ARE AUGMENTED BY A HIGH PROTEIN DIET INTERVENTION TARGETING LEUCINE-RICH MEALS

TIMMONS, J.F., HONE, M., COGAN, K.E., DUFFY, O., MURPHY, J.C., EGAN, B.
UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: Most nutrition interventions targeting muscle mass and function in older adults utilise powdered protein or oral nutrition solutions, and few studies have employed food-based nutrition interventions to support exercise training. The amino acid leucine plays a key role in the stimulation of muscle protein synthesis by ingested protein as does an even distribution of protein throughout the day, but these strategies are under-explored in older adults.
OBJECTIVES
To determine if a food-based nutrition strategy targeting the equivalent of 3 g of leucine per main meal can augment exercise training-mediated effects on lean body mass (LBM) and physical function in older adults.
METHODS: Participants [(n=56; M/F, 28/28; age, 69.3±4.0 y; BMI, 26.6±3.7 kg/m2] were randomly assigned to Nutrition (NUT), Exercise (EX), and Exercise and Nutrition (EX+NUT) for a 12 week intervention. Exercise consisted of 3x24 min of concurrent aerobic and resistance exercise per week. The nutrition intervention provided meal plans and weekly engagement targeting leucine-rich meals at breakfast, lunch and dinner. Body composition (DXA), dietary intake (three day diet record), and physical function (test battery including chest and leg press strength and aerobic fitness) were assessed before (PRE), during (MID), and after (POST) the intervention.
RESULTS: Daily protein intake increased in NUT (0.99±0.34 vs. 1.43±0.39 g/kg body mass, $p<0.05$) and EX+NUT (0.90±0.20 vs. 1.57±0.49 g/kg body mass, $p<0.05$), but not EX (1.14±0.35 vs. 1.05±0.28 g/kg body mass). Body mass increased by ~1% in both EX+NUT and NUT (both $p<0.05$), but this was in the form of LBM (1.1±1.7%, $p<0.05$) and leg LBM (1.6±2.6%, $p<0.05$) in EX+NUT, and fat mass (3.3±5.5%, $p<0.05$) in NUT. Several measures of strength, physical function and aerobic fitness were improved to a similar extent in both EX and EX+NUT groups, but leg strength improved to a greater extent ($p<0.05$) in EX+NUT (33.4±37.7%) compared to EX (12.8±16.6%).
CONCLUSION: Concurrent aerobic and resistance exercise training improves aerobic fitness, strength and physical function in older adults, but when combined with leucine-rich meals provides a more effective strategy to increase lean body mass and strength in this population.

NO DIFFERENCE IN RECOVERY FROM EXERCISE-INDUCED MUSCLE DAMAGE WHEN SUPPLEMENTING WITH PLANT-BASED PROTEIN COMPARED TO ANIMAL PROTEIN.

BROWN, M.A.1, EASTGATE, G.1, COLE, M.2, HUGHES, J.D.1
UNIVERSITY OF GLOUCESTERSHIRE

INTRODUCTION: Recent evidence suggests that there is growing visibility of veganism in elite sport populations. Despite this, little is known about the consequences of adopting a vegan diet for athletic performance and recovery. Many athletes experience symptoms of exercise-induced muscle damage (EIMD) during intense training periods, and a common strategy to reduce the associated symptoms involves nutritional intervention; namely with supplementation of protein and protein analogues. Whilst plant-based protein ingestion has been investigated in the context of exercise recovery, few have made comparisons with animal protein and, to our knowledge, no study has explored this in individuals following a vegan diet. Therefore, this study aimed to investigate the effect of plant-based protein supplementation compared to animal protein supplementation on symptoms of EIMD and recovery in physically active males following a vegan diet.
METHODS: Ten males were assigned to consume either a mixed plant-based protein (PB) or whey protein concentrate (WP) supplement twice per day for 3 days post EIMD. Delayed onset muscle soreness (DOMS), countermovement jump (CMJ) height, squat jump (SJ) height, sprint power, creatine kinase (CK) and aspartate transaminase (AST), were collected pre, immediately post, 24, 48, and 72h post-exercise. For four days prior to, and throughout the data collection period, participants consumed a plant-based diet. Procedures were approved by the School Ethics Committee and participants provided written informed consent.
RESULTS: DOMS significantly increased following EIMD, peaking at 48h post-exercise ($p=0.003$). CMJ ($p<0.001$) and SJ ($p=0.001$) height decreased post EIMD and gradually returned to baseline levels during recovery, however sprint power was not affected by exercise ($p=0.137$). AST ($p=0.004$) and CK ($p=0.013$) levels increased post EIMD, peaking at 24 and 48h, respectively. Significant time effects for all variables except for sprint power suggests that participants experienced EIMD. However, there were no group or interaction effects in any dependent variable (all $p>0.05$); suggesting that the EIMD and recovery responses were similar between PB and WP groups.
CONCLUSION: Recovery from muscle damaging exercise is not different between PB and WP supplementation in males following a plant-based diet. This work therefore provides support for the use of PB, as a practical addition to vegans dietary routines in order to promote exercise recovery to a similar extent when compared with animal protein.

THE EFFECT OF MILK ON RECOVERY FROM REPEATED SIMULATED TEAM-SPORT IN FEMALES

RANKIN, P., CALLANAN, D., OBRIEN, K., DAVISON, G., STEVENSON, E., COCKBURN, E.

INSTITUTE OF TECHNOLOGY CARLOW

INTRODUCTION: Team-sport athletes engage in multiple training sessions or games within short periods of time resulting in insufficient recovery, which can impact subsequent performance. This study investigated the effects of milk on recovery from repeated bouts of simulated team games (STG) in females.
METHODS: In an independent-groups design, 20 female team-sport athletes completed an STG circuit (2x~30min bouts with a 10min 'half-time'). Peak torque, rate of force development (RFD), countermovement jump (CMJ), reactive strength index (RSI), sprint performance, muscle soreness and tiredness, symptoms of stress, serum creatine kinase (CK), high-sensitivity C-reactive protein (hsCRP), lipid hydroperoxides (LOOH) and protein carbonyls (PC) were determined pre- and 24h, 48h, 72h and 96h following the circuit. At 48h, following the measurement of dependent variables, a second STG was completed. Performance (5m and 15m sprint performance, lap time, CMJ), physiological (heart-rate) and perceptual (RPE) measures was recorded during each STG. Immediately following each STG participants consumed either 500ml of milk (MILK) or 500ml of an energy-matched carbohydrate (CHO) solution.
RESULTS: Compared to CHO, MILK had a beneficial effect in attenuating losses in peak torque for knee extension (60◦/s) from baseline (B)-24h (-6 v -10%; likely, small) and B-48h (-5 v -9%; possible, small), knee flexion (60◦/s) from B-24h(-4 v -11%; likely, small), B-48h (-5 v -14%; likely, moderate), B-72h (-2 v -11%; likely, small) and knee flexion (180◦/s) B-48h (-3 v -9%; likely, small). A benefit for MILK was also observed for 5m sprint performance B-24h (-1 v -3%; possible, small), B-48h (-2 v -4%; possible, moderate), B-72h (-2 v -5%; likely, moderate), 10m sprint performance B-48h (-1 v -3%; likely, small), B-72h (-2 v -3%; likely, small) B-96h (-1 v -1%; possible, small) and perception of the symptoms of stress B-24h (12 v 21%; likely, small), B-48h (17 v 32%; very likely, small), B-72h (17 v 30%; likely, small). Unclear outcomes were noted for RSI, CMJ and RFD. Unclear outcomes for serum markers were observed, though a harmful effect for MILK was seen for hsCRP B-2h (factor 1.1 v 0.9; likely, small), B-24h (factor 1.5 v 0.9; likely, moderate), B- 48h (factor 1.2 v 0.7; likely, moderate) and for LOOH B-24h (factor 1.0 v 0.9; likely, small). For STG variables trivial (HR, CMJ) and unclear (5m sprint, 15m sprint, lap-time, RPE) outcomes were recorded.
CONCLUSION: In conclusion consumption of 500ml of milk may be a valuable post-exercise intervention strategy as it attenuated losses in muscle function and perceptions of stress following repeated simulated team-sports games. However, further investigation is warranted to determine if MILK can influence subsequent team-sport performance.

POSTPRANDIAL AMINO ACID CONCENTRATIONS AFTER CONSUMPTION OF DAIRY PRODUCTS

KUDLA, U., VAN DEN BORNE, J.J.G.C., GANZEVLES, R.A., KARDINAAL, A., NIEUWEHUIJSE, J.A., LUYTEN, H., HUPPERTZ, T., HORSTMAN, A.M.H.

FRIESLANDCAMPINA

INTRODUCTION: Sarcopenia has been attributed to a diminished muscle protein synthetic response to food intake. The post-prandial increase in muscle protein synthesis is attributed to the rise in plasma essential amino acids concentrations. Most studies on post-prandial aminoacidemia have been done with isolated proteins rather than consumer products and have thereby focused on protein composition but overlooked the effect of product matrix on protein digestion. Consequently, this study was designed to obtain information about the change in postprandial amino acids in blood over time, after consumption of different dairy products in an older population and how this relates to feelings of satiety.
METHODS: Single-blinded within-subject design (cross-over) with 10 men (n=5) and women (n=5) (66.7±4.3 y, BMI 26±3 kg/m2) receiving 6 dairy products (UHT skimmed milk, pasteurized skimmed milk, fat-free yoghurt, full-fat UHT milk, pasteurized non-homogenized full-fat milk, full-fat cheese (semi-matured)) and 2 milk protein ingredients (solutions of whey protein concentrate (WPC) and micellar casein (MC)), with each portion size (700 mL) containing 25 g of protein on a separate test day, with a 1 wk washout period between treatments. Plasma samples were collected before and at 13 time points up to 5 h after consumption of the dairy products. Appetite profile was evaluated using Visual Analogue Scales.
Generalized Linear Mixed Models were used for maximal concentration values (Cmax) and the time point corresponding to Cmax (Tmax). If significant, Bonferroni correction was used.
RESULTS: Significant differences in the change of plasma amino acid (AA) levels over time were observed between the 8 products ($P<0.001$), with the highest (Cmax=139±17 and 117±9 mg/mL, resp.) increase after WPC and yoghurt consumption (both Tmax=60 min). Slightly earlier (t=30 or 45 min), but lower peaks (Cmax between 50±5 and 91±7 mg/mL) and increased levels over a longer period of time were observed for the 4 milk products. MC and cheese consumption resulted in the most extended AA response curves with Tmax both at t=120 min and Cmax=65±7 and 69±7 mg/mL, resp. Full-fat milk products showed delayed response curves compared to skim milk products ($P<0.05$), whereas UHT treatment showed a consistent, but not significant, effect on changes in plasma AA concentration compared to pasteurization. Cheese consumption was associated with the strongest and longest sensations of fullness and satiety, while least fullness and satiety was reported after consumption of UHT skim milk.
CONCLUSION: The fastest amino acid response is seen after consumption of yoghurt, compared to milk and cheese. The results suggest that the product matrix is perhaps even more important than the protein composition These findings may enable us to modulate the rate of absorption of (specific) amino acids, which will open new possibilities in developing products in the areas of e.g. sports or medical nutrition.

DIFFERENT AMOUNTS OF PROTEIN INTAKE INFLUENCE BODY COMPOSITION AND PERFORMANCE IN ELITE CYCLISTS

PAOLI, A.1, MORO, T.2, MARCOLIN, G.1, GENTIL, P.3, BIANCO, A.4

1> UNIVERSITY OF PADOVA, PADOVA, ITALY; 2> UTMB, GALVESTON, TX, US; 3> FEDERAL UNIVERSITY OF GOIAS, GOIANIA, GO, BRAZIL; 4> UNIVERSITY OF PALERMO, PALERMO, ITALY

INTRODUCTION: A higher protein intake has been recommended for either resistance and endurance athletes compared with sedentary subjects. Although ideal protein intake for strength athletes has been widely investigated, less data are available about protein requirement in endurance athletes.
The aim of our investigation was to evaluated the physiological impact of different dietary protein intakes on body composition and performance outcomes in a group of elite cyclists.

METHODS: Forty elite cyclists (1600-1800 km/month) participated in a randomized design diet intervention. Subjects were divided in 4 groups with different levels of protein diet: normal (NP, 1.2 g/kg), moderate (MP, 1.6 g/kg), high (HP, 2.0 g/kg) or very high (VHP 2.4 g/kg)protein for 8 wk. Diets were designed to be eucaloric: fats were maintained constant whilst energy from carbohydrate and protein was modified to ensure the isoenergetic approach. Body composition was assessed via Dual X Ray Absorptiometry (DXA) and via ultrasound to calculate cross sectional area (CSA) of the anterior thigh. VO2max was calculated through expired gas analysis during an incremental test; peak power output and 1 RM half squat test were also performed. Moreover we executed routinely blood exams.
RESULTS: Five subjects withdrew from the experimental protocol. After two months both HP and VHP showed a significant improvement of 1 RM (HP pre 133±14 Kg vs post 141±12 Kg, p<0.001; VHP pre 137±12 Kg vs post 144±11 Kg, p<0.001), PPO (HP pre 505±78 W vs post 534±67 W, p<0.001; VHP pre 512±55 W vs post 541±76 W, p<0.001), and VO2max (HP pre 62.1±5.8 mlO2/Kg vs post 64.5±5.9 mlO2/Kg, p<0.001; VHP pre 61.2±5,5 mlO2/Kg vs post 64.1±7,6 mlO2/Kg, p<0.001), without differences between groups. There were no significant changes of 1 RM and VO2max for both NP and MP whilst NP showed a slight but significant decrease of PPO from 510±68 to 501±45 W, p<0.05. At the end of the experimental period both HP and VHP showed a significant increase of lean body mass (LBM) (HP pre 64.72±1.9 Kg vs post 65.99±2.2 Kg, p<0.001; VHP pre 65.52±2.0 Kg vs post 67.61±1.7 Kg) whilst both NP and MP showed a significant decrease (NP pre 63.31±2.1 Kg vs post 62.4±2.3, p<0.05; MP pre 66.88±1.8 Kg vs post 65.80±2.9). HP and VHP showed a significant increase of anterior thigh CSA (HP pre 50.5±7.8 cm2 vs post 53.4±6.7 cm2, p<0.001; VHP pre 51.2±5.5 cm2 vs post 54.1±7.6 cm2), MP didn't changed CSA showed a significant decrease from 51.0±6.8 cm2 to 50.1±4.5 cm2. No changes of blood values were detected.
CONCLUSION: Taken together our data suggest that an higher protein intake (2.0 and 2.4 g/Kg) may help elite cyclists to improve performance and to increase muscle mass without differences between the two levels of protein intake. Instead 1.2 and 1.8 g/Kg of protein seemed to be not sufficient for this kind of athletes and could impair performance and muscle mass. Future studies directed at mechanisms by which level of protein intake influences performance outcomes are needed.

THE EFFECT OF WHEY PROTEIN SUPPLEMENTATION ON THE TEMPORAL RECOVERY OF SKELETAL MUSCLE FUNCTION FOLLOWING RESISTANCE TRAINING IN RESISTANCE TRAINED MEN.

DAVIES, R.W.1,2, BASS, J.J.1,2,3, CARSON, B.P.1,2, NORTON, C.1,2, KOZIOR, M.1,2, BROOK, M.S.3, WILKINSON, D.J.3, ATHERTON, P.J.3, SMITH, K.3, JAKEMAN, P.M.1,2

1: HUMAN SCIENCE RESEARCH UNIT, CENTRE FOR INTERVENTIONS IN INFECTION, INFLAMMATION & IMMUNITY <4I>, UNIVERSITY OF LIMERICK, IRELAND. 2: FOOD FOR HEALTH IRELAND , PHYSICAL EDUCATION AND SPORT SCI

INTRODUCTION: The recovery of muscle contractile function between successive resistance training (RT) bouts is a determinant of the adaptation to a regimen of RT. Whilst whey protein (WP) augments peri-RT muscle protein synthesis, its effect on the acute recovery of contractile function is equivocal (Davies et al., 2018). This study investigated the effect of supplemental whey protein on the recovery of skeletal muscle contractile function during repeated bouts of RT.
METHODS: Sixteen resistance-trained men (80 [13] kg body mass; 23 [4] y; 2.6 [1.2] y RT experience; mean [SD]) were recruited and habituated to all test procedures. A 7-day dietary supplement intervention study was undertaken using a randomised, double-blind, parallel group design. For the duration of the study subjects consumed a standardised and timed nutrient intake (35 kcal/kg/day; 2 g/kg/day protein; 4.5 g/kg/day carbohydrate; 1g/kg/day fat). Following an overnight fast, subjects were randomly assigned to consume each morning either a WP supplement (WP; n = 8) or an isocaloric, isonitrogenous, non-essential amino acid control (CON; n = 8), dosed at 0.33 g/kg body mass, constituting 17 % of total protein intake.
Peak isometric force attained performing an isometric back squat (PIF) and maximal countermovement jump (CMJ) displacement were used to assess baseline muscle function. Subjects then completed three RT bouts (0.7 1RM back squat; 10 repetitions per set; 0.25 duty cycle; mean point of exhaustion = 8 [2] sets), every other day. Other activities of daily living did not exceed 3 metabolic equivalents. Repeat measurement of PIF, CMJ, muscle pain and serum creatine kinase (CK) activity (an index of muscle damage) was taken pre-RT, +24h and +48h post-RT, each bout. The observed change reported as the mean [low, high] 90% CI, p-value (P) and effect size d (ES).
RESULTS: A 1.0 [0.7, 1.3] fold increase (P < 0.008; ES = 1.0) in CK and muscle pain (20 [10, 30] %; P = 0.011; ES = 1.3) was observed +24h the first RT bout only, confirming that no overt exercise-induced (EIMD) had occurred. An acute loss of PIF was observed following all RT bouts +24h (-19 [-21, -17] %; P < 0.001; ES > 2.0) and +48h for PIF (-19 [-21, -17] %; P < 0.001; ES > 2.0), and +24h for the CMJ (-7 [-9, -5] %; P < 0.05; ES > 0.7). No discernible difference or time x treatment interaction between WP and CON for any measure of function, pain, or CK (ES < 0.4; P > 0.493).
CONCLUSION: This study describes the magnitude and temporal change in skeletal muscle function following single and repeated bouts of RT in resistance-trained athletes. The outcome of the intervention does not support the use of a WP supplement, optimised for enhancement of muscle protein synthesis, to enhance recovery of muscle contractile function. We conclude that, whilst peri-RT supplementation with WP augments muscle protein synthesis, further inference of this pro-anabolic effect should not extend to acute (0 to 48 h) recovery of peri-RT muscle function.

THE EFFECT OF BRANCHED-CHAIN AMINO ACIDS, ARGININE, AND CITRULLINE ON REPEATED SWIMMING PERFORMANCE

HSUEH, C., CHANG, C.

NATIONAL TAIWAN UNIVERSITY OF SPORT

INTRODUCTION: Introduction: Branched-chain amino acids (BCAA) could reduce cerebral uptake of tryptophan, leading to decreased synthesis of serotonin in the brain. Arginine and citrulline could reduce exercise-induced hyperammonemia by increasing nitric oxide synthesis and urea cycle. The combination of these supplements could reduce exercise-induced central fatigue. The purpose of this study was to examine the effect of BCAA, arginine, and citrulline supplementation on repeated swimming performance in teenage athletes.
METHODS: Methods: Eight male and eight female high school swimmers ingested 0.085 g/kg BCAA, 0.05 g/kg arginine and 0.05 g/kg citrulline (AA trial) or placebo (PL trial) in a randomized cross-over design. One hour after the ingestion, the subjects performed a 50 m sprint with their best style every 2 min for 8 times in an indoor 25-m pool. The subjects were asked to swim with their maximal effort each time. The time, stroke frequency and stroke length in each sprint were recorded. Venous blood samples were collected before and after the exercise. The time for each sprint was analyzed by 2-way analysis of variance with repeated measurement.
RESULTS: Results: When all subjects were pooled together, total time for the AA trial was significantly faster than the PL trial (AA: 244.02±22.94 s; PL: 247.55±24.17 s, p<.001). Individual sprint time showed significant trial (p=.001) and trial x time (p=.004) effects. The post-hoc analysis revealed that the AA trial was significantly faster than the PL trial in the 2nd, 5th, and 6th sprint. In female subjects,

there is a significant trial effect (p=.004) with the AA trial being faster in all except the 6th sprint. On the other hand, the trial effect was not significant (p=.072) in male subjects. The AA trial showed significantly lower plasma tryptophan/BCAA ratio. Plasma urea concentration was significantly higher in the AA trial than the PL trial (trial effect p=.023) in females but not males. Plasma concentrations of ammonia and nitric oxide were similar in both trials.
CONCLUSION: Conclusions: The combined supplementation could improve 8 x 50 m performance in high school swimmers, especially in females. The improvement may be the result of alleviated central fatigue, indicated by the lower tryptophan/BCAA ratio.

Oral presentations

OP-BN13 Motor and cognitive training in children

DOES SCHEDULING OF OBJECT CONTROL AND LOCOMOTOR ACTIVITY RESULT IN DIFFERENT EFFECTS ON MOTOR COMPETENCE DURING INTEGRATED NEUROMUSCULAR TRAINING IN 6-7 YEAR OLD CHILDREN?

DUNCAN, M.J., HAMES, T., EYRE, E.L.J.

COVENTRY UNIVERSITY

INTRODUCTION: Combining opportunities to develop fundamental motor skills (FMS) alongside strength and power has most recently been termed 'integrated neuromuscular training (INT) and is becoming increasingly popular as a means to enhance children's motor competence (Fort-Vanmeerhaeghe, et al., 2016). Although INT is effective in enhancing children's FMS and fitness (Duncan et al., 2017), one key aspect that has yet to be examined is whether scheduling of INT activities has an impact on the training response. This study examined whether ordering of object control (e.g., throwing, catching) and locomotor skills (e.g., running, jumping), within an INT program, results in different responses in FMS, muscular fitness and perceived motor competence in 6-7 year old children.
METHODS: Following ethics approval and informed consent 140 children from 3 primary schools were randomised into three, 10-week interventions, Loco First (n = 50) where locomotor skills were dlivered first followed by object control skills; Object First (n =48) where object control skills were delivered first followed by locomotor skills or a control group (n =42, CON) who undertook standard school Physical Education. FMS and muscular fitness were assessed pre and post the 10 week intervention period. FMS: run, jump, throw, and catch were assessed using the Test of Gross Motor Development-2. Three measures of muscular fitness; 10m flying sprint time (secs), standing long jump (cm) and seated 1kg medicine ball (cm) throw were assessed. As baseline scores for FMS differed between groups, data were analysed using ANCOVA with post intervention scores for each variable as the dependent variable and baseline values as the covariate. Gender and Group (Loco First, Object First, CON) were used as between subjects factors.
RESULTS: Results indicated greater total FMS in Loco First and Object First vs CON (P = 0.001) with the increases in FMS being greater for Object First vs Loco First (P = 0.001). Sprint speed (10m) was lower for Object First vs CON (P = .024). Standing long jump distance was greater in Loco First vs CON (P .0001) and Object First (P = .0001). Seated medicine ball throw distance was greater for Loco First and Object First vs CON (Both P = .001).
CONCLUSION: This study suggest that a 10 week INT program in lieu of PE results in positive improvements in FMS and muscular fitness in 6-7 year olds compared to statutory PE. However, scheduling object control skills before locomotor skills within INT has a greater effect on total FMS and muscular fitness in 6-7 year old children.

AGE AND SEX DIFFERENCES IN BALANCE PERFORMANCE IN YOUTH: A SYSTEMATIC REVIEW AND META-ANALYSIS

SCHEDLER, S.1, KISS, R.2, MUEHLBAUER, T.1

1: UNIVERSITY OF DUISBURG-ESSEN, 2: BIELEFELD UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: During childhood and adolescence, neural and muscular capacities responsible for postural control are still emerging (Shumway-Cook & Woollacott, 1985) and particular the former diverge between males and females (Lenroot & Giedd, 2010). This may lead to age- and sex-related differences in postural control potentially affecting the trainability of balance performance in youth. Thus, the aim of this study was to quantify age and sex differences in balance performance in healthy children and adolescents.
METHODS: A systematic literature search was performed in the databases of PubMed, Web of Science, and SPORTDiscus. Inclusion criteria were as follows: (i) participants were healthy non-athlete minors, (ii) at least one measure of balance had to be reported for children (6-12 years) and adolescents (13-18 years) or boys and girls. Weighted standardized mean differences (SMD) were calculated for comparisons of balance performance between age groups (SMDba) and between sexes (SMDbs).
RESULTS: Thirty-four out of 1,366 studies met our inclusion criteria. Data of 7,616 children and 1,037 adolescents was analyzed and revealed a medium-sized effect of age on balance performance in favor of adolescents (SMDba: 0.69). Subdivided by type of balance measure, we observed large effects for static steady-state balance (SMDba: 1.25) and small effects for dynamic steady-state balance (SMDba: 0.25) as well as proactive balance (SMDba: 0.28) in favor of adolescents. Data of 9,537 youths (6-19 years; 5,015 females) was analyzed to study sex differences in balance performance in youth and showed a small effect in favor of girls compared to boys (SMDbs: 0.01). Further analysis revealed a small effect favoring girls for measures of static steady-state balance (SMDbs: 0.28) and a small effect in favor of boys for measures of dynamic steady-state (SMDbs: -0.06) and proactive (SMDbs: -0.19) balance.
CONCLUSION: Results indicate that adolescents outperform children in different measures of balance, which might be attributed to their advanced neural maturation. From a practical perspective, this may influence trainability of balance performance, either in favor of adolescents due to their advanced neural maturation or in favor of children due to their larger adaptive reserve. Regarding sex differences, girls showed better performances in measures of static steady-state balance but not in dynamic steady-state and proactive balance. These inconsistent results and their effects on trainability of balance performance require further research.
REFERENCES: Lenroot RK, Giedd JN. (2010). Brain Cogn, 72(1), 46-55.
Shumway-Cook A, Woollacott MH. (1985). J Mot Behav, 17(2), 131-147.
CONTACT: simon.schedler@uni-due.de

THE ROLE OF MOTOR COORDINATION ON EXECUTIVE FUNCTION IN CHILDREN WITH AND WITHOUT AUTISM SPECTRUM DISORDER

MA, W.Y.1, HUNG, T.M.1, HUANG, C.Y.2, SUNG, M.C.2, CHEN, P.L.2, PAN, C.Y.2
1: NATIONAL TAIWAN NORMAL UNIVERSITY , 2: NATIONAL KAOHSIUNG NORMAL UNIVERSITY

Introduction: Autism spectrum disorder (ASD) is a developmental disorder characterized by impaired social interaction, communication, and behavioral development (APA, 2013). Some of the everyday social and non-social behaviors seen in children with ASD may reflect specific executive dysfunction (Rajendran & Mitchell, 2007). In addition, clinicians now recognize that children with ASD experience delayed or impaired motor development (Staples & Reid, 2010). Research suggests important links between motor coordination and executive function (EF) in typically developing (TD) children. To date, information on motor coordination and EF in children with ASD is scarce, and no published study has examined whether there is an association between these two domains in primary school-aged children with ASD.
Methods: Forty-eight children with ASD and 48 TD children, aged 6-12, participated. Motor coordination and EF were measured by using the Bruininks-Oseretsky Test of Motor Proficiency-2 (BOT-2), the Stroop Color and Word Test, the Wisconsin Card Sorting Task (WCST), and the Go/No-go Test. Independent group t tests were used to compare the BOT-2 and EF measures between children with ASD and TD children. Pearson product-moment correlation coefficients were computed to assess the relationships between the BOT-2 scores and the EF measures for each group.
Results: Findings indicate that (a) children with ASD performed significantly poorer than TD children on all four BOT-2 composite scores (all $p < .01$; fine manual control, manual coordination, body coordination, strength and agility) and a total motor composite ($p < .01$), (b) children with ASD demonstrated significantly poorer on EF measures (Stroop interference; WCST total correct, perseverative responses, and conceptual level response; Go/No-go 1-target and 2-taget correct responses) than TD children (all $p < .05$), and (c) children with ASD showed significant more associations between motor coordination and EF than TD children.
Discussion: Continued development of motor coordination in children with ASD is important. Our results demonstrate that motor coordination is a significant correlate of EF in children with ASD, suggesting that further research is required to explore these preliminary findings of potential advantages of motor coordination in promoting EF through physical activity settings for children with ASD.
Acknowledgments
Supported by Taiwan MOST grants 106-2410-H-017-022-MY3.
References: American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Washington, DC: American Psychiatric Association.
Rajendran, G., & Mitchell, P. (2007). Cognitive theories of autism. Developmental Review, 27, 224-260.
Staples, K. L., & Reid, G. (2010). Fundamental movement skills and autism spectrum disorders. Journal of Autism and Developmental Disorders 40, 209-217.
Contact: a0936709379@gmail.com

AGE-DEPENDENT ADAPTATIONS TO ANTICIPATED AND NON-ANTICIPATED PERTURBATIONS AFTER BALANCE TRAINING IN CHILDREN

WÄLCHLI, M., KELLER, M., RUFFIEUX, J., MOUTHON, A., TAUBE, W.
UNIVERSITY OF FRIBOURG

INTRODUCTION: Postural control undergoes rapid changes during child development with improvements in postural responses to perturbations (Westcott & Burtner, 2004). However, postural responses to externally triggered anticipated and non-anticipated perturbations and the influence of balance training (BT) on such postural responses have not yet been investigated in children. This aspect seems very interesting when considering that responses to anticipated and non-anticipated perturbations require different postural control strategies, i.e. feedforward control in anticipated and feedback control in non-anticipated situations. In this regard, it was suggested that children younger than 8 years may not yet have the ability for appropriate feedforward controlled responses (Hay & Redon, 1999).
METHODS: Twelve young (6.7±0.6 years) and 18 older children (12.0±0.4 years) were exposed to externally induced anticipated (direction known) and non-anticipated (direction unknown) perturbations before (PRE) and after (POST) 5 weeks of BT. Age-matched children (9 young and 9 old) served as control groups and attended regular physical education during the 5 weeks between the PRE and the POST measurement.
RESULTS: In PRE-measurements, older children swayed less than younger children after perturbations ($p = .004$). However, no differences were found within age groups between perturbation conditions. Adaptations from PRE to POST between children exposed to BT and the control group were different ($p < .001$). Trained children decreased the sway path (-11.1%), whereas the control group did not improve their performance (+2.7%). Post-hoc analysis of the younger children exposed to BT revealed similar adaptations in anticipated and non-anticipated situations (-7.9% vs. -12.6%; $p = .278$). In contrast, the older intervention group improved significantly more in anticipated (-15.1%) than in non-anticipated perturbations (-8.2%; $p = .026$).
CONCLUSION: At baseline, older children performed better in both perturbation conditions than younger children, assuming that the postural control system was more matured in the older group. However, neither of the two age groups swayed less in the anticipated condition, may indicating that before the BT the children could not profit from previous knowledge about the direction of the perturbation. When exposed to 5 weeks of BT, only the older intervention group showed superior adaptations in anticipated compared to non-anticipated situations. Thus, the older children had better learned to benefit from prior information in the feedforward controlled situation. This finding supports the previously mentioned suggestion (Hay & Redon, 1999) that feedforward control develops at a later stage than feedback control and requires a more mature postural control system.
Hay, L., & Redon, C. (1999). Exp Brain Res, 125(2), 153-162.
Westcott, S. L., & Burtner, P. A. (2004). Phys Occup Ther Pediatr, 24(1-2), 5-55.

INTEGRATIVE NEUROMUSCULAR TRAINING PROGRAM TO IMPROVE MOTOR COMPETENCE IN PRIMARY SCHOOL CHILDREN. AN EXPLORATORY INVESTIGATION

FONT-LLADÓ, R., FORT-VAN MEERHAEGHE, A., PRATS-PUIG, A.

UNIVERSITAT DE GIRONA

Introduction: Fundamental movement skills (FMS) such as motor skills associated with locomotor, manipulative, and balance are elementary units of movement which are necessary to be mastered to achieve more specialized movement and engaging children in regular participation in physical activity. Integrated neuromuscular training (INT) is a specific methodology that focuses on the development of FMS and physical fitness in order to achieve motor competence.
Objective
To assess an INT program designed specially to improve motor competence in prepubertal children (8yr) performed during PE lessons in primary schools.
Methods: Participants: 45 children [23 boys, 22 girls; age 7.6•0.3 yr] were included in the PEHC (Physical Education, Health and Children) project. Recruited from 2 schools in a Northern Spain region, randomly divided into either a control (learn to swim) or intervention (INT program and learn to swim) group.
Procedure: Preintervention testing includes the Canadian Agility and Movement Skill Assessment (CAMSA) which measured 7 movement skills in a dynamic environment. Intervention: The INT program incorporates FMS and specific strength and conditioning tasks. It lasts 3 months: 20 minutes, 2 days x week and 24 sessions in total. All sessions were executed during the warm up of Physical Education (PE) lessons and were supervised by 2 persons: 1/ the PE teacher previously formed in INT and 2/ an expert in INT. All sessions integrated increasingly difficult tasks in different aspects: FMS, lower extremity strength, general coordination, general strength, pliomtrey tasks, velocity situations, core strength, and static balance, and use different methodologies (circuits, games, and introjective exercices). Experts provide constant corrective feedback. Postintervention data collection followed the same procedure used for preintervention.
Results: After training, changes in motor skills competence between the INT and control group were evident. The total score for motor competence increased by 4 points in the INT group ($p<0.0001$) and also an increase can be seen in the locomotion and manipulative skills scores ($p<0.0001$ and $p=0.039$, respectively). Compared with the control group, the intervention group improved motor competence ($p=0.018$) including locomotion skills ($p=0.045$) as well as manipulative skills ($p=0.044$). The CAMSA doesn't allow to isolate the balance skills.
Conclusion
In the current study we provide evidence for use this INT protocol adapted to be carried on warm-up in a PE lessons in primary school to improve the FMS in children. The effectiveness of the INT program have been shown only in the intervention group. Those results can be explained by a) integrates conditional capacities in a specific way for the FMS benefist, b) gradually increase the level of difficulty, b) provides an unstable base of support, introducing challenge to core control and lower extremity alignment , c) gives verbal instructions to improve performance

Invited symposia

IS-MI05 Counteracting age-related loss of muscle mass and independence: Experiences from the interdisciplinary CALM-study conducted in the Greater Copenhagen area.

EFFICACY AND EFFECTIVENESS OF RESISTANCE TRAINING AND NUTRITION INTERVENTIONS TO MAINTAIN MUSCLE MASS AND FUNCTION

GREIG, C.

UNIVERSITY OF BIRMINGHAM

Counteracting Age related Loss of skeletal Muscle mass (CALM) is an ambitious interdisciplinary project, at the heart of which sits a combined resistance exercise training (RET) and protein supplementation intervention undertaken at scale (n=208) in independently living older men and women (Bechshoft et al., 2017). The rationale underlying this combined approach, i.e., that exercise can stimulate skeletal muscle responsiveness to protein intake of a particular magnitude and quality both acutely and chronically, is based mainly upon data from younger adults. The accumulating literature relating to older adults is more equivocal, although recent systematic reviews suggests that responsiveness in older adults is reduced compared with young (Morton et al., 2017). Furthermore, additional protein intake in adults who already consume sufficient protein (in the case of CALM 1.1 g/kg/day), may confer no additional benefit to muscle health compared with RET alone, although frailer older adults with suboptimal protein intake based upon recent recommendations, may benefit. The pattern of daily protein intake, rather than the total amount, may be important with administration of 'supra-threshold doses' at regular intervals either with or without exercise, being proposed as an effective regimen to accrue muscle mass (Moore et al., 2015). Again, the data relating to chronic studies in older adults eliciting positive changes in muscle function or body composition in response to training are both limited and equivocal. CALM's multi- and interdisciplinary approach has provided a much needed platform from which to explore combined interventions manipulating exercise intensity and quality of protein supplementation in parallel with innovative approaches centred upon food product development and perceptions of protein consumption and exercise. Together the data highlight the need for the design of future RCTs to be undertaken with knowledge and understanding of social, cultural, and historical influences. Otherwise, the ability to implement particular regimens, even those which have efficacy, may be at best challenging and at worse, ineffective.
References: Bechshøft RL, Reitelseder S, Hojfeldt G et al. Trials (2016) 17:397
Morton RW, Murphy KT, McKellar SR et al. Br J Sports Med. 2017 Jul 11
Moore DR, Churchward-Venne TA, Witard O et al J Gerontol A Biol Sci Med Sci. 2015 Jan;70(1):57-62
c.a.greig@bham.ac.uk

SOCIETAL CONSTRUCTION TO SUPPORT AND MOTIVATE HEALTHY AGING

ULIJASZEK, S.

UNIVERSITY OF OXFORD

INTRODUCTION: Despite progressive chronological and biological aging, elderly individuals may have up to several decades of good and active life beyond retirement. New approaches are needed to reframe people post-retirement as being socially and economically important. This presentation will examine the importance of creating and maintaining community, both physically and virtually, to healthy aging.
METHODS: Critical reading of anthropological, sociological, public health and biosciences literature on healthy aging, to create a biocultural perspective on healthy aging in relation to physical activity and sociality.
RESULTS: Societal participation and social communication among aging populations are as important to health and well-being in this group as good diet and physical activity. Environmental, physical, political and social structures interact with human behaviour in maintaining healthy diet, adequate bone and muscle mass.
There are different ways in which physical activities, such as walking and hiking groups, and social dancing help to counter the erosion of social and cultural capital associated with aging, and provide informal support into later life.
CONCLUSION: Societal participation and social communication among aging populations are as important to health and well-being in this group as good diet and physical activity. This should be structured into everyday life politically and behaviourally.

AN ACTIVE OLD LIFE – RATIONALES FOR PARTICIPATION IN A RCT FOCUSING ON PHYSICAL ACTIVITY

JESPERSEN, A.

UNIVERSITY OF COPENHAGEN

Introduction: In this presentation, I will explore the arguments and rationales for participating in a RCT study, focusing on physical activity and healthy lifestyle, as the participants in the trial stated them. In my presentation I will follow a resent proposal in social science to use 'health practices', as an alternative to the concept of 'health behaviour', which tends to separate peoples' engagements with matters of health and illness from the social, political, cultural and economic contexts [Cohn, 2014, Blue et al., 2016]. The argument is that a focus on health practices, i.e. as locally situated and composite everyday doings will provide a much better understanding of the situated conditions that shape peoples (non-)participation in health practices, such as physical activity, in everyday life contexts [Cohn, 2014].
Methods: Based on a selection of short, qualitative interviews (N=50) conducted at baseline with research participants in the CALM study, I examine the personal and practical conditions that the participants pointed to as significant for their engagement with the trial.
Discussion: Understanding the rationales of participation from the point of view of the participants not only allows an understanding of the meticulous efforts invested by the participants in engaging in - in this case an intervention study – but also more broadly in changing lifestyle. It also allows for designing health interventions more appropriately, i.e., interventions that accommodate different rationales and encourage meaningful processes of change.
References:
Blue S, Shove E, Carmona C, Kelly MP. Theories of practice and public health: understanding (un)healthy practices. Critical Public Health. 2016:1-15.
Cohn S. From health behaviours to health practices: an introduction. Sociology of Health & Illness 2014: 157-62.

Oral presentations

OP-BN14 Neuromuscular control

MOTOR UNIT CONTROL PROPERTIES IN ECCENTRIC AND CONCENTRIC EXERCISE

KLINE, J.C., SHIWANI, B., ROY, S.H., CHIODINI, J.P., DE LUCA, G.

DELSYS INC. AND ALTEC INC.

INTRODUCTION: The mechanisms used by the central nervous system to coordinate movement during training, exercise and rehabilitation remain poorly understood. Today the most common approaches for investigating the control of human movement typically infer neural control mechanisms using biomechanical measurements from motion capture, instrumented force plates or inertial measuring systems. A more practical solution for directly accessing neural mechanisms of human movement is to develop new ways of analyzing the surface electromyographic signal that can leverage the advanced capabilities and diverse applications of modern wireless sEMG systems. Our group has been working to develop sensors and algorithms for automatically measuring the action potentials of individual motor units directly and noninvasively from the sEMG signal. But while current sEMG decomposition algorithms can be used to study neural control during isometric contractions or constrained cyclic contractions, there remains an unmet need for measuring the motor unit contributions during unconstrained exercise, training and natural human movement.
METHODS: To achieve this goal, we are advancing our decomposition algorithms to overcome three primary challenges of extracting motor unit data from sEMG signals recorded during dynamic movement: 1> tracking non-stationary changes in motor unit action potential shapes that occur with position and length changes of the muscle fibers, 2> improving the temporal resolution of firing rate measurements across dynamically varying activities, and 3> localizing firing detections amongst complex superpositions typically encountered in non-cyclic exercise. We tested these algorithms on n=5 control subjects <3 males, 2 females, mean age 32.8 ± 12.6 yr.> using sEMG signals recorded with the dEMG acquisition system from the biceps brachii muscles during resistive exercise involving both concentric and eccentric contractions at different speeds.
RESULTS: Results from all subjects tested indicated that the algorithms were able to identify a broad range of motor units from 8 to 24 above the 90% accuracy benchmark. The measured activity indicated clear differences in motor unit firing behavior between the concentric and eccentric phases of the exercise, with relatively higher firing rates and greater rate changes during concentric contractions and lower firing rates and more gradual rate changes during eccentric contractions.
CONCLUSION: These results mark a first step towards delineating the neural contributions to dynamic exercise and training, and hold promise for new research opportunities to use quantitative measure of neural control mechanisms to design more efficient training and exercise paradigms and tailor rehabilitation protocols to motor unit-based outcome measures.

INFLUENCE OF CONTRACTION INTENSITY ON NEUROMUSCULAR ADJUSTMENTS DURING A SUSTAINED FATIGUING CONTRACTION IN HAND MUSCLE

ABDELMOULA, A., BAUDRY, S., DUCHATEAU, J.

UNIVERSITÉ LIBRE DE BRUXELLES

INTRODUCTION: During sustained submaximal voluntary contractions, the neural and muscular systems undergo numerous changes with some of them limiting the time to task failure (1). The contributions of neural and muscular changes in time to task failure may vary with the target force to be maintained (2). This work examines the influence of contraction intensity on spinal and supraspinal excitability, and muscle tissue oxygenation during a submaximal voluntary contraction performed with the abductor pollicis brevis (APB).
METHODS: Twelve subjects sustained an isometric contraction at 25 and 50 % of the maximal voluntary contraction (MVC) force until failure with APB in separate sessions. MVC force was measured before and at the end of the sustained contractions. Surface electromyography (EMG), motor evoked potentials (MEP) induced by transcranial magnetic stimulation, short (H) and long latency (LLR) reflex were recorded during the contraction, and responses expressed relative to the maximal compound muscle action potential (Mmax). Muscle tissue oxygenation assessed by near-infrared spectroscopy (NIRS) was measured during the contraction.
RESULTS: As expected, the time to failure was longer for the task performed at 25% (275±90s) than at 50% MVC (113±46s; $p<0.05$). The MVC force decreased ($p<0.05$) by 50±14% and 45±10% at failure for 25% and 50% MVC tasks, respectively. At the end of the sustained contractions, the EMG activity was increased but did not differ between the two contractions (62% and 69 % for 25% and 50% MVC; $p=0.10$; respectively). Muscle tissue oxygenation decreased less during the sustained contractions performed at 25 (-76%) than 50% MVC (-87%; $p<0.001$). M wave area decreased with similar extent at 25% and 50% MVC. Normalized MEP and H reflex area increased with a similar extent during both sustained contractions. In contrast, LLR increased more at 25% (+92%) than 50% MVC (+41%; $p=0.03$).
CONCLUSION: These results suggest that intensity-related differences in muscle oxygenation may have influenced the sensory signal. The different magnitude of change in LLR response in the two contractions without difference in MEP changes between contractions requires, however, further investigations to resolve this apparent discrepancy.
REFERENCES:
1. Taylor et al. (2016) Med Sci 48: 2294-306
2. Booghs et al. (2012) Exp Physiol 97 : 918-29

A SINGLE SESSION OF REMOTE ISCHEMIC PRECONDITIONING DOES NOT ENHANCE FINE MOTOR SKILL LEARNING

FISCHER, J., HEGTMANN, C., HENRIKSEN, M.R., KROGH, M., KROGH, M., THOMSEN, G.V., LARSEN, R.G., STEVENSON, A.J.T.

AALBORG UNIVERSITY

INTRODUCTION: Five sessions of remote ischemic preconditioning (RIPC) can enhance gross motor learning (Cherry-Allen et al., 2015, J Neurophysiol, 113(10); Cherry-Allen et al., 2017, J Motor Behav, 49(3)). The aim of this study was to investigate the effect of one session of RIPC on fine motor skill learning. A single session of high intensity exercise is found to improve motor learning (Roig et al., 2012, PLoS ONE, 7(9); Thomas et al., 2016, PLoS ONE, 11(7)), and it is suggested exercise could be considered as a form of RIPC (Hess et al., 2015, Nat Rev Neurol, 11(12)). However, no research has investigated the effect of one session of RIPC when learning a fine motor skill. We hypothesized that a RIPC group will improve performance during retention and transfer tests compared to a sham group.
METHODS: 24 healthy young adults were randomized and stratified by gender into two groups and underwent either five sets of RIPC with 200 mmHg or sham conditioning with 20 mmHg applied to the left arm. Participants then completed five four-minute blocks of visuomotor accuracy-tracking task (VAT) training using the dorsiflexor muscles of the dominant leg, followed by a bilateral transfer test consisting of one block of VAT. To test retention and transfer effects, a single block of VAT was performed in each leg after one day and after one week. Data were analyzed using two-way between-within subjects ANOVAs for retention and transfer blocks separately.
RESULTS: No time-by-group interactions for VAT block performance were identified. There were main effects of time such that both groups improved VAT performance compared to baseline, including retention and transfer.
CONCLUSION: One session of RIPC did not enhance motor learning on a fine motor skill compared to a sham group. Our results provide novel information indicating that a single session of RIPC is inadequate in enhancing motor learning. Future studies are needed to investigate the dosage of RIPC required to enhance motor learning, which may have implications for rehabilitation strategies.

LOAD DEPENDENCY OF THE STRETCH SHORTENING CYCLE - CORRELATION OF MUSCLE ACTIVITY AND RATE OF FORCE DEVELOPMENT

FREYLER, K., KRAUSE, A., GOLLHOFER, A., RITZMANN, R.

UNIVERSITY OF FREIBURG

INTRODUCTION: During bouncing, the stretch-shortening-cycle (SSC) describes the muscular activation pattern and is defined by a stretching of a pre-activated muscle-tendon complex immediately followed by a muscle shortening in the concentric push-off phase (Komi 1984). Regarding the efficiency of bounces, two factors seem to be of considerable importance: the muscles pre-activation that determines an appropriate level of stiffness before initial touchdown (Avela et al. 1996) and the reflex activity after touchdown, which is supposed to contribute to the muscles force enhancement during the eccentric phase (Komi & Gollhofer 1997). Both factors are assumed to be modulated in response to load variation (Taube et al. 2012), and loading is considered to be of major relevance for the force-generating capacity in the SSC. This study aimed to identify load-dependent changes in biomechanical and neuromuscular characteristics of the SSC during bouncing in reduced loading conditions. For that purpose, neuromuscular control of lower limb muscles as well as correlations between the muscles pre-activation, reflex components and the force output have been assessed in 0.16g, 0.38g and 1g.
METHODS: Experiments were executed during a parabolic flight campaign. In 8 subjects, peak force (Fmax), ground contact time (GCT), rate of force development (RFD), jump height (H), momentum and jump frequency were measured. Electromyographic activities (EMG) in M. soleus (SOL), gastrocnemius medialis (GM) and tibialis anterior (TA) were assessed before (PRE) and during ground contact for the reflex phases short-, medium- and long-latency response (SLR, MLR, LLR).
RESULTS: With gradually decreased g-forces Fmax, RFD, momentum and jump frequency were reduced, while GCT and H increased ($P<0.05$). Concomitantly, EMG activity decreased in GM for PRE, SLR, MLR and LLR and in SOL for SLR, MLR and LLR ($P<0.05$). Fmax as well as RFD were positively correlated to SOL EMG in SLR and MLR ($P<0.05$), RFD and Fmax were positively correlated to GM EMG during PRE and LLR ($P<0.05$).

CONCLUSION: Findings emphasize that biomechanically relevant adaptations in response to load-variation were accompanied by muscle- and phase-specific modulations in neural control (Komi 1984). Gravitational variation is anticipated and compensated by a load-adjusted muscle activity. Importantly, pre-activation and reflex phases were differently affected: in the reflex phases SLR and MLR, SOL is assumed to contribute to the decline in force output with decreasing load and complementary in PRE and LLR, GM seems to be of major importance for force generation.
REFERENCES: Avela J, Santos P, Komi P. Eur J Appl Physiol 72: 553-562, 1996.
Komi P, Gollhofer A. J Appl Biomech 13: 451-460, 1997.
Taube W, Leukel C, Gollhofer A. Exerc Sport Sci Rev 40: 106-115, 2012.
Komi P. Exerc Sport Sci Rev 12: 81-121, 1984.

PROTECTIVE EFFECT ON ECCENTRIC EXERCISE-INDUCED MUSCLE DAMAGE BY MAXIMAL ISOMETRIC CONTRACTIONS OF THE CONTRALATERAL LEG

CHEN, T.C.1, TSAI, S.H.1, HO, C.C.1, HUANG, G.L.1, LAI, J.H.1, TSENG, K.W.2, NOSAKA, K.3
1 NATIONAL TAIWAN NORMAL UNIVERSITY, 2 UNIVERSITY OF TAIPEI, 3 EDITH COWAN UNIVERSITY

INTRODUCTION: The magnitude of muscle damage of the elbow flexors is attenuated when the same exercise is repeated by not only the same muscle but also the homologous muscle of the contralateral arm within 4 weeks, which is known as the contralateral repeated bout effect . It has been also reported that two maximal voluntary isometric contractions of the elbow flexors at a long muscle length confer protective effect against maximal eccentric contractions of the contralateral arm performed within 2 days later . However, it is not known whether other muscles than the elbow flexors show this contralateral effect. Thus, the present study investigated the hypothesis that 10 MVIC of the knee flexors would attenuate the magnitude of muscle damage after 100 maximal eccentric contractions <100 MaxEC> of the knee flexors performed by the contralateral leg. This study also compared the magnitude of the protective effect between the contralateral condition and ipsilateral condition in which 10 MVIC and 100 MaxEC were performed by the same leg.
METHODS: Young <20-22 y> men were randomly placed to one of the three groups ; an ipsilateral , a contralateral , or a control group. The IL and CL groups performed 10 MVIC at 20o knee extension at 2 days before 100 MaxEC performed by the opposite leg and the same leg, respectively, and the control group performed two bouts of 100 MaxEC with the non-dominant leg in 2-week apart. Changes in maximal voluntary concentric contraction torque of the knee flexors , range of motion of the knee joint , plasma creatine kinase activity and muscle soreness of the knee flexors before, immediately after and for 5 days after 100 MaxEC were compared between the groups by a mixed-design two-way ANOVA.
RESULTS: MVC-CON, ROM, SOR and CK did not change significantly after 10 MVIC, but changed significantly after 100 MaxEC for all groups. However, the changes in these variables after 100 MaxEC were smaller for the CL and IL groups when compared with the first bout of the control group. When comparing the CL and IL groups, the changes after 100 MaxEC were greater for the CL group than IL group <-7%, 11 mm>. The changes in MVC-CON, ROM and SOR after 100 MaxEC were not significantly different between the IL group and the second bout of the control group, but were greater for the CL group than the second bout of the control group.
CONCLUSION: These results supported the hypothesis that 10 MVIC reduced muscle damage of the contralateral leg, and showed that the magnitude of the protective effect conferred by 10 MVIC was less for the CL than IL condition. It is concluded that MVIC at a long muscle length confer protective effect on the homologous muscle of the contralateral limb, and this adaptation is evident for not only for arm but also leg muscles.

Oral presentations

OP-BN15 Muscle-Tendon Biomechanics

RELIABILITY OF ULTRASONOGRAPHY TO MEASURE VASTUS LATERALIS MUSCLE THICKNESS AND PENNATION ANGLE USING A STANDARDISED OPERATING PROCEDURE.

THORNLEY, I., JOHNSON, M.I., FRANCIS, P.
LEEDS BECKETT UNIVERSITY

INTRODUCTION: Ultrasonography (US) is a portable imaging technique that can be used to quantify skeletal muscle thickness (MT) and subsequently, estimate skeletal muscle mass. In addition to thickness, architectural properties of skeletal muscle such as pennation angle (PA) can be estimated using US. Reliability has previously been reported for the measurement of MT and PA using US.[1] However, there is inconsistency in the methods used and the clarity of their reporting. To overcome this, a systematic review of the literature was conducted, and a standardised operating procedure for measuring vastus lateralis MT and PA was developed.
The aim of this study was to assess the intra rater reliability of ultrasonography to measure vastus lateralis MT and PA using a standardised operating procedure.
METHODS: Following ethical approval from the Leeds Beckett University research ethics 16 healthy adults (males=8, females=8) aged 24-61 years, provided written informed consent to have measurements of vastus lateralis MT and PA taken. Participants were supine with the knee hanging over the edge of a medical plinth to create a relaxed 90° angle. The measurement site was identified by measuring 50% of the distance between the greater trochanter and the lateral femoral condyle; this was then marked. The transducer (5cm in width) was placed on the marked site and three separate images were captured on the right leg of each participant using the ultrasound (LOGIQ E, GE Healthcare). Images were downloaded to Image J where MT and PA were measured for each of the three separate images captured. The intra class correlation coefficient (ICC) and associated 95% confidence interval (95% CI) were calculated in SPPS (version 24) using a 2-way mixed-effects model (absolute agreement). The standard error of measurement (SEM) for MT and PA was obtained using the formula: Pooled SD x Sqrt(1 - ICC).
RESULTS: Excellent levels of intra-rater reliability was achieved for MT (ICC= 0.98; 95% CI 0.97-0.99; p>0.01) and PA (ICC=0.99; 95% CI, 0.97-0.99; p>0.01). The SEM was 0.03cm for MT and 0.08° for PA.
CONCLUSION: Excellent levels of intra-rater reliability and a small SEM could be obtained in the measurement of vastus lateralis MT and PA using a newly established standardised operating procedure. These results were demonstrated in a heterogeneous sample (age and activity levels). This study is the first to report the reliability of MT and PA measurements using a standardised operating procedure. More-

over, it is the first study to provide a clear and reliable standardised operating procedure available for use in the measurement of vastus lateralis MT and PA.
Reference: Oliveira, V., Carneiro, S. and Oliveira, L. (2016) Reliability of biceps femoris and semitendinosus muscle architecture measurements obtained with ultrasonography. Research on Biomedical Engineering, 32 (4), pp. 365-371.
Contact: Isobel Thornley; i.thornley@leedsbeckett.ac.uk

SITE- AND GENDER-DIFFERENCES IN MORPHOLOGICAL AND MECHANICAL PROPERTIES OF THE PLANTAR FASCIA IN ASYMPTOMATIC YOUNG INDIVIDUALS

SHIOTANI, H.1, YAMASHITA, R.2, MIZOKUCHI, T.2, KAWAKAMI, Y.3

WASEDA UNIVERSITY

INTRODUCTION: The plantar fascia (PF) is a dense connective tissue primarily contributing to the foot arch support. Previous studies revealed that the proximodistal site- and gender-differences exist in plantar fascia thickness (Crofts et al., 2014; Huerta & Garcia, 2007). However, few studies have attempted quantitative evaluation of PF elasticity in vivo, and its site- and gender-differences are not clear. In this study, we used the shear wave elastography to test our hypothesis that not only PF thickness but also its elasticity is site- and gender-specific.
METHODS: Forty healthy young participants (20 males, age: 22.7 ± 2.0 years; 20 females, age: 22.2 ± 1.8 years) with no history of lower limb or foot injury were recruited. Ultrasound shear wave elastography (Aixplorer, SuperSonic Imagine, France) was used to obtain PF thickness and shear modulus. The scanning of PF was performed in a longitudinal direction at five different sites from the calcaneal attachment (CAL) to the second metatarsal head. A two-way (site × gender) repeated measures analysis of variance with a Bonferroni post hoc test and an independent t-test was performed. Statistical significance was set at $p < 0.05$.
RESULTS: PF at CAL was significantly thicker and stiffer (higher shear modulus) than the other four measurement sites in both genders. Males' PF were thicker at CAL compared with females (males: 2.8 ± 0.4 mm; females: 2.3 ± 0.3 mm). At all measurement sites, females had significantly stiffer PF than males (males: 69.0 ± 26.6 kPa; females: 96.3 ± 26.9 kPa).
CONCLUSION: In this study, both the thickness and shear modulus showed clear site differences. These results partly support a previous finding on the site difference of PF thickness and further reveal the inhomogeneity of PF elasticity. This may reflect greater loading and mechanical stresses at CAL of PF during daily activities (Arnold et al., 2010; Chen et al., 2015). In addition, the gender differences partly support a previous finding on the PF thickness and further add to the gender specificity of PF elasticity. It has been reported that females have higher joint laxity (Shultz et al., 2007), lower toe flexor muscles' strength (Uritani et al., 2014), and larger deformation of the longitudinal foot arch (Fukano & Fukubayashi, 2012). These findings imply that PF of the female participants compensates for the shortage of other arch supporting tissues by becoming stiffer, to resist the mechanical stress on the foot arch.
REFERENCES:
Arnold, J. B., Causby, R., Pod, G. D., Jones, S. (2010). Diabet Foot Ankle, 1: 5518.
Crofts, G., Angin, S., Mickle, K. J., Hill, S., Nester, C. J. (2014). Gait Posture, 39: 35-39.
Fukano, M., Fukubayashi, T. (2012). Foot, 22: 6-9.
Huerta, J. P., Garcia, J. M. A. (2007). Eur J Radiol, 62: 449-453.
Shultz, S. J., Shimokochi, Y., Nguyen, A. D., Schmitz, R. J., Beynnon, B. D., Perrin, D. H. (2007). J Orthop Res, 25(8): 989-996.
Uritani, D., Fukumoto, T., Matsumoto, D., Shima, M. (2014). J Foot Ankle Res, 7: 28.

TWO-POINT METHOD FOR THE ASSESSMENT OF LEG MUSCLE MECHANICAL CAPACITIES IN FIELD CONDITIONS

GARCÍA-RAMOS, A.1,2, ZIVKOVIC, M.3, DJURIC, S.3, MAJSTOROVIC, N.3, MANOVSKI, K.3, JARIC, S.3

1: FACULTY OF SPORT SCIENCES, UNIVERSITY OF GRANADA. 2: FACULTY OF EDUCATION, CATHOLIC UNIVERSITY OF THE MOST HOLY CONCEPCIÓN. 3: FACULTY OF SPORT AND PHYSICAL EDUCATION, UNIVERSITY OF BELGRADE.

INTRODUCTION: The force-velocity (F-V) relationship during multi-joint exercises has been traditionally determined from the F and V data obtained under multiple (more than two) loads (multiple-point method).1 Since the F-V relationship in these exercises was described as highly linear, it was proposed that the F-V relationship could be accurately determined from the F and V data collected under only two loads (two-point method), considerably reducing testing time and the associated fatigue.2 Although several studies have confirmed the high reliability and validity of the F-V relationship obtained from only two points,3 it should be noted that all these studies examined the feasibility of the two-point method from a testing procedure based on multiple loads. To explore the feasibility of the two-point method in field conditions, this study compared the reliability and magnitude of the F-V relationship parameters (maximum F [F0], maximum V [V0], F-V slope, and maximum power [P0]) obtained through the application of only two loads (i.e., two-point method) vs. six loads (i.e., multiple-point method).
METHODS: Ten physically active men (age: 19.5±0.9 years, body mass: 79.0±9.0 kg, height: 183.9±8.4 cm) conducted 4 testing sessions after a preliminary familiarization session with the leg cycle ergometer exercise. In a counterbalanced order, subjects performed 2 sessions of the multiple-point method (6 loads applied for the F-V modelling) in one week and 2 sessions of the two-point method (only the lightest and heaviest loads were applied) in another week.
RESULTS: The main findings revealed that (I) the reliability of the F-V relationship parameters was high and of comparable magnitude for both the multiple- (CV and ICC range: 1.91%-3.94% and 0.72-0.99) and two-point methods (CV and ICC range: 1.41-4.62% and 0.76-0.95), (II) the P0 assessed from the multiple-point method was significantly lower than the obtained from the two-point method (P=0.041; ES=0.36) due to a significant decrease in F0 (P=0.039; ES=0.41) but not in V0 (P=0.570; ES=-0.15), and (III) the magnitude of the F-V relationship parameters obtained from the multiple- and two-point methods were highly correlated ($r > 0.80$).
CONCLUSION: These results support the two-point method as a reliable, valid, and fatigue-free procedure for assessing the muscle mechanical capacities through the F-V relationship in the leg cycle ergometer exercise.
REFERENCES:
1. Jaric S. Int J Sports Med. 2015;36(9):699-704
2. Jaric S. Sports Med. 2016;46(11):1585-1589
3. García-Ramos A, Jaric S. Strength Cond J. 2017. In press

EFFECT OF FOOT STRIKE PATTERN ON BEHAVIOR OF MEDIAL GASTROCNEMIUS MUSCLE-TENDON COMPLEX DURING RUNNING

TAKESHITA, T., NORO, H., TAGURI, A., KATO, R., YOSHIDA, T., HATA, K., YANAGIYA, T.

GRADUATE SCHOOL OF JUNTENDO UNIVERSITY

INTRODUCTION: In a comparison of the foot strike pattern (FSP), there are many differences in kinematic and kinetic valuables, like typical impact force in the rear-foot strike (Lieberman et al., 2010). Though previous studies showed much difference of kinematics and kinetics characteristics between FSP, there is no study which compared the behavior of muscle-tendon complex. This study aimed to clarify whether the behavior of medial gastrocnemius muscle-tendon complex differs between two FSP.
METHODS: Eight healthy males participated in this study (age: 21.88±0.93yrs; height: 1.75±0.06m; weight: 66.69±3.88kg). They ran on a motorized treadmill for 40 seconds at the pace of 7 minutes per kilometer and were conducted to run with fore-foot strike (FFS) and rear-foot strike (RFS) for each trial. Running motion was captured with a digital high-speed video camera at 240fps. The ground reaction force was collected with the use of mounted force platform. To quantify muscle activity, surface electromyogram data was collected. An ultra-sonographic apparatus was used to measure fascicle length in the medial gastrocnemius. Muscle-tendon complex (MTC) length was estimated using the equation (Hawkins and Hull, 1990). Series elastic element (SEE) length was calculated with the use of MTC length, pennation angle and fascicle length (Fukunaga et al, 2001). These data were normalized to 100% at 1 running cycle time followed by Farris and Sawicki (2014).
RESULTS: Maximal MTC length was significantly longer in RFS ($p<0.05$), but SEE was tend to lengthen after initial contact in FFS ($p<0.05$). Also, fascicle was remarkably lengthened in RFS at the initial contact ($p<0.05$). Lengthening velocity of SEE was higher in FFS in the middle of stance phase ($p<0.05$).
CONCLUSION: From the view of SEE, there is a noticeable occurrence of the stretch-shortening cycle in FFS. Considered occurrence of this phenomenon in spite of such a lower running pace, FFS seems to be comfortable to perform faster running economically. Though there is some definitive difference in behavior of MTC, fascicle, and tendon, it is necessary to consider the effect of elasticity and viscosity in two FSP.
References: Farris, D. J., & Sawicki, G. S. (2012). Proc Natl Acad Sci U S A, 109(3), 977-982.
Fukunaga, T., Kubo, K., Kawakami, Y., Fukashiro, S., Kanehisa, H., & Maganaris, C. N. (2001). Proceedings of the Royal Society B-Biological Sciences, 268(1464), 229-233.
Hawkins, D., & Hull, M. L. (1990). Journal of Biomechanics, 23(5), 487-494.
Lieberman, D. E., Venkadesan, M., Werbel, W. A., Daoud, A. I., DAndrea, S., Davis, I. S., Pitsiladis, Y. (2010). Nature, 463(7280), 531-535.
Contact: tomonaritakeshita@gmail.com

TIME COURSE OF MUSCLE TENDON FUNCTION AND STRUCTURE FOLLOWING A FIVE MINUTE STATIC STRETCHING EXERCISE

KONRAD, A., TILP, M.

KARL- FRANZENS- UNIVERSITY GRAZ

INTRODUCTION: Previous studies have shown that a single static stretching exercise decreases muscle stiffness immediately after the stretch, which recovered 30 minutes after the stretching (Kay and Blazevich, 2012). However, the precise time course of the response of muscle and tendon properties (e.g. muscle stiffness) and function responses (e.g. range of motion (RoM)) within the first 10 min minutes after stretching are not yet known. Therefore, the purpose of this study was to investigate the time course of the changes of the various muscle and tendon mechanical properties and the function responses of the gastrocnemius medialis (GM) and the Achilles tendon (AT) following 5 min of static stretching.
METHODS: Fourteen healthy volunteers (seven healthy females (mean ± SD; 24.9 ± 3.1 years, 166.0 ± 6.1 cm, 60.0 ± 8.4 kg) and seven healthy males (mean ± SD; 27.5 ± 8.3 years, 180.1 ± 6.2 cm, 75.9 ± 6.5 kg)) were tested on four separate days in a random order with three different rest times (0 min, 5 min, 10 min) after 5×60s of stretching or following a control period without stretching. During each test, the dorsiflexion RoM, passive resistive torque (PRT), and maximum voluntary contraction (MVC) were measured with a dynamometer. Ultrasonography of the GM muscle-tendon junction displacement and motion capture allowed us to determine length changes in the AT and GM, respectively, and hence to calculate their stiffness. Two-way repeated-measures ANOVA tests or Friedman tests were performed to test for differences between the conditions.
RESULTS: Following the stretching, we observed a significant increase in RoM and a decrease in MVC at 0 min, 5 min, and 10 min post-stretching. This could be attributed to an increase in muscle elongation which also lasted at least 10 min. Furthermore, a significant decrease in PRT and muscle stiffness was observed up to 5 min after the stretching. A decrease in muscle-tendon stiffness was observed immediately, but not 5 or 10 min after the stretching. No changes in tendon stiffness or in any variable in the control group were detected.
CONCLUSION: We conclude that the effects of a 5×60s static stretching exercise changes the muscle-tendon functions (RoM, MVC), which are related to mechano-morphological changes of the muscle but not the tendon structure, respectively. Although the functional changes last for at least 10 min, changes in muscle stiffness recover within 5 min of the stretching. Hence, we speculate that other factors, such as increased stretch tolerance (Magnusson et al. 1996), lead to longer-lasting changes of muscle-tendon function.
REFERENCES:
Kay AD, Blazevich AJ. J Appl Physiol 2009;106:1249–1256.
Magnusson SP, Simonsen EB, Aagaard P, Dyhre-Poulsen P, McHugh MP, Kjaer M. Arch Phys Med Rehabil 1996;77:373–378.
CONTACT:
andreas.konrad@uni-graz.at

Oral presentations

OP-PM81 Physiology: mixed +

EFFECTS OF SUBJECT'S POSITION ON PLANTARFLEXION TORQUE

STAFILIDIS, S., SICKINGER, C.

UNIVERSITY OF VIENNA

INTRODUCTION: Numerous studies [1,2,3] examined the mechanical and morphological properties of the lower leg muscle tendon unit. The majority of the research was conducted in commercial design isokinetic dynamometers which have been made elastic for comfort (cushioning pads) rather than rigid for accuracy [4]. It has been postulated that the maximal torque can be, among other factors, affected by the elasticity of the dynamometer arm-foot system and the displacement of the dynamometer/ankle joint axis. Although corrections have been proposed [1,2], the elasticity of the dynamometer arm-foot system can alter the geometry of the muscle fascicles through the joint rotation [2] and negatively affect the muscle's force generation capability. Consequently, it is essential to reduce the elasticity of the foot-arm system prior testing. In this study we tested the hypotheses that by increasing the pressure of the foot on the dynamometer plate we can reduce the elasticity, the joint rotation and increase the maximal exerted torque.
METHODS: Eighteen males (29±6y, 77±10kg, 181±5cm) performed in randomized order 3 maximal voluntary plantarflexion contractions on a dynamometer (HUMAC) in 4 different (0-3-6-9cm; toward the dynamometer plate) subject positions. All contractions were performed in the same hip-knee-ankle angle configuration (110-180-90°). Reflective markers were placed on anatomical points of the lower leg and the dynamometer. An insole (Pedar 100Hz) was used to acquire the foot pressure. Kinematics and torque signals were captured at 200 and 2000 Hz respectively. A one-way repeated ANOVA with Bonferroni correction ($p<.05$) was used for the depended variables (torque, pressure and joint rotation) over positions.
RESULTS: A significant main positioning effect ($p<.001$) was found for torque, pressure and joint rotation. Positions 6 & 9cm showed significant ($p<.001$) higher torque (126±29, 148±26, 167±25 and 172±27Nm; 0-3-6-9cm respectively) than 0 and 3cm but not between them. The joint rotation decreased ($p<.001$) from 15.5±3.9 to 7.1±2.5° and the peak pressure increased significantly ($p<.001$) from 71±25 to 339±85 kPa (at 0 and 9cm).
CONCLUSION: The results showed that forward positioning of the subject can increase the maximal exerted torque for >35%. This effect is important in longitudinal study designs, since a not standardized positioning can alter the torque ~4%/cm. The increased torque can be attributed to the reduced joint rotation and therefore the operation of the muscle fascicles in their optimum region of force-length relation. The lack of torque differences between position 6 and 9cm indicates the existence of an optimal subject positioning.
REFERENCES:
1) Arampatzis et al. (2005) J Biomech. 38:885-92
2) Karamanidis et al. (2005) J Electromyogr Kinesiol. 15:608-16.
3) Stafilidis & Arampatzis (2007) J Sports Sci. 25:1035-46
4) Osternig (1986) Exerc Sport Sci Rev. 14:45-80
Contact: savvas.stafylidis@univie.ac.at

HYPEROXIA SPEEDS PULMONARY OXYGEN UPTAKE KINETICS AND INCREASES CRITICAL POWER DURING SUPINE CYCLING

GOULDING, R.P., ROCHE, D.M., MARWOOD, S.

LIVERPOOL HOPE UNIVERSITY

INTRODUCTION: We have previously demonstrated that critical power is mechanistically related to the phase II time constant <τ_V̇O2> of oxygen uptake kinetics . CP has been shown to be greater in hyperoxia compared to normoxia . However, whether this effect is related to faster V̇f O2 kinetics in hyperoxia is presently unclear. Exercising in the supine position impairs O2 delivery and increases τ_V̇O2•,•raising the possibility that hyperoxia will reduce τ_V̇O2•in the supine position. Therefore, we hypothesised a concomitant reduction in τ_V̇ O2 alongside an increase in critical power when determined in hyperoxia compared to normoxia. Such evidence would demonstrate that τ_V̇O2 is an independent determinant of CP.
METHODS: 8 healthy men completed an incremental ramp test on a supine cycle ergometer to determine V̇8O2 max and the gas exchange threshold . This was followed by 8 visits whereby CP was determined via 4 severe-intensity constant load exercise tests to exhaustion, each repeated once in normoxia and once in hyperoxia . Moderate-intensity exercise bouts at 70% GET were repeated 4 times in each condition to characterise the kinetics of pulmonary V̇sO2, muscle deoxyhaemoglobin <•[HHb]; via near-infrared spectroscopy>, and absolute concentrations of oxyhaemoglobin <[HbO2]>.
RESULTS: CP was greater and τ_V̇ O2•was reduced in H versus N. Additionally, [HbO2] during exercise was greater in H versus N, whereas •[HHb] was unchanged . τ_V̇O2 was significantly inversely related to CP in H , however no relationship was observed in N .
CONCLUSION: This study provides further experimental evidence that τ_V̇O2 is an independent determinant of CP. CP was greater in H, and this was observed alongside measures of increased O2 availability when compared to N. The lack of relationship between τ_V̇O2 and CP observed in N is consistent with previous research for supine exercise . That this relationship was restored in H likely suggests that the supine position introduces a kinetic dissociation between pulmonary and muscle V̇fO2 that was reversed by H, thus demonstrating unequivocally that τ_V̇O2 is an independent determinant of CP.
References: DiMenna FJ, Wilkerson DP, Burnley M, Bailey SJ, Jones AM. <2010>. J Appl Physiol, 108, 283-292.
Goulding RP, Roche DM, Marwood S. <2017>. Exp Physiol, 102 <9>,1158-1176.
Vanhatalo A, Fulford J, DiMenna FJ, Jones AM. <2010>. Exp Physiol, 95 <4> 528-540.

MORPHOLOGICAL CHANGES OF LEG MUSCLES AND SUBCUTANEOUS FAT FROM COMPRESSION PRESSURES IN ACTIVE-HEALTHY INDIVIDUALS

LEE, C.W.D.

THE CHINESE UNIVERSITY OF HONG KONG

INTRODUCTION: Wearing sports compression garment is popular however, the efficacy in exercise and recovery performance remains controversial; limited data on the relationship of applied compression pressure (COMP) to tissues morphological responses (Brown et al., 2016; Partsch, 2016) unlike in clinical studies on compression stockings (Partsch and Mosti, 2008). Therefore, we aimed to investigate the muscles and subcutaneous fat morphological responses to different COMPs in active-healthy participants during rest.
METHODS: Thirty-two participants (Male:16; Age = 21.8 ± 1.7 years; Weight = 61.0 ± 8.8 kg; Height = 169.2 ± 7.0 cm; % Body fat: 16.0 ± 8.7%) were provided with three different lower-body COMPs (LOW: gymnastic tights, MED: sports compression tights on top of LOW, and HIGH: sports compression sleeves on top of MED). The leg skinfolds and circumferences were measured with standardized techniques; cross-sectional area of leg muscles (CSAmuscle) and subcutaneous fat (CSAfat) were measured using 0.25T MRI, at calf, knee, thigh levels, and in supine and upright positions.
RESULTS: The COMP at LOW (calf: 2.9 ± 1.4, knee: 1.6 ± 1.5, thigh: 2.2 ± 1.3 mmHg), MED (calf: 16.8 ± 3.0, knee: 11.1 ± 3.6, thigh: 10.7 ± 1.6 mmHg) and HIGH (calf: 38.8 ± 4.4, knee: 26.2 ± 4.3, thigh: 21.3 ± 2.3 mmHg) were monitored. A COMP of 38.8 ± 4.4 mm Hg at calf, and 10.7 ± 1.6 mmHg at thigh, induced significantly smaller CSAmuscle ($P < 0.05$). There was no main effect of COMP at knee ($P = 0.051$) and thigh ($P = 0.087$) CSAfat; and no main effect of position at CSAmuscle and CSAfat ($P < 0.05$). The COMP was negatively correlated to, female's CSAmuscle ($P < 0.01$, $r = -0.4$) and CSAfat ($P < 0.001$, $r = -0.7$); male's CSAmuscle ($P < 0.05$, $r = -0.3$) and CSAfat ($P < 0.005$, $r = -0.5$); but did not correlate to body height and weight, leg skinfold and leg circumference ($P > 0.05$) in females. Males, had bigger CSAmuscle and smaller CSAfat at all leg levels ($P < 0.001$), and experienced higher COMP at calf ($P < 0.05$) and thigh ($P < 0.05$) than in females, in MED and HIGH conditions.
CONCLUSION: Using MRI, we observed that 38.8 ± 4.4 and 10.7 ± 1.6 mmHg are critical COMP for calf and thigh muscles compression in active-healthy individuals during rest. The leg muscle and subcutaneous fat respond differently under different COMPs during rest. We suggest that leg muscle and fat composition could affect the exerted COMP therefore efficacy of compression garment wearing, particularly for high leg skinfold individual.

NEUROPHYSIOLOGICAL MECHANISMS UNDERLYING MUSIC-RELATED INTERVENTIONS IN THE EXERCISE DOMAIN

KARAGEORGHIS, C.I., DELEVOYE-TURRELL, Y., BIGLIASSI, M., GUÉRIN, S.M.R.

BRUNEL UNIVERSITY LONDON

INTRODUCTION: Given recent advances in digital technologies, music applications have rapidly become de rigueur in the exercise domain. Ergonomically-designed personal listening devices are popular with exercisers and millions of music tracks are now available via streaming apps. Over the last 20 years, there has been a large body of scientific work that has addressed the psychological, psychophysical, psychophysiological and ergogenic effects of music during exercise. In very recent years, researchers have shown increased interest in the neurophysiological mechanisms that underlie such effects. Harnessing and understanding the effects of music is important to the central mission of exercise science in getting people in developed countries to become more physically active.
METHODS: The interest in neurophysiological mechanisms has been accelerated by the availability of brain assessment technologies to exercise scientists, such as portable electroencephalography devices, functional magnetic resonance imaging and functional near-infrared spectroscopy . The purpose of this paper will be to provide a synthesis of recent work that has used EEG, fMRI or fNIRS to investigate brain function during exercise with ambient music .
RESULTS: A series of studies using portable EEG in a range of exercise contexts has shown that music can: a> supress theta waves during high-intensity exercise; b> reduce the frequency of the synchronisation–desynchronization–resynchronisation cycle of a neuropopulation; c> reduce the level of connectivity across somatosensory regions of the brain; and d> up-regulate beta waves in the frontal and frontal-central regions during self-paced walking. The few studies that have used fMRI in an exercise context reveal that: a> fast/loud music elicits activation in structures integral to visual perception, allocation of attention and motor control; and b> music increases activation in the left inferior frontal gyrus, and activity in this region is negatively correlated with exertional responses. Work with fNIRS is currently at a nascent stage. Nonetheless, based on some preliminary data, a putative hypothesis will be expounded to suggest that the effects of music on perception of exertion, affective responses and exercise endurance are mediated by corresponding changes in the activity of the dorsolateral prefrontal cortex. Ostensibly, music might delay the increase in brain oxygenation that is evident during exercise.
CONCLUSION: This paper contributes to a proposed paradigmatic shift in exercise psychology, from cognitivism to hedonism , as a means by which to tackle the scourge of sedentariness and obesity.

EFFECT OF THE TREADMILL SURFACE ON PHYSIOLOGICAL DEMANDS DURING CONTINUOUS LONG-DISTANCE RUNNING

COLINO, E.1, GARCÍA-UNANUE, J.2, SÁNCHEZ-SÁNCHEZ, J.2, GALLARDO, L.1

1. UNIVERSIDAD DE CASTILLA-LA MANCHA; 2. UNIVERSIDAD EUROPEA DE MADRID

INTRODUCTION: Differences in long distance running physiological demands between treadmill (TM) and overground (OG) running for well accommodated athletes have been related to the effect of the surface and to the lack of air resistance on the TM. To compensate the overall effect of the TM, it is a common practice to increase the grade of the TM to 1% to approximate the metabolic demands of an OG run. However, the accuracy of that adaptation might differ according to OG surfaces and may not be precise during prolonged exercise involving high metabolic rates. Under those conditions, the lack of air replacement during TM running can affect heat dissipation, contributing significantly to fatigue despite of reducing the energy required to overcome air resistance. The purpose of this study was to analyse the isolated effect of the surface on physiological demands during TM and OG long distance running by controlling air resistance
METHODS: Ten (n=10) recreationally trained male distance runners (age: 28 ± 5 years, height: 174 ± 6 cm, body mass: 70 ± 6 kg, %body fat: 16.4 ± 3.1, VO2peak: 58.2 ± 7.5 ml·kg-1·min-1) completed three 40-min running trials at constant speed in a randomised, counterbalanced order on separate days: 1 on asphalt (AS), 1 on a 400-m tartan track (TA); and 1 on a TM. Trials were performed at the same time and the same day of the week for each subject, and diet, liquid intake and sleeping hours were controlled. The first test was performed at a self-selected, moderately vigorous pace (10K pace). Speed was adjusted to be constant during the test. For tests 2 and 3, the same

constant speed was reproduced. During TM running, athletes ran against an oncoming airflow equal to their running speed. Heart rate (HR) was continuously monitored during the runs. Maximum HR (HRMAX) and mean HR (HRMEAN) were analysed in the 40-min gap and every 10 minutes. Besides, 4 different intensity zones were identified based on athletes' peak HR (low: <75%; moderate: 75-85%; high: 85-95%, and maximal: >95%), and total time spent in each HR zone was assessed. Non-parametric Kruskal-Wallis H Test was used to compare parameters between surfaces. Where differences were identified, post-hoc pairwise comparisons were performed using Dunn-Bonferroni tests
RESULTS: HRMEAN(30'-40') and HRMAX(20'-30'), HRMAX(30'-40') and HRMAX(0'-40') were significantly higher during TM running compared to TA running ($p<0.05$). Also, time spent at maximal HR zone was significantly greater on TM compared to TA (12.22%; ES=1.48; $p<0.05$). No other significant differences were found, although HR-time graph suggests that TA requires less HR during a 40-minute running test at constant speed
CONCLUSION: The effect of the surface itself is responsible for significant changes on physiological stress during long distance running. When subjected to an equivalent airflow, physiological demands of running on TM reproduce faithfully those of running on AS. However, there is a lack of representativeness of TM surfaces with respect to TA surfaces

EFFECT OF PRIOR HEAT EXPOSURE ON THE RECOVERY OF MUSCLE FORCE, MUSCLE OXYGENATION AND MICROVASCULAR FUNCTION FOLLOWING EXERCISE-INDUCED MUSCLE DAMAGE

IHSAN, M.1, SABAPATHY, M.2, HUSSAIN, S.2, HAIYUM, M.3, TAN, F.4

1: ASPETAR , 2: NATIONAL UNIVERSITY OF SINGAPORE , 3: REPUBLIC POLYTECHNIC , 4: SINGAPORE SPORT INSTITUTE

INTRODUCTION: Muscle damage is characterised by a decline in muscle force, decreased movement economy, and impaired microvascular function. Recent reports demonstrating improved muscle contractility (Racinais et al., 2017) and oxidative function (Ihsan et al., 2014) following passive heat exposure renders such treatment a viable strategy to ameliorate the effects of muscle damage. As such, this study investigated the effects of prior heat exposure on the recovery of muscle force and muscle oxidative function following exercise-induced muscle damage.
METHODS: Twenty males were equally assigned to a control (CON) and an experimental group (HEAT), and performed a 30-min downhill run (DHR) to elicit muscle damage. HEAT received three consecutive days of heat treatment (45-60 min of hot water immersion at 40-42°C) prior to DHR. Microvascular function (near-infrared spectroscopy) and maximal voluntary isometric contraction (MVIC) of the knee extensors were assessed. Additionally, participants performed two treadmill-based constant speed runs, during which running economy (RE), muscle deoxygenation and stride parameters were analysed. All measurements were conducted prior to DHR and repeated for four days post-DHR (D1-D4). Data were analysed using Cohen's effect size (d), and assessed qualitatively as - possible; 75–95 %, likely; 95–99 %, very likely; 99 %, almost certain.
RESULTS: When compared between conditions, prior heat treatment resulted in attenuated decrement in MVIC compared with CON throughout D1-D4 (d=0.64-1.49, likely to most likely). Likewise, HEAT resulted in 'likely to very likely' decrease in ROMS (d=0.65-1.19) between D1-D3. Moreover, prior heat conditioning 'likely' attenuated the decline in MVF (d=0.58-0.73) following DHR. HEAT demonstrated no effects on RE or stride parameters during running.
CONCLUSION: This study demonstrates a protective effect of heat exposure against EIMD, as evidenced by the attenuated decrease in muscle force, microvascular function, and improved the sensation of soreness. The mechanisms involved, may in-part be due to a heat-induced up-regulation of HSPs and/or PGC-1α, which in turn have been purported to mediate against cellular damage and stimulate angiogenic events. While we have established that prior heat exposure may reduce the deleterious effects of EIMD, further studies are needed to elucidate the mechanisms involved.

Oral presentations

OP-PM84 Validity of physiological tests

DETERMINATION AND VALIDATION OF MAXIMAL FAT OXIDATION IN TRAINED INDIVIDUALS USING AN UPPER BODY GRADED EXERCISE TEST

RØMER, T., HANSEN, M.T., FRANDSEN, J., DELA, F., HELGE, J.W.

UNIVERSITY OF COPENHAGEN

INTRODUCTION: A graded exercise test (GE) on a bicycle ergometer is the commonly used method to determine the maximal fat oxidation rate (MFO) and the intensity that elicits MFO (FatMax). This method is validated in both well-trained and obese individuals. Upper body (UB) exercise MFO and FatMax are not well elucidated and to our knowledge there is no validated UB GE test. Interestingly, the role of training specificity on MFO remains to be explored. Thus, the aim of this study was to develop and validate a GE protocol for determination of MFO and FatMax during UB exercise in trained individuals and to investigate the role of training specificity on MFO. Our hypothesis was that a higher MFO and FatMax would be observed in specific UB trained individuals than in controls.
METHODS: On separate days fat oxidation rate was assessed during GE (GE1 and GE2), with 3 minutes stages and 15W increments until respiratory exchange ratio exceeded 1.0, on a double poling (DP) ski ergometer (ThoraxTrainer) in 10 trained men. Subjects were divided into cross-country skiers (SKI, n=5) and UB endurance trained controls (CON, n=5). The groups were matched on age (28±1 vs. 28±2 yrs. mean±SEM [p=0.89]), body fat percentage (13.1±0.9 vs. 13.2±1.1% [p=0.97]) and treadmill running peak oxygen uptake (VO2peak) (65.5±1.7 vs. 64.4±1.1 ml•min-1•kg-1 [p=0.66]), respectively for SKI vs. CON. The GE was validated against MFO and FatMax determined from fat oxidation rates at rest and during 10 minutes continuous exercise bouts (SCE) at 35, 50 and 65% of DP VO2peak separated by 45 minutes breaks.
Venous blood samples before each test or exercise bout and pulmonary gas exchange measurements during exercise were obtained.
RESULTS: Two-way ANOVA RM analysis revealed no difference in MFO between GE (GE1; 0.421±0.03, GE2; 0.446±0.03 g•min-1 [p=0.29]) or groups (SKI; 0.410±0.03, CON; 0.457±0.05 g•min-1 [p=0.43]). No difference in FatMax was found between GE (GE1; 41.2±1.5, GE2; 43.1±2.5 %VO2peak [p=0.45]) or groups (SKI; 43.6±2.6, CON; 40.7±3.0 %VO2peak [p=0.40]). Pearson's correlation coefficient was excellent for MFO (r=0.77, n=10 [p=0.01]) between GE1 and GE2. Coefficient of variation within-subjects was 8±2% for MFO. A Bland-Altman analysis of the agreement between GE revealed a bias of -0.02 g•min-1 (95% LoA -0.15 to 0.10 g•min-1) for MFO. No systematic difference was observed in MFO between GE and SCE (p=0.48) or groups (p=0.96).

CONCLUSION: These results demonstrate that the GE has a high day to day reliability and validity in determination of MFO in trained individuals. In contrast to our hypothesis no difference was found in MFO or FatMax between SKI and CON, indicating that training specificity does not play a major role on UB exercise MFO. However, considerable intra-individual variation was observed and further studies are thus required.

VALIDITY AND RELIABILITY OF AN ON-COURT FITNESS TEST FOR ASSESSING AND MONITORING AEROBIC FITNESS IN SQUASH

JAMES, C., FARRA, S.

NATIONAL SPORTS INSTITUTE, MALAYSIA

INTRODUCTION: Existing on-court squash fitness tests are predominantly designed to provide a final performance score and do not yield a wealth of physiological data. Such data helps sport science practitioners and coaches understand the adaptations that have led to changes physical fitness, allowing individualised training to be prescribed. Moreover, some on-court tests require specialist computer equipment or involve simulated racket strokes, which are difficult to standardise at high intensities. This study investigated the validity and reliability of a novel squash-specific fitness test that requires only an accompanying audio track to be performed. This test is completed to volitional exhaustion, involves prolonged submaximal exercise stages and is completed without racket strokes.
METHODS: Eight professional squash players, who had been based at the National Squash Centre of Malaysia for at least 2 years, completed three tests in a counter-balanced order; an incremental laboratory treadmill test (LAB) and two tests of the squash fitness test (ST). This test involved repeated, multi-directional shuttle runs at increasing speeds, until exhaustion. Players completed all tests using the same portable metabolic cart (Cosmed K5, Italy).
RESULTS: ṘO2peak measured during ST was agreeable with LAB (typical error [TE] = 3.3 mL.kg-1.min-1, r = 0.79). The mean bias between LAB and ST was smallest when a 10 second rolling average was adopted (2.5 mL.kg-1.min-1), compared with 20 (3.9 mL.kg-1.min-1) or 30 second (4.2 mL.kg-1.min-1) rolling averages. There were no differences between LAB and ST (all p>0.05) in maximum heart rate (LAB=195 [7] b.min-1, ST=200 [7] b.min-1), post exercise blood lactate concentration (LAB=9.2 [1.9] mMol-1, ST=8.6 [1.9] mMol-1) or end of test RPE (LAB=19.6 [0.5], ST=19.1 [0.8]). Test performance in ST was highly reliable, with 74 (10) laps completed in ST1 and 75 (12) laps in ST2 (mean bias = 1 lap, TE= 3 laps, r = 0.97). Physiological markers were also reliable, including V̇O2peak (TE = 1.5 mL.kg-1.min-1, r = 0.95), lap number at 4 mMol-1 (TE = 4 laps, r= 0.77) and average VO2 during the first 4 stages (TE = 0.94 mL.kg-1.min-1, r = 0.95). Similar variability in i V̇O2peak was observed across 10, 20 and 30 s rolling averages (all TE < 1.5 mL.kg-1.min-1).
CONCLUSION: This on-court squash fitness test allows valid and reliable measurements of pertinent submaximal and maximal physiological markers such as peak oxygen uptake (l V̇O2peak), the lactate turnpoint and oxygen cost, whilst providing a performance score in a sport-specific environment. Data from this test can be used to track changes in aerobic fitness from training, as well as monitor training intensity and assist with prescribing individualised training. Consequently, we recommend the use of this test for amateur and elite squash players.

A NOVEL FOOTBALL-SPECIFIC AGILITY TEST: VALIDITY, RELIABILITY AND PRACTICAL APPLICATIONS.

RAGO, V., BRITO, J., ERMIDIS, G., BAGATIN, R., BARREIRA, D., FIGUEIREDO, P., REBELO, A.

PORTUGUESE FOOTBALL FEDERATION

INTRODUCTION: Agility is a key physical capacity in football players. Although various agility tests are commonly employed in team sports athletes (i.e. Illinois test, IAT), currently, there is no football-specific agility standard test. The Arrowhead Agility Test (AAT), (SPARQ, 2009) apparently provide a more football-specific assessment, than other commonly-used agility tests. The aims of this research were: (i) analyse the validity and reliability, (ii) quantify the associations with other physical capacities, (iii) to verify whether the capacity to discriminate between age-groups and competitive standards (CS), and (iv) to establish AAT normative values, of the AAT.
METHODS: Three independent studies were conducted. Concurrent validity and reliability of the AAT were determined in 24 regional-level players quantifying the correlation (r) between performance in AAT and in the IAT, and analysing the AAT test-retest results using ICC and CV. Standard error of measurement (SEM), smallest worthwhile change (SWC), and minimal detectable change (MDC) were also calculated. A backward multiple regression was employed to quantify the association between AAT and other physical capacities [5- and 15-m sprint time (T5 and T15), and countermovement jump] in 56 regional-level players. Normative values for the AAT, and discrimination between age-groups (senior, U18 and U16) and CS (national vs. regional-level), were determined in 264 players, using exploratory data analysis and multiple comparisons, respectively.
RESULTS: Irrespective of the outcome type (one side, or sum of both), the AAT was moderately valid, in relation to the IAT (r=0.86 to 0.89). Absolute reliability of the AAT was good (ICC= 0.76 to 0.85) whereas relative reliability was <5% (CV=1.6 to 2.7%). The ability of the AAT to detect changes in performance was good (SWC, 0.06 to 0.12 s > SEM, 0.01 to 0.03 s). MDC ranged from 0.01 to 0.06 s. T15 explained a significant amount of performance variance in the AAT (R2=0.42; P<0.01). Despite correlated, T5 did not explained performance in the AAT (r= 0.33; P=0.01). National-level players were more agile than regional-level players (ES=-1.9 to -0.3; P<0.05). Senior and U18 players had a better AAT performance than U16 (ES=-2.3 to -0.8; P<0.05). Normative ranges (sum of right and left) of AAT (25th-75th percentiles) for national-level were 15.98-16.82, 16.05-17.06, and 16.70-17.51 s for senior, U18 and U16 players, respectively. Regarding regional-level, ranges were 16.17-16.98, 17.05-18.08, and 17.98-19.40 s for senior, U18 and U16 players.
CONCLUSION: The AAT is valid and reliable to measure agility in football players. The most agile players in the test were also the most quicker (T15), indicating that AAT can simultaneously encompass sprint testing. Moreover, the test discriminates players from different CS. Our findings can be considered by strength and conditioning coaches involved in testing football players.
REFERENCES:
SPARQ. (2009). Boys' soccer testing protocols.

THE REPEATED SPRINT TEST ON A NON-MOTORIZED TREADMILL IS ABLE TO DETECT CHANGES IN PERFORMANCE IN 4TH LEAGUE AUSTRIAN SOCCER PLAYERS

TRISKA, C.1, KARSTEN, B.2, RIEDERER, P.1, TSCHAN, H.1

1: UNIVERSITY OF VIENNA ; 2: LUNEX UNIVERSITY

INTRODUCTION: Repeated sprint ability is described as the ability to maintain a maximal power output during repeated sprints and also to recover from prior sprints during the rest interval. High levels of RSA are essential in intermittent team sports, such as soccer. RSA is of

high interest in research and RSA tests are commonly implemented in performance assessments throughout the training season. The aim of this study was to assess the RSA before and after the summer preparation in 4th league Austrian soccer players using a non-motorized treadmill .
METHODS: For the determination of the RSA ten male soccer players performed two RSA-tests on the NMT , measuring PO during the sprints at 200 Hz. Horizontal force was measured using a force belt attached to the waist of the participant. The RSA-tests comprised 6x 6 s maximum effort sprints interspersed by 10 s walking. After each test mean PO, peak PO, fatigue index and fatigue rate were calculated. During the 5-week intervention period participants performed a soccer specific training 4x/week that comprised mainly interval game forms and core stability, but no specific sprint training. A repeated measures ANOVA was used to assess the differences between the tests. Effect size was calculated using partial Eta-squared <np2>.
RESULTS: Mean FI was 31.6±6.5% and 22.4±8.0% before and after the intervention . Mean FR was 30.3±7.2 W/sprint and 20.8±8.4 W/sprint before and after the intervention . No significant differences were found for the peak PO for sprints 1-5 between the tests , however, peak PO for sprint 6 was significantly higher in the post-tests . No significant differences were found for the mean PO for sprint 1-4 , however, mean PO was significantly higher for sprint 5 and 6 in the post-tests .
CONCLUSION: This study shows that the RSA-test on a NMT using PO values is sensitive to detect changes in an athletes RSA. It is suggested that results of the post RSA-test reflect the training intervention where, to increase aerobic fitness, participants mainly performed soccer-specific interval games. Moreover, no increase in mean or peak PO was found during sprints 1-5 as no specific strength or power training was performed during the intervention.
References: 1. Castagna et al. <2017>; 2. Duarte et al. <2016>; 3. Morcillontois et al. <2015>
Contact: christoph.triska@univie.ac.at
Twitter
@christophtriska

RUNNING-BASED ANAEROBIC SPRINT TEST IS SENSITIVE TO THE TRAINING EFFECT AND ASSOCIATED WITH THE PERFORMANCE IN THE MATCH FOR FUTSAL PLAYERS

BARBIERI, R.A.1,3, MILIONI, F.2, BARBIERI, F.A.2, VIEIRA, L.H.2, DO-SANTOS, J.W.2, DE ANDRADE, V.L.4, PAPOTI, M.3
1: ESTÁCIO ,2: UNESP ,3: EEFERP USP ,4: UNESP

INTRODUCTION: Anaerobic power is determinant in certain actions during a futsal match. Running-based Anaerobic Sprint Test (RAST) (Zagatto, et al., 2009) is commonly applied in the futsal (Barbieri et al., 2016) to access the anaerobic power. Therefore, the relationship of the index obtained in the RAST with the match physical demands as well as with training effect is important to the ecological validity of the test. So, the aim of the present study was to verify the relationship between RAST indexes with the physical demands of the official match and verify the training effects on the RAST indexes.
METHODS: Fourteen professional futsal players (25.5±2.2yrs; 75.7±8.1kg; 174.4±6.0cm; 51.4±3.3ml.kg-1.min-1) were recruited. The RAST test was performed before and after the last 6 weeks of the season. The RAST indexes was calculated based on the study of Andrade et al., (2013). The official match was performed in the same week of the re-test and it was record by Two video cameras (SONY® DCD-SR21) adjusted to a frequency of 30 Hz and the automatic tracking was analyzed in the DVIDEOW® software (Vieira et al., 2016). It was individually calculated the time-motion patterns: distance covered (D), distance per minute (Dm) peak of velocity (Vpeak), velocity mean (Vmean), number of sprints (NS) and percentage distance covered in high intensity (above 15.5 km.h-1) (DS).
RESULTS: D, Dm, Vpeak, Vmean, NS and DS of the match were 2810±1501m, 90±28m.min-1, 27.5±4.3km.h-1, 5.4±1.7km.h-1, 24.6±16.5 a.u., 22.3±12.7% respectively. The RAST indexes (Peak power, mean power, Peak velocity and mean velocity) showed strong significantly correlations with peak velocity on the first half of the match (0.76, 0.85, 0.77 and 0.85 respectively; $p < 0.05$). After 6 weeks of training, Maximal and mean power, Maximal and mean velocity and the impulse from the RAST were significantly high in comparison before the training period (pre:9.7±1.7: post:10.9±1.3W.kg-1; pre:7.8±0.8: post8.6±1.0W.kg-1; pre:6.9±0.4: post:7.2±0.3m.s-1; pre:6.5±0.2: post:6.7±0.3m.s-1; pre:1885.2±95.7: post:1991.8±76.4N.s-1; respectively).
CONCLUSION: The RAST test was sensitive to verify the effects of 6 weeks of training on the anaerobic capacity with strongly relationship with the performance of the first half in the official match. Therefore, RAST may be a good test to verify the anaerobic adaptations from the training and predict the performance in the first half in official match.

THE VALIDITY OF RELATIVE SPEED THRESHOLDS DERIVED FROM THE 30–15 INTERMITTENT FITNESS TEST TO QUANTIFY EXTERNAL TRAINING LOAD IN RUGBY LEAGUE

SCOTT, T.J., MCLAREN, S.J.
UNIVERSITY OF QUEENSLAND

INTRODUCTION: Monitoring training load (TL) is an important aspect of player management in rugby league (RL). Running-based external TLs are typically expressed as locomotor output over set arbitrary or relative speed thresholds. The physiological justification for arbitrary speed thresholds has been questioned, however, with relative speed thresholds proposed as superior (Scott et al. 2017). Despite this, little is known regarding the best means of threshold determination. We therefore aimed to assess the validity of relative speed thresholds derived from the of 30–15 Intermittent Fitness Test (IFT) for quantifying external TL in RL players.
METHODS: Forty-five professional RL players competing in the National Rugby League competition participated in this study. Players completed the IFT at the beginning and completion of the pre-season period, with the end-stage velocity (vIFT) used to determine relative speed thresholds. We chose 68% and 87% vIFT to represent estimates of the first and second ventilatory thresholds (VT1-IFT, VT2-IFT), respectively (Scott et al. 2017). Subsequently, distances covered above VT1-IFT and VT2-IFT were recorded in each completed training across the entire 2017 season (n=3160 individual session observations) using Global Positioning Systems. Internal training intensity and TL was quantified via session ratings of perceived exertion (sRPE; CR10) and Edwards training impulse (TRIMP; from heart rate recorded in each session), respectively. Training sessions were categorised as; skills (SK; n=2191), skills-conditioning (SK-CON; n=499), conditioning (CON; n=259) and speed-agility (SP-AG; n=211). A within-player design was used to examine the relationships between VT1-IFT, VT2-IFT and internal measures (construct validity).
RESULTS: Within-player relationships between VT1-IFT and sRPE were large during SK-CON (r=0.57; 90% confidence limits ±0.05) and SP-AG (0.53; ±0.09) and small during SK (0.29; ±0.03) and CON (0.22; ±0.10). For VT2-IFT, relationships with sRPE were large during SP-AG (0.54; ±0.09), moderate during SK-CON (0.44; ±0.06), and small during SK (0.24; ±0.03) and CON (0.16; ±0.11). The within-player relationships between VT1-IFT and TRIMP were moderate during CON (0.38; ±0.10), SK (0.33; ±0.03) and SK-CON (0.33; ±0.07), and small during

SP-AG (0.22; ±0.12). For VT2-IFT, relationships with TRIMP were moderate during CON (0.31; ±0.10) and small during SK (0.28; ±0.03), SK-CON (0.23; ±0.08) and SP-AG (0.18; ±0.12).
CONCLUSION: Distances covered above vIFT-derived relative speed thresholds have substantial and positive relationships between internal intensity/TL in RL players during a range of training modes, suggesting they may be a valid measure of external TL. In agreement with past findings, however, the strength of these relationships are moderated by the speed of the threshold and the mode of training (McLaren et al. 2018).
REFERENCES: McLaren et al. (2018). Sports Med,48(3), 641-658.
Scott et al. (2017). Int J Sport Physiol Perform. Ahead of print.

Oral presentations

OP-PM48 Training / Testing: Strength

NO-LOAD TRAINING INCREASED MUSCLE STRENGTH AS MUCH AS TRADITIONAL TRAINING AT 40% OF 1RM

TESSUTTI, V.2, DE O SANTOS, G.B.1, CURTOLO, M.1, DE AZEVEDO, P.H.1, TUCCI, H.T.1, YI, L.C.1
1UNIVERSIDADE FEDERAL DO ESTADO DE SÃO PAULO; 2UNIVERSIDADE DE RIBEIRÃO PRETO-CAMPUS GUARUJÁ.

INTRODUCTION: One of the ways developed to increase muscle strength is a resistance training. Studies suggest, that a training performed at least 40% of 1RM may result in muscle strength gains, based on its prolonged stimulation of the myofibrillar proteins synthesis [1, 2]. There are also some discussion about the possibility of force gain with training without external load (NL), also called mechanotransduction, depending the activation it can make on the involved motor units of the chosen exercise, still sugesting the possibility of muscular growing in this condition [3]. Thus, the aim of this study was to verify if a no load training can increase strength as much as the conventional strength training method, with overload at 40% of 1 RM, in healthy young adults.
METHODS: Twenty-four male college students between the ages of 18 and 30 enrolled in the study, without upper limbs strength training in the last twelve months. All participants underwent an intervention to increase muscle strength for eight weeks, twice a week, lasting 40 minutes for each training. The maximum isometric muscle strength of the brachial biceps and the triceps brachii was measured by the Manual Dynamometer Manual Lafayatte®, model 926644. The results of strength, were measured in kilograms-force, and normalized by body mass, in kilograms, using the formula: [(kg force / body mass) x 100] [4]. For the blood lactate variable, the arterialized blood samples (25 µl) were collected. Blood lactate concentrations were measured using a portable lactate analyzer, which enzymatic determination and reflectance photometry (wavelength 660 nm) was used. The groups performed two exercises to strengthen the biceps brachii and triceps brachii. The Control Group (CG) performed the movements through dumbbells with a load equivalent to 40% of its 1RM.
However, the no-load group (NLG) performed the same of CG movements, performing dynamic maximum voluntary contractions (DMVC), contracting the biceps and triceps brachii muscles simultaneously. The data were analyzed through the statistical program SPSS version 20.0 (SPSS Inc. Chicago, IL, USA). A significance level of 5% was considered for all analyzes.
RESULTS: The NL training through maximal voluntary contraction promoted the same strength gains in the biceps and triceps muscles when compared to subjects underwent strength training at 40% of 1RM, in addition to showing increased metabolic demand.
CONCLUSION: The study shows that dynamic maximal voluntary contraction may be an option for muscle strength training in injured individuals, who for some period of time cannot receive overloads on their joints and bones, but need muscle strengthening as a process of their recovery.

THE EFFECT OF CONCURRENT EXERCISE ORDER ON TRAINING ADAPTATIONS IN ACTIVE MALES

LEE, M.J.1, BALLANTYNE, J.1, BISHOP, D.J.1,2, BARTLETT, J.D.1
1: VICTORIA UNIVERSITY , 2: EDITH COWAN UNIVERSITY

INTRODUCTION: Concurrent endurance (E) and resistance (R) training can interfere with hallmark resistance training adaptations (i.e. strength and hypertrophy). A prior exercise session may hinder training quality and performance in the following session, inducing unfavourable physiological milieus for optimal adaptations to occur. Thus, the choice of exercise session order is an important consideration for training program design. This study investigated the effects of concurrent exercise order on maximal strength, body composition, and aerobic fitness, compared to resistance-only training.
METHODS: Healthy, active males (n = 20) were randomised into: 1) ER, endurance before resistance exercise; 2) RE, resistance before endurance exercise; or 3) RO, resistance-only. Participants trained 3 days/week for 9 weeks with concurrent sessions separated by ~3 hours. E involved 2-min cycling intervals at 40-90% of the difference between lactate threshold (WLT) and peak aerobic power (Wpeak), with 1-min rest. R involved 3-4 sets of upper- and lower-body exercises (12 to 6-RM). Body composition (DXA), aerobic fitness (graded incremental test), and lower-body maximal strength (leg-press 1-RM) were tested pre- and post-training. Percent changes from baseline are reported as mean ± 90% confidence limits (CL). Standardised effects (ES) ± 90% CL were used to determine the magnitude of within- and between-group comparisons, where <0.2 = trivial, 0.2-0.6 = small, 0.6-1.2 = moderate, 1.2-2.0 = large, 2.0-4.0 = very large and >4.0 = extremely large effects.
RESULTS: All groups improved relative leg-press strength (RO: 25.7 ± 4.2%, ES = 1.0 ± 0.15; ER: 25.8 ± 8.9%, ES = 1.0 ± 0.31; RE: 24.8 ± 5.5%, ES = 0.97 ± 0.19), with trivial differences between them. There were likely trivial effects of exercise order on increases in relative VO2peak (-1.0 ± 4.1%, ES = -0.06 ± 0.23) and Wpeak (0.5 ± 5.6%, ES = 0.02 ± 0.26). RE resulted in possibly smaller improvements in WLT than ER (-6.0 ± 9.3%, ES = -0.27 ± 0.44). All training groups increased total lean body mass (RO: 3.1 ± 1.3%, ES = 0.23 ± 0.09; ER: 3.3 ± 1.5%, ES = 0.24 ± 0.11; RE: 3.5 ± 1.3%, ES = 0.25 ± 0.09); however, effects between groups were very likely trivial. RE resulted in possibly greater reductions in fat mass compared to ER (-6.2 ± 11.2%, ES = -0.17 ± 0.31) and RO (-9.3 ± 9.1%, ES = -0.26 ± 0.26).
CONCLUSION: These data do not support the hypothesis of attenuated strength and lean mass gains following concurrent training. In healthy, active males, a 9-week concurrent training program (regardless of exercise order) presents a viable strategy to induce gains in leg-press strength and total lean body mass comparable to resistance-only training, whilst also improving aerobic fitness. However, exercise order effects were apparent for improving lactate threshold (favouring ER) and fat mass loss (favouring RE). Thus, the choice of concurrent session order should be dictated and periodised according to the specific goals in each phase of a training program.

GLOBAL TRAINING EFFECTS OF TRAINED AND UNTRAINED MUSCLES WITH YOUTH CAN BE MAINTAINED DURING 4 WEEKS OF DETRAINING

BEHM, D.G.

MEMORIAL UNIVERSITY OF NEWFOUNDLAND

INTRODUCTION: Global (whole body) effects of resistance training (i.e., cross-education) may be more pervasive with children than adults. Detraining induces less substantial deficits with children than adults. It was the objective of this study to investigate the global responses to 4-weeks of detraining after 8-weeks of unilateral leg press (LP) training in 10-13-year-old, pre-peak-height-velocity stage boys.
METHODS: Subjects were randomly separated into two unilateral resistance training groups (high load/low repetitions: (HL-LR) and low load/high repetitions and control group. Assessments at pre-training, post-training and detraining included dominant and non-dominant limbs, unilateral, one repetition maximum (1RM) and 60%1RM LP, knee extension, knee flexion, elbow flexion, and handgrip maximal voluntary isometric contraction (MVIC), and countermovement jump (CMJ).
RESULTS: All measures significantly increased from pre-test to detraining for both training programs except for elbow flexion MVIC with increases only with HL-LR. All measures except CMJ and handgrip MVIC significantly decreased from post-test to detraining except for elbow flexion MVIC with decreases only with HL-LR. The dominant trained limb experienced significantly greater LP improvements (pre- to detraining) and decrements (post- to detraining) with LP 1RM and 60% 1RM LP. In conclusion, youth HL-LR and LL-HR global training effects of trained and untrained limbs demonstrate similar benefits (pre- to detraining) and decrements (post- to detraining) with detraining.
CONCLUSION: The findings emphasize that training any muscle group in a child can have positive global implications for improved strength and power that can persist over baseline measures for at least a month.

CROSS-EDUCATION EFFECT DEPENDS ON SET CONFIGURATION OF BICEPS CURL STRENGTH TRAINING

FARIÑAS, J.

UNIVERSITY OF A CORUNA

INTRODUCTION: Cross education (CE) consists in strength transfer to untrained contralateral limb after unilateral strength training program (Lee & Carol, 2007; Farthing, Krentz & Magnus, 2009; Ruddy & Carson, 2013; Beyer et al., 2016). The magnitude of this effect has been recently quantified in a strength gain in the non-trained limb of 11.9% (Manca, Dragone, Dvir & Deriu, 2017). The aim of this study was to compare the strength gains in the non-trained arm flexors after two unilateral training programmes differing in set configurations but with the same total volume and repetition-to-rest ratio
METHODS: Thirty-five sport science students were randomly assigned in three groups: traditional training group (TT), cluster training group (CT) and control group (CON). Throughout ten sessions (five weeks; two sessions per week) TT performed with the dominant limb 5 sets of 6 repetitions of unilateral biceps curl with 135 seconds between sets, while CT performed 30 repetitions of the same exercise with 18.5 seconds between each repetition.
RESULTS: For the trained arm, TT improves 1RM ($p<0.001$), number of repetitions with 10RM load (10RMr) ($p=0.005$) and maximum voluntary contraction ($p=0.011$). Performance of the non-trained arm improved significantly only in TT for 1RM ($p<0.001$) and 10RMr ($p=0.012$).
CONCLUSION: Cirer et al. (2017) observed a direct relationship between training load applied and the effect in contralateral limb. According with this, we have demonstrated that a key factor to modulate the magnitude of CE is the set configuration, being necessary to be performed at least a 60% of maximum number of repetitions allowed by a load.
These results suggest that when volume and repetition-to rest ratio are equated, more fatiguing set configurations result in a higher cross education magnitude. Specifically, sets of at least 6 repetitions with the 10RM load seem to be needed in order to optimize the gains in non trained arm flexors.
REFERENCES:
Beyer, K. S., Fukuda, D. H., Boone, C. H., Wells, A. J., Townsend, M. S., Jajtner, A. R., Gonzalez, A.M., Hoffman, J.R., Stout, J. R. (2016). J Strength Cond Res. May;30(5):1213-23.
Cirer-Sastre, R., Beltrán-Garrido, J. V., & Corbi, F. (2017). J of Sports Sci and Med, 16(2), 180–186.
Farthing, J. P., Krentz, J. R., & Magnus, C. R. a. (2009). J of Applied Physiology (Bethesda, Md. : 1985), 106(January 2009), 830–836.
Lee, M., & Carroll, T. J. (2007). Sports Med (Auckland, N.Z.), 37(1), 1–14.
Manca, A., Dragone, D., Dvir, Z., & Deriu, F. (2017). European J of Applied Physiology, 117(11), 1–20.
Ruddy, K. L., & Carson, R. G. (2013). Front Hum Neurosci. Jul 29;7:397.
CONTACT:
juan.farinhas@gmail.com

MUSCLE MASS AND STRENGTH GAINS FOLLOWING A 6-MONTH RESISTANCE TYPE EXERCISE TRAINING PROGRAM ARE LOST WITHIN ONE YEAR WHEN EXERCISE TRAINING IS DISCONTINUED IN OLDER INDIVIDUALS

SNIJDERS, T., VERDIJK, L.B., LEENDERS, M., VAN LOON, L.J.

MAASTRICHT UNIVERSITY

INTRODUCTION: Supervised resistance type exercise training programs implemented over 3-12 months induce substantial gains in muscle mass, strength, and functional capacity in older individuals. However, it remains unclear if older individuals are able to maintain their gains in muscle mass and strength without any supervised interventions. In the present study, we assessed the capacity of older adults to maintain their gains in muscle mass and strength during one year after partaking in a successful 6-month resistance type exercise training program.
METHODS: Sixty-two healthy older men and women were included in a 6-month supervised resistance type exercise training program. Upon the cessation of the training program, participants were not provided with any guidance or incentives to continue exercise training. One year after completion of the training program, all participants were contacted and invited back to the laboratory to assess quadriceps muscle cross-sectional area and muscle strength <1RM leg extension>. A total of 35 subjects who had participated in the supervised training program, responded and agreed to the 1y follow-up measurement. Subjects were divided into two groups: individuals who had continued resistance type exercise training on an individual basis and individuals who had not continued any regular weight lifting exercise .
RESULTS: No significant differences between baseline characteristics and/or response to the initial resistance type exercise training program were observed between individuals who were included in the present study and those who were lost to follow-up 0.05>. The

increases in quadriceps CSA <+506±209 and +584±287 mm2> and leg strength <+32±12 vs +34±10 kg> that had been observed in response to the initial training program did not differ between the individuals assigned to the STOP and CONT group, respectively .
One year after cessation of the exercise training program, participants had lost muscle mass, with a greater decline in quadriceps CSA in the STOP vs CONT group <-579±268 vs -309±253 mm2, respectively; P<0.05>. Muscle strength had decreased significantly compared to values after the 6 month training program , with no differences observed between the STOP vs CONT group <-21±8 vs -18±8 kg, respectively; P>0.05>.
CONCLUSION: Though prolonged resistance type exercise training effectively increases muscle mass and strength in older adults, muscle mass and strength gains will be lost within one year after discontinuation of the program without supervised exercise training.

GREATER INCREASES IN MUSCLE STRENGTH BY PROGRESSIVE ECCENTRIC THAN CONCENTRIC RESISTANCE TRAINING

NOSAKA, K.1, CHEN, T.C.2, LAI, J.H.2, TSENG, K.W.3, TSENG, W.C.3
1 EDITH COWAN UNIVERSITY, 2 NATIONAL TAIWAN NORMAL UNIVERSITY, 3 UNIVERSITY OF TAIPEI

INTRODUCTION: Greater improvement of muscle function after eccentric than concentric resistance training was reported in many studies . Chen et al. reported that 12-week progressive ET of the knee extensors that did not induce muscle damage symptoms, improved muscle function greater than CT. It appears that muscle damage is not a main factor contributing to the improvement of muscle function, but it is not clear why ET can increase muscle function greater than CT. The present study compared between a progressive ET and CT for the time course of changes in maximal voluntary isometric contraction and electrically stimulated torque of the elbow flexors, and upper arm circumference .
METHODS: Sedentary young men were placed to ET or CT group . Both groups performed 5 sets of 6 contractions of the elbow flexors of the non-dominant arm once a week for 5 weeks, in which the load was increased from 10 to 30, 50, 80 and 100% of MVIC. MVIC and ES torque, elbow joint range of motion , CIR and muscle soreness <100-mm visual analog scale> were measured before, immediately after, and for 3 days <10–80% sessions> or 5 days <100%> after each session. Plasma creatine kinase activity was measured before and 3 days <10–80%> or 5 days <100%> after each session. Changes in these variables over time were compared between groups by a mixed-design two-way ANOVA.
RESULTS: Decreases in MVIC <20–29%> and ROM <3–8°> were evident only at immediately after the 3rd–5th CT sessions . Similar decreases in MVIC <14–21%> and ROM <3–7°> were also found at immediately after the 3rd–5th ET sessions. MVIC <6–16%> and ROM <1–4°> decreased, and CIR <1–2 mm>, muscle soreness <2 mm> and CK <73–75%> increased at 1–3 days after the 3rd and 4th ET sessions. After the 5th ET session, significant changes in all variables were evident , but these variables returned to baseline by 2–3 days post-exercise. Significant increases in MVIC and ES torque from the baseline were evident before the 3rd bout, and the differences in the values of these variables between ET and CT became larger after the 3rd bout. ET showed greater increases in MVIC <23%> and ES <24%> when compared with CT <10%, 10%>, but CIR increased similarly between ET <3%> and CT <2%> at 5 days after the 5th session.
CONCLUSION: It appears that minor muscle damage was induced after the 3rd–5th ET sessions. The magnitude of increases in MVIC and ES torque was more than two-fold greater for ET than CT after the 5th session. It is interesting that the differences in the training effects between ET and CT increased after muscle damage was evident for ET. It is possible that some factors associated with muscle damage contribute to the greater increases in muscle function after ET than CT.

Oral presentations

OP-BN47 Elite sports

MONITORING OF PHYSIOLOGICAL, BIOLOGICAL AND PERCEPTIVE MARKERS OVER AN ENTIRE SEASON ON WORLD-CLASS HANDBALL PLAYERS.

MAURELLI, O.
UNIVERSITÉ DAMIENS

INTRODUCTION: Few studies have investigated on physiological, biological and perceptive markers during an entire competition season in world class handball players (Bresciani et al., 2010). However, the monitoring of these markers throughout a full season will attempt to illustrate its effects and to reorient, if necessary, training methods. The aim of this study was then to describe the effects of training on the physiological, biological and perceptive markers during an entire season on world-class handball players.
METHODS: Thirteen male handball players, belonging to the professional League 1 (France) were recruited for the study. The players had a training experience (7.6 ± 1.3 years) of the highest level of expertise in France. Mean values (± SD) of age, stature, body mass and fat were 26.6 ± 5.4 years, 189.5 ± 5.1 cm, 93.7 ± 11.9 kg and 10.6 ± 2 % respectively. The 47-weeks season consisted of a pre-competitive preparation period and two competitive periods. During the season, the participants were tested on four occasions: the first test session was performed at the beginning of the season, in July, the second test in November, the third test in March and the fourth test at the end of the season, in June. The tests sessions consisted of jump tests (squat jump and counter movement jump), speed test on a 5 meters start-stop and aerobic test (shuttle-run 20m). Blood samples included haematological examinations (hematocrit (H)), biochemical examinations (creatine phosphokinase (CPK) and ferritin (F)) and blood hormonology (free cortisol (C), testosterone (T), insulin-like growth factor-1 (IGF-1) and insulin growth factor binding protein 3 (IGFBP-3)). In addition, the Hooper index was used every week, early in the week.
RESULTS: The preliminary results of our study show a significant (p <0.05) decrease in H values between T1 and T2, T3, T4 but a significant (p <0.05) increase between T3 and T4. Concerning CPK, our results show no significant change. For F, our results show a significant (p <0.05) decrease between T1 and T4, T2 and T4 and T3 and T4. For C, our results show a significant (p <0.05) decrease between T1 and T4, T1 and T3, T2 and T4 and T2 and T3. Our results also show a significant (p <0.05) decrease in T values between T1 and T2, but an increase between T1 and T3, T1 and T4, T2 and T3, T2 and T4 and between T3 and T4. Finally, our results show a significant (p <0.05) decrease in IGF-1 values between T1 and T4 but no significant change in IGFBP-3 values.
CONCLUSION: The repetition of matches and training during a competitive season causes a drift of biological and perceptives markers among world class handball players. In order to repel fatigue, that can lead to an injury, coaches must carry out a regular follow-up trainng load of athletes throughout the season.

PHYSICAL PERFORMANCE IN ELITE MALE AND FEMALE TEAM HANDBALL PLAYERS

WAGNER, H., FUCHS, P., VON DUVILLARD, S.P.

UNIVERSITY OF SALZBURG

INTRODUCTION: Biological differences between men and women are well known; however, literature-addressing knowledge about the influence of sex to specific and general performance in team handball is almost nonexistent. Consequently, the aim of the study was to assess and compare specific and general physical performance in male and female elite team handball players and to determine if the differences are consequential for general compared to specific physical performance characteristics.
METHODS: Twelve male and ten female elite team handball players performed a game based performance test, upper- und lower-body strength and power tests, a sprinting test, and an incremental treadmill-running test. We measured oxygen uptake, utilizing portable metabolic system (Cosmed K4B2), blood lactate concentration (EKF, Biosen C), heart rate (Polar, Kempele, Finland), sprinting time, and offensive and defensive time actions (Inmotion LPM-system, Abatec, Austria), ball velocity and jump height during a jump shot (PeakMotus, Vicon Peak, UK), leg extension strength (HBM load cell 27-2, Hottinger Baldwin Measuring, Germany), trunk and shoulder rotation torque (ISOMED, D&R Ferstl, Germany), as well as jump height in the counter movement jump (AMTI, Watertown, USA). Independent-samples t-tests were used to determine significant differences between male and female team handball players. Additionally, a multivariate linear model with factors for sex (male vs. female) and test (general vs. specific) was used to determine if sex differences were different in general physical characteristics compared to the specific physical performance characteristics.
RESULTS: Significant differences (P<.05) between male and female players were found for peak oxygen uptake and total running time during the treadmill test, 30m sprinting time, leg extension strength, trunk and shoulder rotation torque, counter movement jump height as well as offense and defense time, ball velocity and jump height in the game based performance test. An interaction (sex × test) was found for time and oxygen uptake.
CONCLUSION: The results of the study revealed that male players are heavier and taller, faster, stronger, jump higher and have a better aerobic performance. However, female players performed relatively better in the team handball specific compared to the general tests. Our findings suggest that especially the significant discrepancy between lower leg strength and specific performance in defense and offense may be an indicator for the significantly higher risk of knee injuries (traumatic and overuse) in females compared to male team handball players.

PHYSIOLOGICAL, CLINICAL AND CHRONOTYPIC PROFILES OF AMATEUR OLYMPIC DISTANCE TRIATHLETES

PUCCINELLI, P., LIMA, G., ANDRADE, M.

UNIVERSIDADE FEDERAL DE SÃO PAULO

INTRODUCTION: As a consequence of the recent existence of triathlon and a great diversity of distances in different events, there are few studies available on the profile of these athletes. Physiological profiles of athletes involved with different sport modalities can provide a basis for understanding the adaptations due to specific training, requirements necessary for sport success and injury risk management. The purposes of the present study are to characterize and compare the differences between sex of anthropometric and physiological profile in addition to medical history, training and daily life habits of triathlon amateur competitors who participated in Olympic distance triathlon races.
METHODS: This is a cross-sectional observational study, which included amateur triathletes (39 men and 6 women), who competed in the same triathlon Olympic distance race. Participants were evaluated for anthropometric characteristics (body mass, height, and body composition through (DXA)), aerobic physical fitness (maximum oxygen consumption (VȮ2máx), anaerobic threshold and respiratory compensation point, maximum aerobic velocity (MAV) and running economy (RE)). Questionnaires on medical history, training routine, sports experience and circadian preference were also applied.
RESULTS: In male group, VĖO2máx, MAV and RE were 59.9 ± 6.3 mL/kg/min, 17.8 ± 1.4 km/h, and 1.17 ± 0.08 kcal/kg/km, respectively. In female group, VfO2máx, MAV and RE were 50.3 ± 6.1 mL/kg/min, 15.0 ± 1.4 km/h and 1.27 ± 0.10 Kcal/kg/km, respectively. From the total participants, 47% (83% women and 41% men) have not conducted any periodic medical follow-up for sports practice, and 36% (50% women and 33% men) have never undergone a pre-participation sports assessment; 49% (16%women and 53% men) still feel tired when they wake up, and 42% (50% women and 61% men) had musculoskeletal injuries in the last year; 69% (40% women and 66% men) exhibit the morning profile for circadian preference.
CONCLUSION: Male triathletes presented higher VĖO2máx and MAV than female, but there were no significant differences in RE between sexes. A high percentage of the athletes, men and women, had no periodic medical follow-up, still felt tired after waking up, and presented musculoskeletal injuries. The comparisons between men and women might be influenced by sample size. However, this data on highly trained amateur triathletes can be compared to other independent evaluations. This will guide the determination of individual weaknesses and strengths and can be useful to design specific training programs and medical care.

THE EFFECT OF 8 WEEKS ALTITUDE'S DIFFERENT TRAINING LOAD ON PERFORMANCE OF ELITE ROWERS

BINHHONG, G.

SHANGHAI UNIVERSITY OF SPORT

INTRODUCTION: Training load is the key point of sports training. The training practice presents that appropriate load during altitude training play a positive role on aerobic ability and performance. This study discusses the different training load for 8 weeks altitude training and the different training effect of performance, provide theoretical basis and methodological reference to improve rowing's altitude training.
METHODS: 32 athletes form national rowing team is spilt into two groups,18 women of single oar and 14 women scullers; They train at Huize Yunnan<2280m> for 8 weeks; We record the training load before, during and after the altitude training; the training volume consist of water training, ergometer training and running; the training intensity consist of 5 levels, and are evaluated by heart rate and blood lactic acid; we test the specific performance by ergometer 6km,2km and 4 level incremental load test before and after altitude training. We test BU and CK at the morning after rest day.
RESULTS: From the view of training volume, the average week's volume of women of singe oar is 7.1km less than women scullers at sea level, volume of water training is 11.2km less; volume of women of single oar decrease form 195km at sea level to 164.1km during altitude training <-15.85%>, whereas volume of women scullers decrease from 184.2km to 171.2km <-7.06%>;From the view of training intensity, proportion of oxygen utilize2 of women of single oar is 118.27% larger than women scullers, whereas proportion of oxygen utilize1, an-

aerobic threshold and oxygen transport of women of single oar are less than women sculler,-30.47% (p<0.01)、-20.29% (p>0.05) and-48.65% (p>0.05);After altitude training, ergometer 6km result of women of singe oar decrease by 0.04%< p>0.05>, whereas women scullers improve by 0.77%, and result of women scullers is better than women of singe oar; the change of power and heart rate at lactic acid threshold of women scullers are better than women of single oar; ergometer 2km result of women of single oar decrease by 0.31% (p>0.05),whereas women sculler improve by 0.73% (p<0.01);During altitude training, average BU and CK of women of single oar is 6.1±1.5mmol/l and 162.6±83.6 U/l, women scullers is 6.4±1.4mmol/and249.4±176.7 U/l; there is significant difference between CK of two groups (p<0.05).
CONCLUSION: After the two groups rowers of similar basic performance finishing 8 weeks altitude training at same place, the different load can lead to different training effect; training volume of rowers during altitude training should remain similar with sea level; the training should rely mainly on water training, and ergometer training and running are supplementary; the training intensity should rely mainly on oxygen utilize1<60-65%>, and focus on developing aerobic ability, and anaerobic threshold and oxygen transport training are supplementary; the main difference of training load is volume and intensity, and the relationship between structure of training load and training effect; and the training intensity is the key reason of different training effect.

Oral presentations

OP-SH09 Mental health, sport and physical activity

EFFECTS OF ORGANIZED SPORT ON THE PSYCHOLOGICAL HEALTH OF CHILDREN FROM DIFFERENT SOCIOECONOMIC BACKGROUNDS

ZHENG, H.S.1, GUO, Y.1, HOPKINS, W.G.2, BOREHAM, C.A.3

1: GUANGZHOU UNIVERSITY . 2: VICTORIA UNIVERSITY . 3: UNIVERSITY COLLEGE DUBLIN

Effects of organized sport on the psychological health of children from different socioeconomic backgrounds
ZHENG, H.S.1, GUO, Y.1, HOPKINS, W.G.2, BOREHAM, C.A.3
1: GUANGZHOU UNIVERSITY (CHINA). 2: VICTORIA UNIVERSITY (AUSTRALIA). 3: UNIVERSITY COLLEGE DUBLIN (IRELAND)
Introduction: Physical activity may enhance not only children's physical health but also their psychological health. Here we have examined the relationship between regular participation in organized sport and psychological difficulties in children, and the modifying effect of socioeconomic status.
Methods: Data were provided by 8977 children (age 5 y) and their families in the national Growing Up in Ireland Study (Wave 3). Parents completed the Strengths and Difficulties Questionnaire, and the total score was recoded into a binary dependent variable representing presence or absence of psychological difficulties. Parents also estimated their childs participation in organized sport on a 5-point scale, which was used as a predictor of psychological difficulties in a logistic regression, with adjustment for possible confounding effects of the childs sex and primary caregiver's sex and age. Separate analyses were performed for children in families of lower and upper socioeconomic status. Outcomes derived as odds ratios were converted to prevalence ratios and interpreted using magnitude-based inference.
Results: Children who were never active in sport comprised 47% of the sample, and their prevalence of psychological difficulties was 11.6%. Compared with children this group, there was an unclear small reduction in prevalence of psychological difficulties in those who were active twice a month (prevalence ratio 0.89, 90% confidence interval 0.60-1.33) but clear moderate reductions for children who played sport for 1 h/wk (0.65, 0.56-0.76), 2 h/wk (0.61, 0.50-0.75) and >2 h/wk (0.69, 0.54-0.90). There was little difference between upper- and lower-class children in the effects of 1 h/wk and 2 h/wk of sport, but for more than 2 h/wk there was a clear difference, with upper-class children experiencing a moderate reduction in psychological difficulties (0.58, 0.42 to 0.80) and lower-class children experiencing a trivial but unclear effect (1.09, 0.72 to 1.67).
Discussion: In this sample, levels of participation in organized sport of 1 h/wk or more were associated with similar reductions in psychological difficulties, with the exception of potentially little benefit for the most active lower-class children. Further analysis of sport participation in this group is warranted, along with factors affecting other dimensions of children's psychological health.

WHAT HAPPENS AFTER ALL IS SAID AND DONE? A RETROSPECTIVE ANALYSES OF SPORT-BASED PROJECTS FOR UNDERSERVED YOUTH

ACIKGOZ, S., HAUDENHUYSE, R., ASCI, F.H.

TRAKYA UNIVERSITY, VRIJE UNIVERSITEIT BRUSSELS, MARMARA UNIVERSITY

What happens after all is said and done? A retrospective analyses of sport-based projects for underserved youth
Acikgoz S.1-2, Haudenhuyse R.2, Asci H.3 1: TU (Edirne, Turkey) 2: VUB (Brussels, Belgium) 3: MU (Istanbul, Turkey)
Introduction: Sport-based projects for young people are seen as a versatile tool that provides opportunities for work on different social issues such as employability, crime prevention and social inclusion. Such projects have been in-demand for decades and continue to receive attention from policymakers, academics and practitioners. Yet, the sustainability and the after-effects of these projects are still unclear. Using a retrospective approach (Ragin and Becker, 1992), this study aims to analyse two completed sport-based projects in Turkey.
Methods: The study used a multiple case study design that comprised face-to-face interviews (33 participants), a focus group (5 participants) and field observations (22 days). The data were collected from participants, parents of participants, project coordinators and sport coaches. Using content analysis, themes were generated from the data with open and thematic coding processes (Smith and Sparkes, 2017). The central question that guided our analysis was if and how the selected sport-based projects had an impact on young participants in underserved areas.
Results: The main themes generated from the analyses were: (i) a moralizing discourse on young people's deficiencies, (ii) the reproduction of hegemonic sport discourse, and (iii) socialisation opportunities through sport.
Conclusion
The projects had some problems regarding planning and implementation. One year after the completion of the projects, findings indicated that there was no tangible impact on keeping young people away from health damaging behaviour and developing social skills through sport education. We concluded with implications on challenges (and possible opportunities) of conducting sport-based projects in poorly organized settings.

References: Ragin, C. C., & Becker, H. S. (Eds.). (1992). What is a case?: exploring the foundations of social inquiry. Cambridge university press.
Smith, B., & Sparkes, A. C. (Eds.). (2016). Routledge handbook of qualitative research in sport and exercise. Taylor & Francis.
Contact: selcukacikgoz@trakya.edu.tr

SYSTEMATIC REVIEW OF MENTAL HEALTH AWARENESS INTERVENTIONS IN SPORT- EVIDENCE TOWARDS POLICY PLANNING

BRESLIN, G., SHANNON, S., HAUGHEY, T., DONNELLY, P., LEAVEY, G.
ULSTER UNIVERSITY & SPORT NORTHERN IRELAND

This is the first systematic review on the effectiveness of sport-specific mental health awareness programs on athletes, coaches and officials mental health knowledge and help-seeking. We sought to determine if such programs enhance mental health literacy, knowledge of mental health and help seeking in response to an increasing recognition that those involved in sport can be vulnerable to mental health problems similar to the general population. All methods of data analysis and reporting followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines with a protocol available on PROSPERO. Six electronic databases were searched: Psychinfo, Medline (OVID interface), Scopus, Cochrane, Cinahl and Sport Discus. Each database was searched from its year of inception. Results: Eleven studies, refined to six were analysed from the 1095 studies retrieved. Five of the six studies found positive changes on at least one outcome measure. Two studies found significant positive changes for all their outcome measures, both finding increased knowledge about mental health disorders. Conclusions: Caution should be taken when interpreting the outcomes of interventions that aim to raise awareness of mental health issues in sport due to weak methodological quality, with the exception of a few studies. Future research should adhere to available guidance from the review as discussed in the presentation when developing and evaluating complex interventions. The findings have guided the development of an Mental Health In Sport Action Plan for Northern Ireland that is worth consideration for other European Countries

THE EFFECT OF A MENTAL HEALTH AWARENESS PROGRAM AMONG ATHLETES: TESTING AN INTEGRATED BEHAVIOUR CHANGE MODEL

SHANNON, S., HAUGHEY, T., LEAVEY, G., BRESLIN, G.
ULSTER UNIVERSITY

Introduction: Athletes involved in competitive sport experience barriers that place them at risk of poor mental health. Recent evidence indicates that few sport-specific, theoretically- informed mental health awareness programs are designed for, and tested, among athletes . To address this gap the State of Mind program was designed using components of the Integrated Behaviour Change framework . The aim was to determine if SOM could increase athletes' intentions to self-manage mental health, and provide a theoretical base on which to modify mental health awareness programs.
Method: A mixed factorial two x two non-randomised controlled trial was conducted, comprising an intervention and control group. Participants' mean age was 21.1 years. The SOM program included self-reflective exercises, vignettes of athlete role models, and group discussions on strategies and resources available for mental health support. The effect of the intervention on mental health self-management intentions was tested through a serial mediation model with four IBC-derived mediators .
Results: In comparison to the control group, the intervention was related to positive changes in mental health intentions , with findings showing some support for the mediating role of IBC variables. Namely, the intervention directly increased autonomous motivation <β=.29> which exerted a positive indirect effect on subjective norms <β=.15>, attitudes <β=.14>, and mental health intentions <β=.12>. Analyses also revealed a positive direct effect for the intervention on attitudes <β=.23> and behavioural control <β=.20>, in which an indirect effect on mental health intentions was facilitated through attitudes <β=.28>.
Conclusions: When attempting to increase awareness of self-management techniques for mental health among athletes, practitioners may consider the promotion of autonomous motives and positive beliefs around mental health optimisation. Components of the IBC, as reported in SOM, may offer a useful framework for behaviour change.
References: Breslin, G., Shannon, S., Haughey, T., Donnelly, P., & Leavey, G. <2017>. A systematic review of interventions to increase awareness of mental health and well-being in athletes, coaches and officials. Systematic reviews, 6<1>, 177.
Hagger, M. S., & Chatzisarantis, N. L. <2014>. An integrated behavior change model for physical activity. Exercise and Sport Sciences Reviews, 42<2>, 62-69.

PHYSICAL ACTIVITY AND SELF-ESTEEM IN CHILDREN AND ADOLESCENTS: UPDATE OF REVIEW OF REVIEWS

CIACCIONI, S., THOMAS, G., VERGEER, I., BIDDLE, S.J.H.
UNIVERSITY OF SOUTHERN QUEENSLAND

Purpose: To provide an update to the review (Biddle & Asare, 2011) of systematic reviews and meta-analyses on the effects of physical activity (PA) on self-esteem (SE) in young people.
Methods: A systematic online search was conducted using Cochrane Library, EBSCOhost, ISI Web of Science, MEDLINE (PubMed), ScienceDirect, and Scopus databases. Inclusion criteria were research published from January 2010 to January 2018 that considered the following outcomes: PA, SE, self-concept (SC), school-aged children and adolescents (5-18 years). Screening and data extraction were conducted in duplicate. Data were analysed and systematically graded for their methodological quality (NIH, 2016).
Results: Ten systematic reviews and meta-analyses were included. Of 295 primary studies, the majority used a cross-sectional design (34.9%), with 30.2% being randomised controlled trials (RCT), and 12.5% non-RCTs. Other designs (i.e., experimental, longitudinal, quasi-experimental, correlational, pre-post) accounted for the remaining 22.4%. The most common exposure variables were general PA, sports, and exercise. Other exposures were yoga, physical education, dance, and weight/strength/aerobic/fitness training. Quality assessment of the reviews indicated that 50% were of "good" quality and 50% of "fair" quality. Partially consistent with meta-analytic reviews in adults, results showed that, in general, PA can lead to improvements in SE and SC, with effect sizes varying from large to small. In particular, associations between PA and self-worth, perceived competence/fitness/appearance were evident, while effects on perceived attractiveness and body image were often only seen over the short-term.

Conclusions: Following a review and update of higher quality systematic reviews and meta-analyses, a recent rapidly growing literature and associations between PA and SE emerged. Findings may be used to inform future research and policy designed to increase levels of SE through PA. However, better quality intervention research is required to increase the confidence in the findings.
Keywords: young people, self-concept, mental health, sport, exercise.
References:
Biddle, S. J., & Asare, M. (2011). Physical activity and mental health in children and adolescents: a review of reviews. Br J Sports Med, 45(11), 886-895
National Institutes of Health (NIH), National Heart, Lung, and Blood Institute. (2016). Quality Assessment Tool for Systematic Reviews and Meta-Analyses. https://www.nhlbi.nih.gov/health-topics/study-quality-assessment-tools

HOW DOES PSYCHOLOGICAL EMPOWERMENT AFFECT THE MEANING IN LIFE BASED ON PASSION? A CONDITIONAL PROCESS MODEL.

CALISKAN, G., OZER, A., INCE, I.
1GAZI UNIVERSITY, 2HACETTEPE UNIVERSITY, 3YILDIRIM BEYAZIT UNIVERSITY

Introduction: Victor Frankl's logotherapy (1985) specified that meaning in life is discovered by creating a work, doing good or loving the others and maintain a stance toward unavoidable suffering. In this context, we can assume that life coaches experience meaning in life getting in relationship with creating teams, making athletes/team successful, explore talents, commitment with passion for works. But, coaches are shown responsible for the failures in the first place. Hence, In Frankl's view, it can be argued that coaches' meaning in life depend on acceptance their failures bravely and perform their decision without being influenced by others. On the other hand, the support of the clubs is important when they come to overcoming difficulties. Therefore, the aim of this study is to examine whether the passion (CP) moderates indirectly psychological empowerment (PE) to have ML in the workplace.
Methods: 227 volunteer Turkish coaches (Mage = 35.89, SD = 9.78) from different sport branches participated in this study. PE (Spreitzer, 1995), CP (Vallerand et al., 2003) and ML Scales (Steger at al., 2006) were used. Process script was performed (Hayes Model 1). Before the moderated analysis, outliers, normality, homoscedasticity, linearity, multicollinearity were checked.
Results: A positive correlation has been determined between the scores of PE and ML. (r =.31, p <.01), whereas the correlation between CP and ML is not significant. One unit increase perceived PE scores leads to an increase of 21 points in ML scores (B =.21, t = 4.88, p =.00) but, CP does not predict ML (B =.03, t =.84, p =.40). However, the relationship between PE and ML scores vary depending on CP in high and moderate groups (B = .01, t = 2.17, p = .03).
Discussion: PE increases ML scores, by virtue of PE supports a more purposeful life (Melton & Schulenberg, 2008). CP doesn't have a direct effect on ML, however, CP*PE increases the ML. Accordingly, the Coaches believe that CP is not enough to realize their aims because of bureaucratic obstacles, Therefore, PE provides making responsive and adaptive decisions and they see their profession as useful, and so it may effect ML positively.
References: Frankl, V. E. (1985). Mans search for meaning: Simon and Schuster.
Melton, A. M. A., & Schulenberg, S. E. (2008). On the measurement of meaning: Logotherapys empirical contributions to humanistic psychology. The Humanistic Psychologist, 36(1), 31-44.
Spreitzer, G. M. (1995). Psychological empowerment in the workplace: Dimensions, measurement, and validation. Academy of management Journal, 38(5), 1442-1465.
Steger, M. F., Frazier, P., Oishi, S., & Kaler, M. (2006). The meaning in life questionnaire: Assessing the presence of and search for meaning in life. Journal of counseling psychology, 53(1), 80-93.
Vallerand, R. J., et. al. (2003). Les passions de lame: on obsessive and harmonious passion. Journal of personality and social psychology, 85(4), 756-767.

11:30 - 12:45

Plenary sessions

PL-PS03 BRAIN AND MUSCLE LEARNING: MODERN DAY PERSPECTIVES

LINKING BRAIN DYSFUNCTION AND MOTOR UNIT PHYSIOLOGY IN ESSENTIAL TREMOR

VAILLANCOURT, D.
UNIVERSITY OF FLORIDA

Essential tremor is a neurological syndrome of heterogeneous pathology and aetiology that is characterized by tremor primarily in the upper extremities. Several studies have found an association of blood-oxygen level-dependent signal in the cerebello-thalamo-cortical pathway with essential tremor, but there is behavioural evidence that also points to the possibility that the severity of tremor could be influenced by visual feedback. In a series of studies, we directly manipulated visual feedback and hypothesized that an increase in visual feedback would exacerbate tremor in essential tremor patients in the 4–12 Hz range. Further, we used functional MRI, high density electroencephalography, and motor unit physiology to better understand the neural pathways and mechanisms from the cerebellum to cortex to muscle related to abnormal tremor. We have found that regions well beyond the classically hypothesized cerebello-thalamo-motor cortical pathway, such as visual and parietal areas, directly relate to essential tremor severity. Further, the cortical oscillations appear to be abnormal with increased visual feedback in the parietal and motor cortex within the 4-12 Hz and 13-30 Hz bands. At the muscle, we observed that the variability of motor unit action potentials relates to tremor severity in essential tremor. This set of studies therefore provides new evidence that a widespread functional network is associated with the severity of tremor in patients with essential tremor measured at the hand during functional imaging and electroencephalography, and is also associated with the clinical severity of tremor. These findings support the idea that the severity of tremor is exacerbated by increased visual feedback, suggesting that designers of new computing technologies should consider using lower visual feedback levels to reduce tremor in essential tremor.

MUSCLE MEMORY AND A NEW CELLULAR MODEL FOR MUSCLE ATROPHY AND HYPERTROPHY

GUNDERSEN, K.

UNIVERSITY OF OSLO

We suggest that skeletal muscle fibres display the hallmarks of a cellular memory, entailing encoding, storing and retrieving information. The muscle cells are the largest cells in the body and are served by multiple nuclei. The classical cell biological model for muscle atrophy has implied that during atrophy, muscle nuclei are lost by apoptosis as to maintain a constant cytoplasmic domain volume for each nucleus. Similarly, during hypertrophy, nuclei are recruited form satellite cells that fuse with pre-existing muscle fibres. Although supported by a large body of literature, newer more precise methods, indicate that this model is not correct.
In particular, direct observations of myonuclei by in vivo time laps microscopy indicates that nuclei are not lost during atrophy. Thus, the number of nuclei reflect the previous size of the muscle fibre, and not its atrophic state. The number of nuclei then represents a long lasting cytoarchitectural imprint or "memory" of the original fibre size.
Newer methods have confirmed that nuclei from satellite cells are added during de novo hypertrophy, and that also these nuclei are maintained during subsequent disuse atrophy, serving as a cytoarchitectural "memory" of a previous hypertrophy. The muscles with an elevated number of myonuclei induced either by previous steroid exposure or exercise (encoding), grow faster with retraining (retrieval), even after a prolonged period of detraining (storage). In humans the memory storage could be very long lasting since our myonuclei probably have half-lives in excess of 15 years. Our findings might have implications for doping rules, and for training advice. It might be beneficial to do early strength exercise since myonuclei are more easily recruited in younger than in old individuals.

13:00 - 14:00

Conventional Print Poster

CP-PM16 Endurance

EFFECTS OF LONG-TERM LOW INTENSITY EXERCISE ON OXIDATIVE CAPACITY IN AGED RAT MUSCLES

SAKAMOTO, M.1, ONAGA, N.1, YONA, M.2, MURO, M.3, TADANO, C.3

1: KITASATO UNIV. , 2: TUPLS , 3. TOHO UNIV. MED.

INTRODUCTION: Ageing leads to a reduced capacity for oxidative phosphorylation in muscle, likely due to a decline in mitochondria content and/or function. Peroxisome proliferator-activated receptor-gamma coactivator 1-alpha (PGC1-alpha) regulates the promotion of muscle mitochondrial biogenesis in response to prolonged exercise (Kang et al, 2013). However, aged muscles are more susceptible to contraction-induced damage. Therefore, setting of a safe and effective intensity of exercise is needed for aged muscles. The purpose of this study was to examine the effect of long-term low intensity exercise on oxidative enzyme capacity in soleus and gastrocnemius muscles.
METHODS: Male Fischer rats were used in this study. These rats were divided into a non-exercise group (Control; N=5), a flat loading group (0 degree; FL, N=2) and a downhill loading group (-16 degree; DL, N=2). The rats were reared from 8 weeks old until 112 weeks old, and the FL and DL rats performed treadmill exercise (10 m/min, 15 min, 2 times/week) during the rearing period. One week after the last exercise, soleus and gastrocnemius muscles were excised and made into frozen serial sections. Serial sections were stained with succinate dehydrogenase (SDH), hematoxylin and eosin. The expressions of PGC1-alpha were measured by immunoblot analysis. SDH activity was analyzed by semi-quantitative measurement using Image J software. Results are expressed as a percent of control value.
RESULTS: Regarding the histological findings of skeletal muscles, there was no observed muscle damage in either the FL or the DL group. The expression of PGC1-alpha in soleus muscle was increased to 230 % of control group in the DL group. In FL group, the expression of PGC1-alpha in soleus muscle was elevated to 178 % of control group. On the other hand, the expressions of PGC1-alpha were not different among the 3 groups in gastrocnemius muscles. In terms of the SDH activity of the soleus muscle, no group-dependent differences were observed in either the soleus or the gastrocnemius muscles.
CONCLUSION: The effects of prolonged low-intensity exercise differed in relation to each muscle and exercise type. It seems that the contribution of fiber type and recruitment pattern of motor units depends on exercise type. These results suggest that long-term low intensity exercise, especially DL exercise, is effective for promoting mitochondrial biogenesis in the soleus muscle.

EXPRESSION OF MARKERS OF BROWNING IN WHITE ADIPOSE TISSUE IN LIFE-LONG ENDURANCE TRAINED ATHLETES

REITZNER, S., KISSLING, S., CHAPMAN, M., SUNDBERG, C.J.

KAROLINSKA INSTITUTET

INTRODUCTION: Physical exercise and training results in adaptations in adipose tissue. Such adaptations may in part be mediated through “cross-talk” with skeletal muscle. One of these adaptations potentially relevant to energy metabolism in endurance athletes is the beiging of white adipose tissue (WAT). Beiging is the process by which WAT shows characteristics of brown adipose tissue (BAT), possibly increasing basal metabolic rate. While the process of beiging in rodents and the existence of BAT in humans has been shown previously, it is unknown if and how life-long endurance exercise influences beiging of WAT depots.
METHODS: Periumbilical subcutaneous adipose tissue biopsies were collected from 14 life-long trained sub-elite endurance athletes (8 male, 6 female; VO2max performance over 90th percentile for their age group) and 13 age-matched controls (6 male 7 female). Gene expression was analyzed on extracted RNA. Fold induction was statistically analyzed by Student’s-test.
RESULTS: UCP-1 gene expression was significantly higher in trained women compared with the control group (p=0.046). No significant difference was found in men when comparing UCP-1 expression (p=0.257). Expression of CIDEA was, again, significantly higher compared with controls (p=0.049), but also in men (p=0.024). Finally, expression of PPAR-γ was significantly higher in trained women (p=0.005). Again no differences were found in men (p=0.924).
CONCLUSION: Life-long endurance training results in a higher expression of brown adipose tissue markers in periumbilical WAT in women, in men only in expression of CIDEA, a factory closely associated with metabolic health. Previous results in rodents show a higher

susceptibility of females to upregulate BAT markers following β-adrenergic signaling. A similar mechanism might be possible in humans. This effect might also be caused by differences in body fat distribution and functionality, with women having a higher prevalence for BAT.

THE EFFECTS OF LEARNING "TACTICS FOR WINNING" FOR LONG-DISTANCE RACES IN JUNIOR HIGH SCHOOL PHYSICAL EDUCATION CLASSES

MATSUMOTO, Y.

HIROSHIMA UNIVERSITY

THE EFFECTS OF LEARNING "TACTICS FOR WINNING" FOR LONG-DISTANCE RACES IN JUNIOR HIGH SCHOOL PHYSICAL EDUCATION CLASSES
Matsumoto, Y.1, Saito, K.1 1: Hiroshima University
Introduction: In Japanese junior high schools, students tend not to have a positive attitude towards long-distance races in physical education (PE) classes. In order to cope with this difficult situation, there have been many studies on long-distance races in junior high school PE classes. However, little is known about the effects of learning "tactics for winning" (Takashima et al., 2017) on student perceptions of long-distance races. The purpose of this study was to analyze the effects of learning "tactics for winning" for long-distance races in junior high school PE classes. Considering the purpose of the study, we set the following two research questions (RQ). RQ1: Does the attitude towards long-distance races of the participants become positive by learning "tactics for winning?" RQ2: Is participant stamina improved by learning "tactics for winning?"
Methods: In this study, a questionnaire was developed based on Takashima (2017) which was used as a pre and posttests. This questionnaire included Likert items based on a five-point scale and open-ended questions. The questionnaire was given to participants at the beginning and the end of the learning unit "long distance races." By analyzing the results of the pre and posttests, we examined for RQ1whether or not the participants' attitudes towards long-distance races became positive after learning "tactics for winning." As for RQ2, the times of the participants' 1000m run were recorded at the beginning and the end of the learning unit "long distance races." By using this measurement, we examined whether the participants' stamina was improved as a result of learning "tactics for winning."
Results: The results of the questionnaire surveys showed that participants' attitudes towards long-distance races became more positive with a statistically significant difference between pre and posttest data. Further, the times recorded on the 1000m run showed that those participants who were in the top 20 for the total time recorded of pre and post runs improved their stamina, with a statistically significant difference between these pre and post runs.
Conclusion
Considering the descriptions in the open-ended questions, participants reported that their attitudes towards long-distance races became positive because learning the "tactics for winning" was perceived as being less monotonous than learning through the previous style of even-pacing. Likewise, many participants stated that they felt the reason why their records of 1000 m run became faster was because they were motivated to run harder in order to win. These results suggest that learning "tactics for winning" for long-distance races is an effective strategy in helping junior high school students to develop a positive attitude towards long-distance races and for improving their stamina.

EFFECTS OF THAI FOLK GAMES ON CARDIOVASCULAR ENDURANCE IN OVERWEIGHT CHILDREN.

BUNGMARK, W.

SILPAKORN UNIVERSITY

Background: At present, Thai children have a lot of weight problems. Because of the rapid technological development, children lack physical activity.
Early Thai people invented folk games to promote physical activity and physical fitness. The Thai folk games provide fun, harmony and good relationships between players.
Objective: This study aims to study effects of Thai folk game on cardiovascular endurance in overweight children.
Method: Volunteers are 27 overweight students from the demonstration primary school grade 1-3 of Silpakorn University. Training by join Thai folk game for 4 weeks, 3 days per week, with 3 different games for a hour per day. Before and after participating in the activity, the volunteers must evaluate the cardiovascular endurance with a 1,200 meters distance run.
Results: After training Thai folk games for a hour, 3 games per day, 3 days per week for 4 weeks. We found that children had a higher run speed of 1,200 meters. Average running speed before training is 13.17±2.75 min. and after 4 weeks of training is 11.90±2.68. When analyzed statistically with pair t-test were significant at level .05.
Conclusion: Thai folk games are the wisdom of the Thai people. Invented in ancient times to promote physical fitness for children and youth. Because of the rapid technological development, children lack physical activity. Thai children have a lot of weight and health problems. Therefore, promoting children play Thai folk games make children run faster and cardiovascular endurance improved. It is also a Thai cultural preservation.

CHANGES OF VARIOUS HEMATOLOGICAL PARAMETERS IN RESPONSE TO VIGOROUS CONTINUOUS ENDURANCE EXERCISE TRAINING IN HEALTHY YOUNG MEN: A SINGLE GROUP ANALYSIS

KNUIMAN, P.

WAGENINGEN UNIVERSITY

INTRODUCTION: Changes of various hematological parameters in response to vigorous continuous endurance exercise training in healthy young men: a single group analysis
Pim Knuiman1, Maria Hopman1,2 and Marco Mensink1
1Wageningen University & Research, the Netherlands
2Radboud University Medical Centre, the Netherlands
It has previously been observed that endurance exercise training affect hematological parameters including erythrocyte volume, hematocrit value, hemoglobin concentration, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC). Moreover, changes in hematological parameters contribute to changes in VO2max with endurance exercise training, predominantly by influencing circulatory oxygen transport capacity to the working muscles. To date, there is little data on the effects of temporary changes in hematological parameters in response to vigorous continuous cycling training. Therefore, the aim

of this single group sub-study was to assess the response of various hematological parameters with prolonged vigorous continuous exercise training.
METHODS: Twenty-four recreationally active young healthy men [mean ± SD (age 22.2 ± 2.7 years; BMI 22.6 ± 1.4 kg·m-2; VO2max 49.8 ± 4.2 ml·kg-1·min-1)] were recruited to participate in the study. Over a 12-week period, subjects performed three cycling sessions of 60 minutes per week on 85% of their heart rate reserve. Blood was taken at baseline, week 2, 4, 6, 8, 10 and 12, at least 48 hours after the last exercise session. Hematological parameters were analyzed on whole blood samples using an automated hematology analyzer. MCV, MCH and MCHC were calculated from erythrocyte count, hematocrit and hemoglobin concentration.
RESULTS: Endurance training led to a decline in erythrocyte count when compared with baseline values following 2 weeks of exercise training and remained at this decreased level until week 12. Hematocrit was significantly lower at week 2, 4, 8, 10 and 12, however, hematocrit concentrations at week 6 were not different compared to baseline. Hemoglobin concentration remained decreased at week 2 and 4 without any further significant change over the course of the training period. Compared to baseline, both MCH and MCHC were increased at week 4, 6, 8, 10 and 12 without any significant differences at week 2. MCV remained unchanged over the course of the training period.
CONCLUSION: In conclusion, the reduction in erythrocyte count, hematocrit and hemoglobin concentration are most likely explained by hemodilution secondary to plasma volume expansion, a typical feature of endurance type activity. Also, intravascular hemolysis may contribute to the decrease in these hematological parameters. The increase in MCH and MCHC may reflect an improved oxygen carrying capacity of the red blood cells and might be a compensatory adaptation for the observed decreases in erythrocyte count, hematocrit and hemoglobin concentration secondary to hemodilution and hemolysis.

APPLICATION OF THE CRITICAL POWER MODEL OF ENDURANCE CAPACITY TO CHANGE-OF-DIRECTION EXERCISE: A PROOF OF CONCEPT

TILLIN, N.A., REES, M.

UNIVERSITY OF ROEHAMPTON

INTRODUCTION: The critical power/speed (CS) model of endurance capacity describes the hyperbolic relationship between exercise speed and time to exhaustion (Tlim). The model is composed of 2 parameters: CS, representing the last sustainable speed; and W' (or D'), the finite work/distance that can be completed above CS before Tlim. The CS model has been robustly applied to different exercise modalities (cycling/running/rowing), and both constant and intermittent speed activities (Jones & Vanhatalo, 2017). However, the CS model has not been applied to exercise involving changes of direction, and proof of its applicability might have important implications for monitoring athletic performance in sports (team/racket) which involve frequent directional changes. This study aimed to: (i) establish proof of concept that the CS model could be applied to change of direction exercise; and (ii) validate a 3-min all-out test for establishing CS and D'.
METHODS: Ten, young, male team-sport players completed a familiarisation and 5 randomly ordered experimental trials, in which they ran continuously between 2 floor plates 15 m apart. Timing gates were at 1.5 and 13.5 m between the plates. In 4 of the experimental trials participants ran between the plates at different constant average speeds, set by a metronone to elicit Tlim within 5-20 min. Both the hyperbolic CS model [Tlim = D' / (S – CS)] and a linear expression of the CS model [Dlim = D' + CS*Tlim] – where S is constant average speed and Dlim is total distance covered – were fitted to each individual data set from the 4 constant average speed trials to determine CSHyp and D'Hyp (hyperbolic), and CSLin and D'Lin (linear). In the 5th experimental trial participants ran as quickly as possible backwards and forwards between the plates for 3 min; with average running speed over the last 30 s defined as CS3min, and distance covered above CS3min defined as D'3min.
RESULTS: Excellent fits of the constant average speed data sets were provided by both the hyperbolic (R2 = 0.96 ± 0.03 and RMS error = 44 ± 26 s), and linear (R2 = 0.99 ± 0.03 and RMS error = 17 ± 12 m) models. CSLin was higher than CSHyp ($P<0.001$) for all participants but varied (coefficient of variation) between the two models by only 3 ± 1%. In contrast, D'Hyp ad D'Lin were statistically similar ($P = 0.981$) between models but varied by 11 ± 9%. CS3min was greater than CSHyp ($P = 0.005$) though similar to CSLin ($P = 0.886$), whilst D'3min was typically 27% lower than both D'Hyp and D'Lin ($P<0.05$).
CONCLUSION: These results provide proof of concept that the CS model can be applied to change of direction exercise, with both hyperbolic and linear expressions of the model providing excellent fits for the constant average speed data. The 3-min all-out test provided accurate estimates of CS but considerably underestimated D', so is only a valid determinant of the former.

EFFECTS OF DOWNHILL INTERMITTENT AEROBIC TRAINING ON ENDURANCE PERFORMANCE IN HUMANS

DIRY, A.1, DAUSSIN, F.2, JEANSOULE, N.3, FREY, A.1, COUTURIER, A.1, THOMAS, C.1

1:INSEP , 2:UREPSSS , 3:UNIV PARIS SACLAY

INTRODUCTION: For many sports, aerobic and strength qualities are required simultaneously. Currently, few training strategies can develop these specific qualities in a unique training session. The aim of this study was to determine, if a high-intensity eccentric training induced a concomitant development of aerobic and strength capacities.
METHODS: 2 groups of 10 subjects performed 12 high intensity interval training (HIIT) sessions in 4 weeks on a treadmill (Little et al., 2010). The control group (CON) ran with 2% uphill and the eccentric group (ECC) performed eccentric trainings from -7 to -10% slope. Before and after the training program, subjects performed an incremental test to determine their maximal aerobic speed (MAS), and their VO2max, an endurance test (4km), a repeated-sprints test ability (RSA), and a strength test on isokinetic ergometer.
RESULTS: Both groups showed a significant improvement for endurance time, with a preservation of initial strength level only for ECC, whereas a strength decrease was observed for CON. No effect was observed on MAS, RSA and VO2max in ECC compared to CON.
CONCLUSION: Our results agree with previous studies on the aerobic capacities improvement in response to HIIT trainings (Gibala & McGee, 2008; Robineau et al., 2016). Positive effect of ECC training on endurance test could be explained by an improvement of endurance capacity per se or by an improvement of energy cost (Yamamoto et al., 2008), rather than by metabolic adaptations. Indeed, the metabolic training intensity was maybe too low in the eccentric modality to improve the VO2max as the metabolic stress is a key factor to improve it (Dufour et al., 2004). Moreover, the strength stimulus associated to decline running was sufficient to maintain strength, but not enough to lead to its improvement as previously reported (Hawley, 2009). Nevertheless, it could be difficult to increase the intensity thanks to the slope due to the important mechanic pressure and the risk of injuries in this modality.
In conclusion, downhill HIIT improved endurance performance with protective effect on strength reduction, compared to classic HIIT.

Conventional Print Poster

CP-PM17 Prevention, Rehabilitation, Injury

EFFECTS OF DYNAMIC SLING TRAINING EXERCISES ON TRUNK MUSCLE ACTIVATION

MORAT, T., HOLZER, D., TRUMPF, R.

GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: To improve trunk muscle strength and stability, unstable devices can be applied in strength training. However, the number of studies which have investigated trunk muscle activation during sling training exercises is still not very extensive. The purpose of this study was to examine the level of trunk muscle activation during different dynamic sling training exercises in healthy, young adults.
METHODS: Thirty-six young adults <18 women, 25.1 ± 3.3 years, 1.78 ± 0.1 m, 71.5 ± 10.4 kg> performed seven different sling training exercises while muscle activation of eight different trunk muscles was measured unilaterally by surface electrodes. Four of the exercises were conducted at two different difficulty levels using the principle of body angle.
RESULTS: The seven sling training exercises differed regarding muscle activation, with significant differences between the three body parts . High muscle activation of the trunk flexor muscles was measured during the body extension <87%>, side plank <81%>, and suspended crunch exercises <76%>. The back muscles tested reached more than half of their maximum reference trial values only during hip abduction <52%>. Regarding the side muscles, the suspended crunch <92%>, side plank <70%> and hip drop <66%> exercises achieved muscle activations of 60% and higher. For body extension, hip drop, and rowing, all eight trunk muscles tested demonstrated a significantly higher muscle activation in the harder version compared with the easy version. During hip abduction, only m. obliquus externus abdominis showed a significant difference between the two difficulty levels.
CONCLUSION: Based on the results, the sling training exercises tested in this study seem to be most effective for the abdominal muscles whereas the back muscles rarely reach 50% of their full muscle activation potential during the sling training exercises investigated. As assumed based on the former literature, changing the body angle during sling training exercises is shown to be a feasible way of adjusting the intensity of sling training. This could potentially be used in longitudinal sling training studies to assure a controlled, progressively increasing training intervention.

EFFECT OF DIFFERENT TRUNK POSTURE ON THE SCAPULAR MUSCLE ACTIVITIES AND KINEMATICS DURING SHOULDER EXTERNAL ROTATION

MIYAKOSHI, K.1, UMEHARA, J.1, KOMAMURA, T.1, UEDA, Y.1,2, TAMEZAWA, T.1, KITAMURA, G.1, ICHIHASHI, N.1

1: HUMAN HEALTH SCIENCE, GRADUATE SCHOOL OF MEDICINE, KYOTO UNIVERSITY 2: DEPARTMENT OF REHABILITATION, NOBUHARA HOSPITAL

INTRODUCTION: Trunk rotation during shoulder exercises affects scapular kinematics and muscle activities (Yamauchi, 2015). Shoulder external rotation at shoulder abduction is a notable motion in overhead sports such as baseball because it causes strong stress to the elbow and shoulder joint. However, no study has focused on the difference of trunk posture during shoulder external rotation at shoulder abduction. Therefore, the purpose of this study was to investigate the effect of different trunk posture on scapular kinematics and muscle activities during shoulder external rotation.
METHODS: Thirteen healthy young men participated in this study. Subjects randomly performed shoulder external rotation at 90° abduction with the dominant arm in 11 trunk postures while sitting on a stool. Eleven trunk postures included flex-extension condition(4 postures: slouch, 20° trunk flexion [flex20], 20° trunk extension [ext20], and maximum trunk extension [ME]), rotation condition (6 postures: maximum contralateral rotation [MCR], 30°contralateral rotation [CR30], 15° contralateral rotation [CR15], 15° ipsilateral rotation, 30° ipsilateral rotation [IR30], and maximum ipsilateral rotation [MIR]), and upright posture as a control. Muscle activities of upper trapezius (UT), middle trapezius (MT), lower trapezius (LT), serratus anterior (SA), infraspinatus (ISP) and latissimus dorsi (LD) were assessed at maximum shoulder external rotation using surface electromyography. Additionally, 3-dimentional scapular kinematics was measured by 6-df electromagnetic tracking device. In each condition, one-way analysis of variance (ANOVA) with repeated measures and Dunnett's comparison for post-hoc test were used to compare upright posture with each posture. A confidence level of .05 was used in the entire statistical test.
RESULTS: For the flex-extension condition, scapular posterior tilt and external rotation significantly decreased but the muscle activities of LT and ISP significantly increased in slouch. In flex20, scapular posterior tilt and external rotation significantly decreased. Also, scapular upward rotation and the activity of SA significantly increased in ME. For the rotation condition, scapular posterior tilt and external rotation significantly decreased but the activity of SA significantly increased in MCR. In CR15, scapular external rotation significantly decreased. There were no significant differences of kinematics but the activity of trapezius muscles significantly increased in MIR and IR30.
CONCLUSION: Difference in trunk posture affects scapular kinematics and muscle activities during shoulder external rotation at 90° shoulder abduction. Our results suggested that the activities of LT and SA which are the muscles that induce scapular posterior tilt are activated in the different trunk posture. In addition, ISP, a shoulder external rotator, tended to be activated in the postures with limitation of scapular movement by rib cage.
Reference:
Yamauchi, T.et al.J.Shoulder Elb. Surg. 24, 955–964 (2015).

INFORMING ATHLETE REHABILITATION WITH TENSIOMYOGRAPHY: A CASE STUDY

MACGREGOR, L.J., SHANKS, N., HUNTER, A.M.

UNIVERSITY OF STIRLING

INTRODUCTION: Collecting the requisite objective evidence to provide informed interventions in training and rehabilitation is a challenge for practitioners working with elite athletes. Tensiomyography (TMG) has been applied to monitor training (de Paula Simola et al, 2015) and recovery (Rey et al, 2012) in sporting settings, and has been proposed as a predictor of injury risk (Alentorn-Geli et al, 2015). This case study examined neuromuscular function of a competitive female swimmer following a period of detraining, after suffering sudden onset knee pain. The aim was to combine TMG with electromyography (EMG) to guide individualised training interventions to optimise retraining.
METHODS: Cross sectional area (CSA) of each thigh was measured; and single leg balance time and 10-repetition maximum (RM) leg press were assessed for each leg. TMG was used to measure muscle displacement (Dm) of vastus lateralis (VL), rectus femoris (RF) and

vastus medialis (VM) on each leg. EMG was used to examine pre-motor time (PMT) of VL, RF and VM during maximal voluntary isometric contraction. The results of the affected limb were compared to those of the contralateral limb. The athlete presented muscle atrophy in the affected leg, along with impaired strength and motor control. Compromised contraction of VM, in the affected limb, was evidenced by impaired Dm and prolonged PMT. Training interventions, aimed at maximising VM activation, were prescribed. Interventions included: blood flow restriction, time under tension and classic strength training principles. Neuromuscular assessments were repeated following 5 weeks undertaking individualised strength training.
RESULTS: At initial assessment, the affected limb displayed 4.3% smaller CSA, and 49% lower 10-RM and 50% shorter single leg balance time, compared to the contralateral limb. TMG revealed similar Dm between limbs in VL (2.2mm vs 3.9mm) and RF (4.8mm vs 6.7mm), but substantially lower Dm in VM of the affected limb (0.5mm vs 2.3mm). VM also displayed longer PMT in the affected limb (233.3ms vs 211.7ms). Following 5 weeks of training, the difference between limbs in CSA, 10-RM and balance time were reduced compared to initial assessments (1.3%, 24.1%, 16%, respectively). VM Dm and PMT were similar between limbs (3.2mm vs 2.8mm and 226ms vs 216.5ms, respectively).
CONCLUSION: In this case study, application of TMG in combination with EMG informed the return to training of an injured athlete, allowing targeted intervention towards impaired muscle. Muscle mass and function were both improved within 5 weeks following initial assessment.

PLAYING THROUGH THE PAIN: SELF-REPORTED SHOULDER FUNCTION OF UNINJURED RUGBY PLAYERS

PARTNER, R., FRANCIS, P.

LEEDS BECKETT UNIVERSITY

INTRODUCTION: The shoulder is the most commonly injured joint in rugby league and among the top 3 in rugby union. Contact injuries make up the majority of shoulder injuries in rugby, but many shoulder pathologies are of insidious onset or linked to training loads. Given that previous injury is the greatest risk factor for future injury in many sports, it is pertinent to develop methods which detect early stage pathology. At present, it is not yet known what the prevalence of players playing with an existing sub-clinical shoulder dysfunction are. The Rugby Shoulder Score (RSS), a uni-dimensional 120-point scale (20 - 140), was developed to monitor shoulder function in players undergoing rehabilitation from shoulder injury. The aim of this study was to use the RSS to estimate the prevalence of sub-clinical shoulder dysfunction in a sample of professional and amateur rugby players.
METHODS: Following ethical approval from the Leeds Beckett University research ethics committee, 86 uninjured players provided written informed consent. RSS assessments were administered, via paper questionnaire, at the mid-point of the season. All players were participating in training and match play at the time of assessment. The sample consisted of 34 professional and 52 amateur players respectively. A RSS of 20 represents a perfect score. An increasing RSS indicates increasing shoulder dysfunction.
RESULTS: The mean RSS score for the entire sample was 35. Professional players demonstrated greater shoulder dysfunction than amateur players (RSS 42 vs. 30; $P<0.05$). Fifty five percent of all players indicated varying levels of shoulder dysfunction (mean 47, range 22-105). Of players with a recorded shoulder dysfunction, 17 reported it affecting their match play or training despite being classified as uninjured. The mean RSS of this sub group (n=17) was 62 (CI 50-75). Players who did not have a perfect RSS but did not report it affecting their match play or training had a RSS of 41 (CI 36-45).
CONCLUSION: The results of study indicate that the RSS can detect sub-clinical shoulder dysfunction in a sample of rugby players classified as uninjured. The prevalence of shoulder dysfunction (RSS >20) was more than half of the sample. Professionals tended to have greater shoulder dysfunction than amateurs. A threshold for minimal clinical importance of the RSS does not exist. However, for a sub group of players (n=17) an RSS range has been identified which appears to indicate a level of dysfunction which may affect match play and training.

EFFECT OF SITTING POSITION HOLDING DEVICE FOR ELDERLY CEREBRAL PALSY PATIENTS – TWO CASES WHERE ACTIVITY OF DAILY LIFE (ADL) AND QUALITY OF LIFE (QOL) WERE IMPROVED –

INAGAWA, T.

NTT MEDICAL CENTER TOKYO

INTRODUCTION: We developed the sitting position holding device for 2 elderly patients with severe disability originating from cerebral palsy. It corrected their abnormal sitting postures and reduced their disability.
METHODS: Case 1: A 61-year-old woman with spastic hemiplegia who stayed in a nursing care home experienced progression of poor posture with aging, and the upper body tilted significantly to the right on a wheelchair. Therefore, she could not have taken a meal by herself for a long time. In order to correct her posture, in cooperation with facility-staff and wheelchair-producers, we made a modular type wheelchair with posture holding devices such as large-head-rest, trunk-hold-lateral-pad, chest-belt, and adduction-prevention-pad of hip joint.
Case 2: A 63-year old man with spastic quadriplegia who received home care services spent the daytime sitting on the sofa in the living room. Because his sitting position was poor, muscle tone of the lower limbs always increased, and flexion contracture of both knees became aggravated. Instead of this sofa, we developed a mold type sitting position holding device, and installed it in the wooden frame with a reclining function.
RESULTS: Case 1: These posture holding devices enabled to reduce sever tension of upper body, and she could take a proper sitting posture. As a result, the upper body no longer tilted to the right. Especially, as the pelvis was in a good position, the movement in both upper limbs improved. Using cut-out-table, she could eat meals by herself. From such good changes in this patient, the caregivers at the nursing home began to reconsider how to care for them from now on.
Case 2: By preventing excessive stretching of the trunk and keeping the hip joint moderately flexed, the flexion position of both knees improved. Using a cut-out-table, he could take meals by himself. In addition, we developed a wheelchair with a sitting position holding device for him. Keeping the good sitting position, tilting and reclining function of the wheelchair reduced his fatigue on the wheelchair; therefore, he could take chance to go out and travel with this wheelchair.
CONCLUSION: Physical function in the patients who have disability due to cerebral palsy tends to decrease easily with their aging. We experienced physical function improvement in these patients who had serious disability and needed physical assistance in every aspect of daily lives by keeping their sitting postures good. Through these cases, we cordially appreciated that providing nursing and home care services, keeping a close eye on their body posture was an important approach to maintaining and improving their ADL and QOL. Also, when making a sitting position holding device like this, liaison with nursing care and medical as well as cooperation with regional and hospital staff appeared to be essential.

THE METHOD USED TO DEFINE LIMB DOMINANCE IN UNINJURED GROUPS AFFECTS THE RESULTANT LIMB SYMMETRY INDEX STATISTICS AND THE IDENTIFIED DIFFERENCES BETWEEN ACL-RECONSTRUCTED AND UNINJURED GROUPS.

MCFADDEN, C., DANIELS, K., STRIKE, S.

UNIVERSITY OF ROEHAMPTON, LONDON. SPORTS SURGERY CLINIC, DUBLIN.

INTRODUCTION: Large asymmetries in joint loading and functional performance observed in individuals following anterior cruciate ligament reconstruction (ACLR) compared to uninjured groups have been associated with risk of re-injury (Sward et al. 2010). The limb symmetry index (LSI) is used to quantify these asymmetries. LSI is calculated using one limb as a reference. Normally the unaffected limb is used as a reference for injured groups and the dominant limb is used for uninjured groups. As multiple definitions of lower limb dominance exist, the reference limb selected and the LSI results reported for uninjured groups may depend on the definition used. The aims of this study were to determine the effect of three common dominance definitions on uninjured LSI group statistics and to evaluate if changes to LSI groups statistics as a result of dominance definition affected the interpretation of differences between LSIs in post-ACLR and uninjured groups.
METHODS: Fifteen healthy male athletes and 15 post-ACLR (mean 28 weeks) participants completed a vertical drop jump, single-leg counter-movement jump and a single-leg hop for distance. Kinetic and kinematic data were recorded for each exercise using a Vicon motion capture system. Peak knee abduction moment (KAM), jump height and hop distance were calculated. KAM has been associated with increased ACL loading and injury while jump height and hop distance LSI are regularly assessed during rehabilitation (Xergia et al. 2013). LSI was calculated using the uninjured limb as a reference in the ACLR group and using three different dominance definitions for the uninjured group: preferred kicking leg (K), highest jump (J) and furthest hop (H). A repeated measures ANOVA model was used to test the effect of dominance definition on LSIs in the uninjured group. Student's t-tests and Cohen's d effect sizes were then used to compare ACLR and uninjured asymmetries for each dominance definition.
RESULTS: Dominance definitions affected reference side selection in 93% of uninjured participants. Hop distance and jump height LSI group means were significantly affected by dominance definition ($p = 0.038$, $p = 0.025$) but KAM LSI was not. Standardised between-group effect sizes (D) and significance values (P) varied considerably for KAM (DK 0.55, PK 0.138; DJ1.03, PJ 0.08; DH 0.56, PH 0.136), jump height (DK 1.73, PK 0.00; DJ 1.09, PJ 0.006; PH 0.001, DH 1. 33) and hop distance (DK 0.98, PK 0.12; DJ 0.37, PJ 0.319; DH 0.08, PH 0.815) depending on the definition used.
CONCLUSION: Different dominance definitions can significantly alter LSI group statistics in uninjured groups and result in diverse and potentially contradictory interpretations when comparing LSIs between post-ACLR and uninjured groups. The definition of lower limb dominance must be considered when evaluating the results of studies assessing LSI in uninjured groups.
Sward et al. (2010). Knee Surg. Sport.Traumatol. Arthros., 18(3) 277–291.
Xergia et al. (2013).J.Orthop.Sport.Phys.Ther.,43(3) 154–1

EVALUATING THE KNEE VALGUS WITH DROP AND ATTACK JUMPS AND THE USE OF THE LANDING ERROR SCORING SYSTEM AS A SCREENING METHOD IN YOUNG ELITE FEMALE AND SEMI-PROFESSIONAL VOLLEYBALL ATHLETES

BRODATZKI, Y.

INSTITUTE OF SPORT AND EXERCISE SCIENCES

INTRODUCTION: Volleyball athletes, male and female, have been observed to jump approximately 100 times during a game. Ferretti, et al. (1992) reported 52 cases of serious knee ligament injuries after landing, often found in a pronounced knee valgus position, of which females are more susceptible than males. To reduce the risk of knee injuries, coaches implement methods to evaluate landing mechanisms. The Landing Error Scoring System (LESS) (Padual et al., 2009) is often used to screen players for potential risk of injuries, such as ACL damage and to establish preventive strategies. Therefore, the aim of the study was to investigate whether there are differences between the drop and attack jump with regard to the knee valgus angle and whether improved performance in the LESS is apparent between semi-professional and young elite volleyball players.
METHODS: 18 active female volleyball athletes, 8 young elite academy players and 10 semi-professional 3rd division players (20 ± 5y, 179 ± 0.3cm, 70 ± 4.5kg), participated in the study. The players performed firstly three valid consecutive drop jumps from a box with a height of 20cm and secondly three valid attack jumps, with 30 seconds rest between the single jumps. Both groups were tested on different days. The jumps were recorded with two cameras, filming from a frontal and sagittal plane. Data was preceded with the free software Kinovea, using the frontal plane angle to evaluate the knee valgus. LESS scoring system was applied afterwards by one rater.
RESULTS: The results of repeated-measures ANOVAs showed a significant difference between jump types, $F(1, 16) = 42.3$ $p < .001$, $eta^2 = .73$, but no significant difference between the groups $F(1, 16) = .04$, $p = .95$, $eta^2 = .0$. Post-hoc comparison showed that knee valgus angle in attack jumps is significantly higher than in drop jumps ($p < .001$). Concerning the LESS, the young elite volleyball players on average scored a result of 'good' (LESS score >4 to ≤5) whereas the semi-professional group were classified on average as 'poor' (Less score, >6).
CONCLUSION: It was observed that the knee valgus angle of the semi-professional players was numerically higher than those of the young elite players. Furthermore, the LESS score of the semi-professional athletes were worse than that of the young elite athletes. Both, the higher knee valgus angle (37.8 ± 18.6°) and the higher LESS score (7.3 ± 3.5) plus the partly inexperience in drop jumping, which has been determined in a previous questionnaire, may indicate that semi-professional players are at potentially greater risk to suffer knee injuries. Due to these findings, coaches and practitioners should be aware of greater knee valgus angles and worsened LESS score in this population and therefore attempt to implement interventions or specific landing training in attempt to alter these trends.
References:
Ferretti, et al., American Journal of Sports Medicine, 20 (2), 203-207, 1992
Padual, et al., American Journal of Sports Medicine, 37 (10), 1996-2002, 2009

COULD MUSCLE INJURY INDUCES CHANGES IN TENDON STRUCTURAL AND MOLECULAR PROPERTIES?

BARIN, F.1,2, RAMOS, G.1, NETO, I.1, OLIVEIRA, A.1, RUIVO, A.1, DURIGAN, J.1, MARQUETI, R.1

1: UNIVERSIDADE DE BRASÍLIA , 2: CENTRO UNIVERSITÁRIO DE BRASÍLIA

INTRODUCTION: Studies have shown that transmission of physiological loads in the tendon mediated by muscle contraction are required to maintain tendon homeostasis and architecture. Thus, the objective of the present study was to evaluate the effects of injury in the gastrocnemius muscle (GA), on the morphological and molecular properties of the calcaneal tendon (CT) of rats.
METHODS: Wistar rats were randomized in four groups (n = 9 animals per group): control without intervention (C), 3 days (3D), 14 days (14D) and 28 days (28D) after muscle cryolesion. Histological techniques (staining with hematoxylin and eosin) were used to analyze cells and vessels volume density (Vv%) in proximal and distal regions (considering the tendon proper and the peritendinous sheath) in CT. Total RNA isolated from frozen tendon samples was analyzed by qPCR for collagen I (COL1A1), collagen III (COL3A1), mothers against decapentaplegic homolog 3 (SMAD3), connective tissue growth factor (CTGF), matrix metalloproteinase-2 (MMP2) and tissue inhibitor of metalloproteinase-2 (TIMP2) to verify molecular changes in CT.
RESULTS: The GA muscle lesion (confirmed by qualitative histological analyzes) culminated in an increase peritendinous sheath cells (Vv%) in the 14D and 28D when compared to the C and 3D groups. The blood vessels (Vv%) increased in the 14D when compared to C group (tendon proprer). No statistical differences were observed in the distal region of the CT for all histological variables in tendon proprer and peritendinous sheath.
COL1A1 mRNA expression decreased in 3D compared with C group, with subsequent increased in 14D compared to 3D group. COL3A1 mRNA expression decreased in 14D compared to C group. The level of CTGF mRNA was decreased in 3D compared to C group, however we observe increased in 14D and 28D compared to 3D group. SMAD3 mRNA expression increase in 14D compared to 3D and 28D group. The gene expression of MMPs and TIMPs were similar after GA muscle injury. MMP2 and TIMP2 decreased in 3D compared to C groups. Besides that, the 14D and 28D groups increased compared to 3D (MMP2 and TIMP2 mRNA expression) and C group (TIMP2 mRNA expression).
CONCLUSION: The main findings (decrease in the mRNA expression of CTGF, COL1A1, MMP-2 and TIMP-2 in the 3D group) evidenced a loss of tendon homeostasis after muscle injury, probably related to the lack of mechanical stimuli induced by contractile tissue injured (stress shielding). Due this fact, the tendon can to be mechanically weak and susceptible to injury. However, the increase observed in these same genes, still linked to SMAD3 in the 14D and CTGF, MMP2 and TIMP2 in the 28D, could be correlated with increases at peritendinous sheath cells may suggest a tissue remodeling, following muscle recovery as well.

Conventional Print Poster

CP-PM18 Health and Fitness: Children and adolescents

IS PHYSICAL ACTIVITY LEVEL CORRELATED TO NEIGHBORHOOD CHARACTERISTICS? AN 15 YEARS FOLLOW UP FROM CHILDHOOD TO ADULTHOOD.

FIGUEIRA JUNIOR, A.1,3, ANDRADE, E.2, CESCHINI, F.1, MONTENEGRO, C.G.3, BOCALINI, D.4, ANDRADE, D.5

SÃO JUDAS TADEU UNIVERSITY1, UNIVESIDADE NOVE DE JULHO2, INSTITUTO DE ENSINO ALBERT EINSTEIN3; UNIVESIDADE FEDERAL DO ESPIRITO SANTO4; UNIVERSIDADE DE SÃO PAULO5

INTRODUCTION: Physical activity is a complex behavior because is related to different determinant factors that increase or not the total amount of daily body movement. Among all determinant factors, the neighborhood environment contributes to the physical activity level for al ages. However it is not clear how neighborhood is perceived for childhood to adulthood. Thus this study aimed to determine the perception of living neighborhood and its association with physical activity behavior of male and female from young to adult live time.
METHODS: We evaluated 192 subjects at 10, 15 and 20 years of age throughout a questionnaire with questions about neighborhood characteristics including the perception of pleasure and 5 to 20 minutes of walking to school, sports facilities, fitness club, convenience stores, bakery, bank, post office, sidewalk quality, traffic, streets connectivity, safety and relationship with other neighbors. Physical activity was determined by frequency, duration of walking to these places at different period of live. The classification in active or insufficient activity is based in total of 300 min/week of movement. Statistical analysis was determined for non-parametric variables by Kolmogorov-Smirnov and Shapiro-Wilk. The comparison among childhood-teenagerhood-adulthood was performed by Chi-Square and Friedman test and Cochran Q test. The significance was $p<.05$
RESULTS: Data evidenced a decrease in amount of physical activity from childhood to adulthood from 332.9% to 30.8% in 5 days or more per week, with similar phenomena to no activity from 18.9% to 16.8% at the same ages. Sports practice decrease from 15.2% to 7.7% at same periods of life. Neighborhood environment was positively related to total amount of physical activity if: the place or facility were at least 5-10 minutes from home; street were save; sidewalks were in good condition; green areas on the way.
CONCLUSION: Data allow us to conclude that good perception of neighborhood positively correlates to the total amount of physical activity, suggesting the urban areas can decrease the physical activity level over life.

GROWTH TRENDS IN AGILITY EVALUATED BY A NOVEL AGILITY TEST, N-CHALLENGE, IN JAPANESE ELEMENTARY SCHOOL CHILDREN

OKUDA, T., MORITA, N., SHIDE, N., OYAMA, Y., AMBE, H., YAMAMOTO, R., SATO, T.

HOKKAIDO UNIVERSITY OF EDUCATION IWAMIZAWA

Introduction: Agility is defined as "a rapid whole body movement with change of velocity or direction in response to a stimulus" (Sheppard and Young 2006). It is one of the main physical fitness components and is also considered a crucial component for success in many sports such as tennis, basketball, and soccer (Hachana et al. 2014). Previous studies regarding agility have compared the agility performance of elite athletes with that of non-elite athletes. However, there was little information on the growth of agility and its related factors, especially increasing body size, in elementary school children. The aims of this study were to clarify growth trends in agility and its related factors in elementary school children.
Methods: We designed a new agility test set on an N-shaped (7.2 m length; 3m width) course, which consists of six sections as follows: 1) response time to light stimulus (the time from emitting light to 60 cm forward of a start line), 2) 6 m straight sprint, 3) change of direction

(right turn), 4) five small hurdles (20 cm height; 80 cm apart), 5) change of direction (left turn), and 6) 6 m zigzag run using 5 poles (1.2 m height; 1.2 m apart). The section times and total time for the six sections were measured by phototube sensors. 1206 elementary school children (1st through 6th graders) performed the test twice. The growth tendency of agility ability from 1st to 6th graders was analyzed.
Results: In total time for the six sections, the 1st graders were the slowest (boys, 11.39 ± 1.06 sec; girls, 11.80 ± 0.91 sec), and the 6th graders were the fastest (boys, 9.51 ± 0.85 sec; girls, 9.94 ± 0.76 sec). A one-way ANOVA revealed a significant main effect for age differences (boys, $F = 69.28$, $p < 0.01$; girls, $F = 78.52$, $p<0.01$). As a result of Tukeys HSD test, the total time for the six sections shortened with increasing age, especially from 1st to 4th graders, in boys and girls. However, total time in girls was not shortened significantly between 4th and 5th graders, or between 5th and 6th graders. Also, total time for the six sections in boys did not improve significantly from 4th to 5th, 4th to 6th, or 5th to 6th graders. There was a significantly weak and moderately negative relationship between body size measures (height and weight) and running time in boys and girls.
Discussion: The agility of elementary school children could be related to an increase in height and weight, but it was shown that agility improved only from 1st to 4th grade. Further study is needed for elucidating growth trends in agility of school children, including other types of agility.
References:
Hachana Y, Chaabène H, Ben Rajeb G, et al. Validity and reliability of new agility test among elite and subelite under 14-soccer players. PLoS One. 9:e95773, 2014.
Sheppard JM, Young WB. Agility literature review: Classifications, training and testing. J Sports Sci 24:919-932, 2006.
Contact: okuda.tomoyasu@i.hokkyodai.ac.jp

SEASONAL VARIATION OF URINE SPECIFIC GRAVITY, TOTAL WATER INTAKE, AND ASSOCIATION WITH SUBJECTIVE FEELINGS OF ADOLESCENT STUDENT-ATHLETES

APHAMIS, G., GIANNAKI, C.D., STAVRINOU, P.S.

UNIVERSITY OF NICOSIA

INTRODUCTION: Adolescents have been shown to be prone to hypohydration as they fail to meet daily required fluid intake (Iglesia et al., 2016). Individuals living in warm countries face a higher risk of dehydration, especially those involved in sport. At the moment there is a lack of published data on seasonal variations between winter and summer. The aim of the present study was to monitor urine specific gravity, water intake and feelings related to hydration in the winter and summer time, among a sample of student-athletes.
METHODS: Thirty-one adolescent (boys n=20) student athletes (age 14-16y) volunteered for this study. Urine specific gravity (USG) was assessed on two occasions: once in the winter and once in the summer time, on arrival at school and at the end of the school day. At the same time points, a subjective feelings questionnaire related to thirst, fatigue and concentration was completed by the participants (alertness (10-cm visual analog scale, Shirrefs et al., 2004). Detailed food and fluid intake records were kept during the study, to allow total water intake estimation. Dehydration cut-off point was set at USG 1.025. Comparisons between seasons and time of day were performed using Repeated Measures ANOVA. Asocciations between USG and subjective feelings were performed using Pearsons correlation.
RESULTS: In the winter, only 36% of the participants arrived hydrated to school, as opposed to 61% in the summer. There was a season effect on USG (USG winter1.027±0.001, USG summer 1.023±0.001, $p=0.001$).USG remained unchanged between beginning and end of school-day. There was no difference on water intake between seasons (winter 960±509ml, summer 951±627ml, $p=0.692$). USG negatively correlated with concentration (winter $p=0.004$, summer $p=0.055$) and fatigue (winter $p=0.016$). There was no correlation between USG and thirst, and there was no difference on thirst between winter and summer ($p=0.753$).
CONCLUSION: A large proportion of adolescents were hypohydrated, and more students were hypohydrated in the winter time compared with the summer time. Thirst did not drive hypohydrated individuals to drink more. Hypohydration was associated with increased feelings of fatigue and decreased feelings of concentration, which can adversely affect school, training and competition performance. Drastic measures must be taken to educate adolescents on fluid intake, especially during winter time.
References: Iglesia, I, Santaliestra-Pasias, AM, Bel-Serrat S., Sadalla-Collese T et al. (2016). Eur J Clin Nutr,70,541-547.
Shirreffs, SM, Merson, SJ, Fraser, SM, Archer, DT. (2004). Br J Nutr, 91, 951-958.
Contact: aphamis.g@unic.ac.cy

EFFECTS OF THE DAILY MILE ON MEASURES OF PHYSICAL FITNESS IN 9 – 10 YEAR OLDS.

GAULT, M., POTTER, J., LAUDER, M.

UNIVERSITY OF CHICHESTER

INTRODUCTION: School-based interventions are an effective way to counteract low physical activity and fitness in children (Kriemler et al., 2011). The Childhood Obesity Strategy (HM Government, 2016) endorses The Daily Mile for schools to engage children in physical activity and improve health. However, despite widespread uptake of The Daily Mile and its endorsement by UK policy, evidence is anecdotal. The current study investigated the effects of The Daily Mile on fitness in 9-10 year olds.
METHODS: In a repeated-measures design, year 5 pupils (9-10 year olds) from 2 schools in West Sussex, UK, were compared during 2 school terms (Jan-July, 26-weeks). School 1 (28 pupils) participated in The Daily Mile (an additional 15-minutes of running/walking integrated into the school day) and school 2 (39 pupils) acted as the control, participating in usual practice for physical activity. At week 0 (Jan) and week 26 (July) body mass index (BMI) z-scores, back-saver sit-and-reach (BSSR, left, L and right, R), handgrip strength (HGS, dominant, D and non-dominant, ND), counter-movement jump (CMJ) and 1-mile run times were recorded. Delta values of best of three trials for BSSR, HGS and CMJ, were analysed, with all parameters assessed by 2-way repeated-measures ANOVA (school x time).
RESULTS: Growth was evident across the intervention period in both schools (mean 3cm, $p<0.0001$) and body mass increased (mean 1.3kg, $p<0.0001$). BMI z-score decreased for both schools from week 0 (mean 0.42, SD 0.90) to week 26 (mean 0.29, SD 0.84), with no difference between the intervention and control school ($p=1.86$). 10 children in school 1 and 9 in school 2 were overweight or obese, according to BMI percentiles, at week 0, with 8 and 5, respectively at week 26. BSSR R did not change from week 0-26 ($p=0.97$), however School 1 was significantly greater than school 2 at week 26 (37 vs 35, $p=0.04$). BSSR L decreased from week 0-26 for both schools ($p=0.038$). Improvements in strength and power were observed in both groups: HGS D was lower for school 2 at week 0 ($p=0.038$), however at week 26 they were similar ($p=0.89$) with a 13% increase for school 2 ($p<0.0001$). Both schools had a similar increase in HGS ND ($p<0.0001$) and CMJ power ($p<0.0001$) at week 26, with no change in 1-mile run time ($p=0.436$).
CONCLUSION: The Daily Mile may be a simplistic and low-cost intervention (Breheny et al. 2018), however, with limited physical benefits in the short-term, compared to usual practice, it has no added value for year 5 pupils. Further research needs to establish additional physi-

cal activity participation by children, impact on attainment and concentration, and the potential contribution of The Daily Mile to physical inactivity in later life (Fairhurst and Hotham, 2017).

WHAT IS HEALTH-RELATED FITNESS? INVESTIGATING THE UNDERLYING FACTOR STRUCTURE OF FITNESS IN YOUTH

BRITTON, U., BELTON, S., ISSARTEL, J.

DUBLIN CITY UNIVERSITY

INTRODUCTION: Health-related fitness (HRF) is generally seen as a multidimensional construct containing components such as cardiovascular endurance, muscular strength, muscular endurance, flexibility and body composition. Evidence exists for the association between health and cardiovascular endurance, and muscular strength/endurance, but not for flexibility. Additionally, the inclusion of body composition as a component can pose problems given the frequency with which body composition is used as a dependent variable where HRF is an independent variable. This study aimed to 1) investigate the underlying factor structure of a four-component (cardiovascular endurance, muscular strength, muscular endurance, flexibility) HRF construct, taking into account problems posed by the inclusion of body composition and 2) identify field-based tests representative of HRF in youth.
METHODS: Participants were 261 children (53% female, 47% males; mean age 12.22 ± 0.48 years). Indicators of four fitness components (20m shuttle run, curl-ups, push-ups, horizontal jump, vertical jump, grip strength, and modified-back-saver-sit-and-reach) were measured. Independent t-tests were used to identify sex differences across all measures. Confirmatory factor analysis (CFA), using maximum likelihood estimation methods, was used to analyse the underlying structure of HRF as a four-component construct.
RESULTS: Significant differences for sex for absolute scores on 20metre shuttle run, horizontal jump, push-ups, flexibility ($p < .001$), vertical jump ($p < .01$), and curl-ups ($p < .05$) were found. When age and sex-specific values were assigned a significant sex difference remained for curl-ups only ($p < .05$). CFA of the four-component HRF model revealed a low contribution of flexibility ($r = .10$) to the overall model, leading to its removal. The subsequent three-component model showed better fit across all fit statistics (NFI, TLI > .90; CFI > .95; RMSEA = .077; SRMR = .045). Analysis of indicator loadings in the three-component model led to the removal of grip strength ($r = .37$) as an indicator of muscular strength, further improving model fit (TLI > .90; NFI, CFI > .95; RMSEA = .10; SRMR = .037). The reduced three-component model was re-specified as a first-order model containing five indicators. Multiple-group analysis of this first-order HRF model found the HRF model to be invariant across gender (CMIN = 5.547; $p = 0.236$) for factor loadings. Measurement intercepts were significantly different between males and females (CMIN = 51.618; $p = 0.000$).
CONCLUSION: These findings suggest that HRF in youth is adequately represented by five indicators representing three components of fitness. Tests of these indicators are practical and time-efficient for measuring HRF in field-based settings. Significant sex differences were found for absolute scores of indicators within the model, but HRF as an overall construct was found to be the same across males and females.

A COMPARATIVE STUDY ON THE PHYSIQUE AND PHYSICAL FITNESS OF CHILDREN IN EAST ASIA

MURAKAMI, K., ICHIMARU, N., ZEONE, K., WENG, C.C., SUZUKI, C., FUJII, M., MAEDA, A.

GRADUATE SCHOOL OF PHYSICAL EDUCATION, NATIONAL INSTITUTE OF FITNESS AND SPORTS

A Comparative Study on the Physique and Physical Fitness of Children in East Asia
Murakami K.1, Ichimaru N.2, Zeone K.3, Weng C.C.4, Suzuki C.1, Fujii M.1, Maeda A.5 1: Graduate School of Physical Education, National Institute of Fitness and Sports in Kanoya(Kagoshima, Japan), 2: University of Teacher Education Fukuoka(Fukuoka, Japan), 3: Kangwon National University(Kangwon, Korea), 4: National Taiwan University of Sport(Taichung, Taiwan), 5: National Institute of Fitness and Sports in Kanoya(Kagoshima, Japan)
Introduction: The purpose of this research is to measure the physique and physical fitness of children in East Asia (Japan, Korea, Taiwan), and to conduct basic research to propose the physical problem of physical strength and physical fitness of each country and the health problems accompanying.
Methods: we measured physique and physical fitness for junior high school students in East Asian three countries. The total was 190 students. (70 Japanese (38 boys, 32 girls), 66 Korean (33 boys, 33 girls) and 54 Taiwanese (25 boys and 28 girls).). The measurement contents were Height, Weight, Body fat percentage, Grip strength, Standing width jump and Throwing.
Results: As a result of boys, Height was 161.0 cm in Japan, 166.8 cm in Korea, 165.7 cm in Taiwan. There was a significant difference between Japan and Korea and Taiwan. Weight was 52.8 kg in Japan, 60.7 kg in Korea, 58.4 kg in Taiwan. Body fat percentage was 17.1% in Japan, 21.2% in Korea, 18.9% in Taiwan. There was a significant difference between Japan and Korea. Grip strength was 30.9 kg in Japan, 31.1 kg in Korea, 28.5 kg in Taiwan. Standing width jump was 194.3 cm in Japan, 187.4 cm in Korea, 192.0 cm in Taiwan. Throwing was 19.6 m in Japan, 17.8 m in Korea, 18.3 m in Taiwan. As a result of girls, height was 153.5 cm in Japan, 158.7 cm in Korea, 155.8 cm in Taiwan. There was a significant difference between Japan and Korea. Weight was 45.6 kg in Japan, 54.2 kg in Korea, 51.4 kg in Taiwan. There was a significant difference between Japan and Korea and Taiwan. Body fat percentage was 18.0% in Japan, 18.3% in Korea, 16.0% in Taiwan. There was a significant difference between Korea and Taiwan. Grip strength was 24.7 kg in Japan, 20.7 kg in Korea, 18.7 kg in Taiwan. There was a significant difference between Japan and Korea and Taiwan. Standing width jump was 176.5 cm in Japan, 139.4 cm in Korea, 150.6 cm in Taiwan. There was a significant difference between Japan and Korea and Taiwan. Throwing was 13.8 m in Japan, 8.5 m in Korea, 10.2 m in Taiwan. There was a significant difference between Japan and Korea and Taiwan.
Conclusion
From the results of this study, Ⅰ. Korean children have a high proportion of obese children. There is a need for improvement. Ⅱ. Recent Japan has a low level of physical strength. However, children in Korea and Taiwan were lower in physical strength than such Japan. It was remarkable especially in girls.

THE EFFECT OF INTRODUCTION OF STANDING DESKS TO AN ELEMENTARY SCHOOL

TANAKA, R., SHIKANO, A., NOI, S.

NIPPON SPORT SCIENCE UNIVERSITY

INTRODUCTION: In recent years, the children's risks of being sedentary for too long have been pointed out. Primack et al (2009) reported in a longitudinal study that the length of time spent sitting can predict depression seven years prior to it's onset. Studies on the introduction of standing desks have been conducted with regards to time spent in a sedentary state, and suggest that as the number of steps increases, low intensity exercise time decreases (Sherry et al., 2016). In addition, Rosenbaum et al (2017) reports that standing work has a

more positive impact on executive function when compared to working whilst seated. These previous studies may indicate that the introduction of standing desks within schools could increase the amount of physical activity, improve their executive function and decrease the likelihood of depression.In this study, we aimed to examine the introduction of standing desks and their influence on physical activity, executive function, depression and subjective symptoms of fatigue among elementary school students in Japan.
METHODS: The subjects were 88 students from fifth grade classes in elementary school, Tokyo, Japan, and the study was carried out throughout October to December 2017. Of the three classes, one class (N=30) was the intervention class, the second class (N=58) was the control class. For evaluation of depression, the DSRS-C (Depression Self-Rating Scale for Children) abbreviated version, was conducted before and after the intervention. For measurement of executive function, the "Flanker task" was conducted. For evaluation of subjective symptoms of fatigue, "Jikakushoshirabe" was conducted. A Pedometer with an accelerometer (Lifecorder GS, manufactured by Suzuken Co., Ltd.) was used for measuring the amount of physical activity during the intervention period.
RESULTS: A comparison between the number of steps taken before the intervention and after,The total number of steps per day increased significantly in the intervention class compared to the control class. There was no change in the proportion of those who scored highly for depression, both in the control class and the intervention class. In addition, the subjective symptoms of fatigue the feeling of sleepiness decreased, and the feeling of malaise increased in the intervention class compared with the control class. Detailed results, including results of executive functions evaluated using Flanker tasks, should be reported on the day.
CONCLUSION: The results of this study suggested that the introduction of standing desks can help combat the problem of child sleepiness.
This research was implemented a part of research conducted by collaboration between Nippon Sports Science University Noi Laboratory and Okamura Mfg. Co.
REFERENCE:
Primack BA,Swanier B,Georgiopoulos AM,Land SR(2009).Arch Gen Psychiatry,66,181-188
Rosenbaum D,Mama Y,Algom D(2017).Pcychological Science,28,1864-1867
Sherry AP,Person N,Clemes SA(2016).Prevebtive Medcine Reports,3,338-347

PARENTAL WILLINGNESS TO PAY FOR THE PREVENTION OF CHILDHOOD OVERWEIGHT AND OBESITY IN PRESCHOOLS

LAUER, R.1, HERMELING, L.1, KELSO, A.1, STEINACKER, J.M.1, KESZTYÜS, D.1,2

ULM UNIVERSITY

INTRODUCTION: Willingness to pay (WTP) can be used as a threshold for cost-effectiveness analyses in the field of prevention. The aim of the present study was to examine parental WTP to reduce the incidence of childhood overweight and obesity in a sample of preschool children from Southwest Germany participating in a multi-level (physical activity, sedentary behaviour and diet) health intervention study.
METHODS: Cross-sectional data from children aged three to five years and their parents were assessed in the fall of 2016 within the scope of the health survey, an evaluation study of the health promotion program "Join the Healthy Boat". Children´s anthropometric data were taken by trained staff, while parental data (anthropometrics, socio-demographics and health-related variables, such as parental physical activity) were assessed via questionnaires. Parents were asked if they were in general willing to pay for a reduced incidence of childhood overweight and obesity by half (general WTP; "yes", "no"). Further, parents who answered "yes" were asked to indicate the amount of money they were willing to pay for this measure each month (amount of WTP). Man-Whitney-U tests and Fishers exact tests were used to assess group differences according to general WTP (α=0.05). A logistic regression analysis for general WTP was conducted.
RESULTS: Data for general WTP were available for 708 parents. A general WTP was declared by 46.6% of the parents with a mean amount of 32.09 (median WTP= 20.00, IQR=40, n=294). Parents considering overweight and obesity as a problem, having a higher household income, fathers staying at home more often to care of a sick child, fathers with higher BMI, and mothers having more working hours a week were significantly more often willing to pay ($p<0.05$), according to bivariate analyses. Surprisingly, there was no association with children´s weight status, migration background, parental education level as well as their physical activity level. The regression analysis showed that general WTP was associated with fathers staying at home to care for a sick child and father´s BMI. Mother´s working hours per week and household income were marginally significant.
CONCLUSION: The high general willingness to pay for the prevention of childhood overweight and obesity found in this sample of the surveyed parents indicates an awareness towards this health-related issue. Worktime-related factors seem to be associated with parental WTP, while astonishingly no associations with children´s weight, some socio-demographics and parental physical activity were visible.

PREVALENCE OF HYPERTENSION AND CARDIAC FUNCTION IN OVERWEIGHT AND OBESE CHILDREN AND ADOLESCENTS

PANAYIOTOU, G.1, ANTONIADES, O.1,2, DOUDA, H.2, SMILIOS, I.2, SPASSIS, A.2, TOKMAKIDIS, S.P.2

1: EUROPEAN UNIVERSITY CYPRUS , 2: DEMOCRITUS UNIVERSITY OF THRACE

INTRODUCTION: The association between obesity and hypertension has been demonstrated by clinical studies in children (Lu et al., 2013; Rosner et al., 2013) and increased adiposity is associated with an adverse cardiovascular risk (Falaschetti et al., 2010). The purpose of the present study was to determine the prevalence of hypertension as well as practical clinical indicators of cardiac function in overweight and obese children and adolescents.
METHODS: A total of 1.987 healthy Greek and Cypriot children and adolescents were divided according to their age (8-10 yrs, 11-12 yrs, 13-15 yrs, >16 yrs), the stage of hypertension (Normotensive, Hypertensive) and the obesity level (Normal weight, Overweight, Obese). Measurements were obtained on anthropometric characteristics (height, body mass, BMI), blood pressure (SP: systolic, DP: diastolic) and resting heart rate (HR) in order to determine the pulse pressure at rest, mean arterial pressure, rate pressure product and cardiac index using specific equations.
RESULTS: The prevalence of hypertension was about 25.7% in both overweight/obese males and females. The normotensive non-obese participants presented better values in systolic ($p<.001$), diastolic ($p<.001$) and mean arterial pressure ($p<.001$), heart rate ($p<.05$), rate pressure product ($p<.05$) and the cardiac index ($p<.001$) as compared to hypertensive overweight/obese participants. When a stepwise multiple regression was applied in the overweight/obese group, using the cardiac index as a dependent variable ($y=3.570-.034\times W+.040\times HR-.061\times DP+.031\times SP-.036\times Age$), 95.7% of the total variance was explained by body mass (W:45.4%), heart rate (HR:22.6%), diastolic (DP:14.5%) and systolic (SP:12.7%) blood pressure and age (Age:0.5%). In addition, a negative correlation was found between BMI and cardiac index ($r=-.662$, $p<.001$) while positive correlations were observed with other hemodynamic parameters ($r=.33$ to $.55$, $p<.05$).

CONCLUSION: The results of this study revealed that increased body mass affected the cardiac function of overweight/obese young people, irrespective of gender, and they were also associated with hypertension. In clinical practice, it is necessary to implement such useful prognostic indicators in childhood and adolescence in order to detect risk factors leading to cardiovascular disease at an early age.
References: Falaschetti E, Hingorani AD, Jones A, Charakida M, Finer N, Whincup P, Lawlor DA, Smith GD, Sattar N, Deanfield JE (2010). European Heart Journal, 31, 3063-3072.
Lu X, Shil P, Luo CY, Zhou YF, Yu HT, Guo CY, Wu F (2013). BMC Public Health, 13, 24.
Rosner B, Cook NR, Daniels, S, Falkner B (2013). Hypertension, 62(2), 247-54.

Conventional Print Poster

CP-PM19 Training and testing: Strength, power, time-trials

ACUTE EFFECT OF DIFFERENT KINDS OF RECOVERY PERIODS IN METABOLIC PARAMETERS AND PERFORMANCE DURING SETS IN RESISTED EXERCISE

PEREIRA, A.C.C., FERREIRA, H.F., SILVA, W.D., GOMES, N.G.S., SILVA, E., FREITAS, W.Z.
INSTITUTO FEDERAL DE EDUCAÇÃO, CIÊNCIA E TECNOLOGIA DO SUL DE MINAS GERAIS

INTRODUCTION: Recovery periods between repeated resistance efforts determine the magnitude of resynthesis of energy sources, in addition to promote removal of metabolic products (FLECK; KRAEMER, 2006). Studies by Robergs, Ghiasvand and Parker (2004) and Rafo et al. (2008) reported that the accumulation of cellular metabolites such as Lactate (Lac) and H + resulting from high intensity exercise are negatively related to the performance of individuals. Thus, the objective of the present study was to verify the acute effect of active and passive recovery periods and their combination on Lactate concentrations [LAC], blood pH and performance during the series in resisted exercise in the bench press.
METHODS: Eight males (23 ± 2.9 years, 75.5 ± 9 kg, 174.8 ± 4 cm), exercising for at least 6 months, were evaluated in the maximum load on the 1 repetition maximal test (1RM) in the bench press and, after 48h, the anaerobic threshold (AT) through the Conconi test. AT was used to determine the intensity of the active recoveries periods. After one week the subjects started the 4 protocols (randomized) passive recovery (PR), active recovery (AR), passive / active recovery (PAR) and active / passive recovery (APR). All breaks were 2 minutes long. Duration of the recovery periods (PAR/APR) was 1 minute for each kind of pause totaling 2 minutes. The active pauses were performed 2 km / h below the AT of the subjects, in a treadmill. In each protocol the subjects performed six sets in the bench press until the concentric failure at 70% of 1RM to verify strength (performance). Lactate and pH blood samples were taken prior to the protocols and after the 3rd and 5th series. Statistical analysis was performed by the SPSS-20, using the Shapiro-Wilk test, ANOVA with post hoc Bonferroni for groups and moments, with a significance level of $p < 0.05$.
RESULTS: Significant increases in [Lac] and significant decreases in pH comparing pretest values for 3rd and 5th grades were observed for all the kinds of recoveries, intra-group. However, AR, PAR and APR were more efficient in the significant reduction of [Lac] and increase of pH values, in the 3rd and 5th grades, when compared to the same PR moments, intergroups. It was also observed that in all kinds of pauses performance was significantly reduced throughout the series (intra-group), but no significant differences (intergroups) were found for all moments evaluated.
CONCLUSION: It was concluded that, although AR, PAR and APR were more efficient in the significant reduction of [Lac] and increase of pH values, especially in the 3rd and 5th grades, when compared with the same PR moments (intergroups), do not positively influence on performance.

TENSIOMYOGRAPHY AS A TOOL TO ASSESS MUSCLE SPECIFIC TRAINING ADAPTATIONS.

WILSON, M.T., RYAN, A., VALLANCE, S.R., DIAS-DOUGAN, A., CONTRERAS, B., MACGREGOR, L., HUNTER, A., HAMILTON, D.L.
UNIVERSITY OF STIRLING

INTRODUCTION: The Gluteus Maximus (GM) is a prime mover for the hip extension (HE) movement, which is important to performing many athletic movements such as sprinting and jumping. Thus, athletes pay considerable attention to training hip extension through exercises such as the back squat (BS) (Schoenfeld, 2010). We know that improving lower limb strength through BS training can lead to improvements in sprint time (Seitz et al, 2014); a common measure of athletic performance and predictor of sporting success (Kuzmits and Adams, 2008). Very little is known however, about how specific muscle groups respond to training a compound movement such as the BS. The non-invasive technique of Tensiomyography (TMG) may allow us to determine adaptive responses within specific muscle groups.
TMG provides an objective assessment of skeletal muscle function (Simola et al, 2016). However, to our knowledge TMG has never been employed in a training study to assess or predict changes in specific skeletal muscle groups. Therefore, the aim of this study was to investigate whether TMG is capable of tracking contractile property adaptations of the GM, in response to 6 weeks of HE training in men naive to resistance training.
METHODS: TMG analysis of GM velocity of contraction (Vc), was performed on 17 non-resistance trained males, before and after a 6-week HE resistance training programme. Pre and Post-training measures of 1 rep max BS, and HE maximal isometric voluntary contraction (MVC) were performed to establish changes in dynamic and static strength of the hip extensors.
RESULTS: A significant increase in BS 1 rep max strength ($P < 0.0001$) was found between pre and post training measures, in addition to a significant increase ($P = 0.0024$) in GM Vc. A significant increase ($P = 0.0139$) in HE MVC was found between pre and post training measures. To investigate a possible interaction between the change in GM Vc and HE strength, Pearsons correlation coefficients where calculated between the changes of the two variables ($r = 0.05933$, $P > 0.05$).
CONCLUSION: HE resistance training was shown to be effective in increasing BS 1 rep max strength, a desirable outcome for athletes seeking improvements in sprinting time.
TMG has shown that it may be used to track training adaptations in the GM and may provide a novel method of assessing training adaptations within specific skeletal muscle groups. Our results also suggest that changes in Vc of the GM are not reflective of changes in isolated GM strength, and therefore not reflective of changes in functional strength of the GM.
References:

Schoenfeld, B. J. (2010). JSCR, 24(12), 3497-3506.
Kuzmits, F., and Adams, A. (2008). JSCR, 22(6), 1721-1727
de Paula Simola, R. A., Raeder, C., Wiewelhove, T., Kellmann, M., Meyer, T., Pfeiffer, M., & Ferrauti, A. (2016). J Electromyogr Kinesiol, 30, 73-80
Seitz, L. B., Reyes, A., Tran, T. T., Saez de Villarreal, E., & Haff, G. G. (2014). Sports Med, 44(12), 1693-1702.

EFFECTS OF EIGHT WEEKS OF BENCH PRESS AND SQUAT POWER TRAINING ON STABLE AND UNSTABLE SURFACES

ANTIC, V., RADOVANOVC, D., IGNJATOVIC, A.
FACULTY OF SPORT AND PHYSICAL EDUCATION - UNIVERSITY OF NIS

INTRODUCTION: Resistance training exercises under unstable conditions, such as with unstable devices have gained popularity in the past decade, and additionally, numerous studies have evaluated the role of instability in resistance training programs. In the literature, loads between 30% and 60% have been suggested as the loads that produce the highest values of muscular power in bench press output and 40-65% of 1RM in half squats. The load of 50% of 1RM should be considered reasonable for power enhancement on unstable surfaces, allowing proper techniques to be employed during the exercises, without any excessive anxiety about falling. The purpose of this study was to determine the differences in muscular strength and power outputs after eight weeks of stable and unstable resistance training.
METHODS: Seventy two male recreationally active subjects were divided into three groups . Unstable and stable training groups trained twice a week for 8 weeks. Each training session consisted of bench press and squat exercises <6 sets of 6 repetitions for each exercise>. In both conditions, all of the participants performed the exercises with their maximal velocity of movement during concentric phase with the load of 50% of 1RM. Pre and post-training measures included 1RM and peak power in stable and unstable conditions for bench press and squat.
RESULTS: The results showed that both training programs produced greatest power gains on the surface on which the training was performed. This specificity during testing indicated that strength gains were in part specific for the type of exercise velocity used in the training. Moreover, the results showed that there was a significant difference in main effects found with the training induced improvement between the training groups in pre- to post-test in squat 1RM, showing the transfer of specific unstable training exercises on 1RM squat. However, this was not the case in 1RM bench press. Additionally, both modalities produced significant training effects.
CONCLUSION: The findings of this study showed that explosive training with 50% of 1RM on unstable conditions was more effective regarding maximal strength in squat then in bench press exercises.

INFLUENCE OF DIFFERENCE COMPETITION LEVEL OF 400-M SPRINT ON 3-AXIS ACCELERATION OF CENTER OF GRAVITY

KATO, R., YOSHIDA, T., TAKESHITA, T., NORO, H., TAGURI, A., HATA, K., YANAGIYA, T.
GRADUATE SCHOOL OF JUNTENDO UNIVERSITY

INTRODUCTION: Maintaining higher running velocity in 400-m race is thought to be important for runners to achieve faster running. Hanon and Gajer (2009) had reported that the faster sprinter tends to lower the latter half speed, others had reported the faster sprinter suppress lowering the latter half speed. On the other hand, Christine et al (2009) had reported the faster sprinter suppress lowering the latter half speed. Moreover, Yamamoto et al (2014) classified the speed pattern of 400-m race as following 3 types, that is higher speed type in the former half, speed maintain type for all the race, and speed decline type in the latter half of the race. However, it is not known the race pattern related differences in the movement of center of gravity of runner during 400-m running. Therefore, the purpose of present study was to investigate the effect of athletic performance level on the motion of center of gravity using 3-axial accelerometer.
METHODS: Twelve male sprinters (age:19.2±1.16yrs, height:176.0±5.24cm, weight:67.31±3.95kg), their specialization event was 400-m or 400-m hurdle, were served as subjects of this study. After enough warming up, they ran for 400-m in all their effort from crouching start. They were divided into two groups, that is faster group and non-faster group. A wireless wearable 3-axis accelerometer is fixed on their waist by rubber belt, the direction setting of the vectors were as follows, vertical (x), medio-lateral (y), and anterior-posterior (z) during sprinting. Three-axial acceleration were recorded at 100Hz during 400-m sprint running. Digital video movies of sprint running were recorded by panning shot for the purpose of counting running times. Running time every 100m were measured by Doppler sensor.
RESULTS: Significant group difference was observed in 400-m sprint times between faster group (48.53±0.35 sec in faster group (n=6), and 51.69±1.09 sec in slower group n=6). Two way ANOVE revealed no main effect was obtained in acceleration among groups. On the other hand, main effect of distance was obtained in acceleration of vertical, anterior-posterior.
CONCLUSION: There was a significant difference between two groups in latter half section. Therefore, it is important to keep running speed in latter half section. In 3-axis acceleration, faster group showed higher impulsive force than non-faster group. And faster group showed lower upper force than non-faster group. Therefore, impulsive force is maintenance by reduce vertical motion. In 400-m sprint, the factor of high performance is running speed continuation in latter half section. Therefore, it is important to reduce up-and-down and to keep higher impulsive force.
REFERENCES :
(1). Hanon, C and Gajer, B : J.Strength Cond. Res,23(2):524-531 (2009)
(2). Christine Hanon and Brund Gajer : journal of strength and conditioning research, 23: 524-531 (2009)
(3). Kohei Yamamoto : Japan J.Phys. Educ. Hlth. Sport Sci. 59: 159 173, (2014)

PEAK POWER DURING SLEDGE PUSHING ON SKILLRUN(TM) TREADMILL CORRELATE WITH 15 M SPRINT PERFORMANCE

FEDELE, G.1, CUZZOLIN, F.1,3, ESSER HORSHAM, E.1, SENNI, S.1, ZANUSO, S.1,2, PAVEI, G.4
1 TECHNOGYM SCIENTIFIC DEPT, CESENA 2 UNIVERSITY OF COVENTRY, 3 UNIVERSITY OF PADOVA, 4 DEPARTMENT OF PATHOPHYSIOLOGY AND TRANSPLANTATION, UNIVERSITY OF MILAN

INTRODUCTION: Sledge towing is a common training modality in many track and field disciplines and team sports (Monte et al. 2017; Morin et al. 2017). This training is usually performed outdoors or indoors in large spaces, with the consequent weather and space limitations respectively. Recently, a new treadmill (Skillrun(TM), Technogym) with the capability to perform sledge pushing as well as walking and running was launched in the market. Treadmill output during pushing is the mechanical power and the maximal speed achieved.

The aim of this study was to test the correlation of the power output of the embedded pushing test with the performance parameters derived from the 15 m sprint test.
METHODS: Twenty-seven physically active male subjects (34.6±7.2 years old, 81.3±15.7 kg body mass, 1.79±0.07 m height; mean±SD) participated in this study. Subjects, after having familiarize with the testing procedures, visited the testing facility twice in two consecutive days at the same time of the day. On day 1, they completed the sledge test embedded on the treadmill: three 15 m maximal sprints on the passive treadmill pushing a sledge with a load corresponding to 50%, 70% and 90% of their body mass; each sprint was separated by 3 minutes of passive recovery. Peak power (W/kg) for each added load condition was recorded and the highest considered for comparison. On day 2, three 15 m sprints were performed indoor, with 3 minutes of passive recovery among sprints. Sprint speed over 15 m was recorded by photocells (Microgate Witty), the best trial was considered for comparison. Each sprint was videotaped by a GoPro6 camera at 120 Hz in order to calculate acceleration every two meters; maximal acceleration was considered for comparison. The video analysis was performed with Tracker software using vertical poles as references placed at 2-meter intervals.
RESULTS: Peak power output was 12.4±1.4 W/kg; for 66% of participants peak occurred at load =70% of body mass. Fifteen m speed was 5.79±0.27 m/s and maximal acceleration 10.7±2.2 m/s^2. Peak power correlated significantly with 15 m speed (Peak Power = 3.54*speed -8.116, with speed in m/s, R^2=0.472, p<0.01) and demonstrated a weak correlation with maximal acceleration in the 15 m sprint (Peak power = 0.344*acceleration +8.693, with acceleration m/s^2, R^2=0.274, p<0.01).
CONCLUSION: peak power evaluated with the sledge test embedded in the Technogym SkillRun correlates with the 15 m sprint performance test and could be used by coaches to evaluate sprinting capabilities directly on the treadmill. Thus, the improvement in peak power while pushing can be an effective method to evaluate training adaptations. The novelty of the power profile (and peak) during sledge pushing on the treadmill could also be a new valuable tool for coaches to prescribe training intensity.
References:
Monte A, et al. (2017). Int J Sports Physiol Perform, 12, 1052-1058
Morin JB, et al. (2017). Int J Sports Physiol Perform, 12, 840-844

COMPARISON OF PEAK POWER MEASURED IN A KEISER AIR POWERED LEG PRESS MACHINE, AND PEAK AND AVERAGE POWER OBTAINED IN A 30 SECONDS WINGATE ANAEROBIC TEST IN WELL-TRAINED CYCLISTS.

HAFSTAD, A., GUNDERSEN, H., IVERSEN, V., KRISTOFFERSEN, M.
WESTERN NORWAY UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: In cyclists, sprint performance and anaerobic power are commonly measured using a 30-second Wingate Anaerobic Test (WAnT). The aim of the present study was to compare peak power (PP) output in watt (W) measured in a Keiser air powered leg press (LP) machine, and PP and average power (AvgP) measured by a WAnT.
METHODS: Twenty-one well-trained cyclists (age: 29 ±6 year, bodyweight: 75.93 ±10.6 kg, VO2max: 61.3 ±5.8 ml/kg/min) were included in the study. Participants performed tests at three occasions: at baseline, and 4 weeks and 10 weeks after baseline. Prior to the baseline test, all participants had a familiarization session at the Keiser LP machine (A300, Modell 002531BA, Keiser Co. Inc., Fresno, California, USA) where 1-repetition maximum was obtained. At each occasion, all testing was performed over two days with a minimum of 48 hour in-between tests. At day one, a 10-step power profile in the Keiser LP machine was performed, in addition to a VO2max and lactate profile test. The second day a WAnT were performed as part of a 100 min cycling test on an electromagnetically braked cycle ergometer. The WAnT (load 80g/Kg) was carried out after 5 min cycling at 150 W, 5 min at 175 W and 5 min at the same power that gave a blood lactate concentration of 2 mmol/L (calculated individually from the lactate profile test).
RESULTS: Peak power values (W·Kg-1) obtained in the LP machine was 19.9 % higher compared with PP in the WAnT (17.47 ±2.67 W·Kg-1 vs. 14.57 ±2.42 W·Kg-1, p<.001) and 87.2 % higher compared with AvgP in the WAnT (17.47 ±2.67 W·Kg-1 vs. 9.33 ± 1.0 W·Kg-1, p<.001). There were significant correlations between PP obtained in LP (W·Kg-1) and in the WAnT (W·Kg-1) (r = .71, p<.001), and between PP in LP (W·Kg-1) and AvgP in the WAnT (W·Kg-1) (r = .70, p<.001).
CONCLUSION: Our results show that PP for well-trained cyclists measured in the Keiser LP machine are significantly higher than PP and AvgP measured in the WAnT. The correlation between PP in LP and PP and AvgP in the WAnT indicates that well-trained cyclists that produce high power output in a Keiser LP machine, also have the ability to produce a high PP and AvgP output in a WAnT.

DISTANCE RUNNING PERFORMANCE AND HIGH-INTENSITY RUNNING ECONOMY IN HIGHLY TRAINED FEMALE DISTANCE RUNNERS

TANJI, F.1, NABEKURA, Y.2
1: JAPAN INSTITUTE OF SPORT SCIENCES , 2: UNIVERSITY OF TSUKUBA

INTRODUCTION: Distance running performance can be estimated by physiological variables: maximal oxygen uptake and running economy . In particular, RE is more important than VO2max in highly trained athletes. Moreover, RE measured at an intensity above the lactate threshold is demonstrated to be strongly related than RE measured at an intensity below the LT . However, this has not yet been reported in female runners. Both aerobic and anaerobic energy metabolisms contribute to the energy metabolism during track events; however, women have a lesser anaerobic capacity than men. Hence, it is unclear whether REaLT and/or anaerobic capacity are essential for female distance runners. This study aimed to reveal the association between the distance running performance and physiological variables, including both the REaLT and anaerobic capacity, in highly trained female distance runners.
METHODS: This study included 26 female distance runners participated in this study. They underwent multi-incremental running tests on a treadmill to assess the aerobic [RE at 15.0 km·h−1 as REbLT and at 16.2 km·h−1 run as REaLT, VO2max, and LT] and anaerobic [maximal blood lactate concentration] capacities.
RESULTS: There was a significant association between the IAAF score and RE15.0 and Lamax but not with RE16.2 , VO2max , and LT . Furthermore, 76.8% of the difference in the IAAF score could be explained by RE15.0 , Lamax and VO2max . However, RE15.0 and RE16.2 showed an inverse association with VO2max.
CONCLUSION: The main finding of this study is that not REaLT but both superior REbLT and Lamax are essential for distance running performance in highly trained females, and high VO2max seems to be a precondition for them. However, runners with a high VO2max tend to have lower RE, suggesting that it is difficult to achieve superior both VO2max and RE. Distance runners should not only focus on improving REbLT but also on maintaining VO2max training.
REFERENCES:
Ingham SA, Whyte GP, Pedlar C, Bailey DM, Dunman N, Nevill AM. <2008> Med Sci Sports Exerc, 40: 345-350.

Tanji F, Shirai Y, Tsuji T, Shimazu W, Nabekura Y. <2017> J Phys Fitness Sports Med, 6: 41-48.
CONTACT: fumiya.tanji@jpnsport.go.jp

THE BLOOD LACTATE RESPONSE TO ANAEROBIC SWIMMING SETS

MOUGIOS, V., KABASAKALIS, A., NIKOLAIDIS, S., TSALIS, G.
ARISTOTLE UNIVERSITY OF THESSALONIKI

INTRODUCTION: Blood lactate is considered the gold standard for assessing the metabolic profile of training sets. In competitive swimming, a plethora of training sets is recommended for anaerobic metabolism enhancement. However, data on the blood lactate concentration after such sets are scarce. Thus, the aim of this study was to bring together our experience on the blood lactate response to anaerobic swimming training sets and translate this experience into practical guidelines.
METHODS: A total of six investigations, including training sets differing in terms of distance per bout (25 to 100 m), total distance (200 to 400 m), and work-to-rest ratio (1:1 to 1:9), were assessed. A total of 155 competitive male and female swimmers, aged 12 to 20, participated in these investigations.
RESULTS: Large increases in blood lactate were achieved with all sets, although they were highest after sets of 50 and 100 m (not 25 m) bouts with work-to-rest ratios ranging from 1:7 to 1:9. Mean (SD) post-exercise lactate concentrations ranged from 9.2 (3.0) to 18.5 (2.7) mmol/L. Effect sizes were high, ranging from 3.3 to 5.0. Where a test-retest design was used, swimming speed and blood lactate concentrations were highly reproducible (intraclass correlation coefficients being > 0.9 for speed and > 0.7 for lactate). A significant correlation between speed and lactate was found in the minority of cases and was rather weak (r ranging from 0.45 to 0.59).
CONCLUSION: Training sets with bouts of 50 or 100 m and long rest intervals are suitable for inducing top blood lactate concentrations. It is then up to the coach to use the set that best fits the specific aims of a training session; for example, either pursue the enhancement of anaerobic metabolism through high lactate concentrations or work with lactate levels closer to those achieved during competition (Vescovi et al., 2011). The anaerobic training sets evaluated exhibit low day-to-day and time-of-day variability. Thus, using and comparing training sets at different time points is fairly safe. Finally, since swimming speed can explain only a small part of the variability in blood lactate, other factors, like stroke rate (Morouço et al., 2017), must be considered in order to explain the metabolic cost of swimming training sets.
REFERENCES:
Morouço PG, Barbosa T, Arellano R, Villas-Boas JP. (2017). Int J Sports Physiol Perform, doi: 10.1123/ijspp.2017-0223, e-pub ahead of print.
Vescovi JD, Falenchuk O, Wells GD. (2011). Int J Sports Physiol Perform, 6(1), 106-117.

EVALUATION AND COMPARISON OF AMATEUR RUNNERS' CRITICAL SPEED AND RUNNING SPEED IN A 10-KM RUNNING RACE

RIBEIRO, H., KELLY, L., BARROSO, M., CORREA, H., MAYA, A., CUNHA, V., BAIÃO, V., FERREIRA, A.
CATHOLIC UNIVERSITY OF BRASÍLIA

INTRODUCTION: By the increase in the number of amateur runners, understanding race speed has become important to the definition of running strategy and the ideal training throughout the preparation period, especially through tests of easy application, low cost and good accuracy (Gomez-Molina et al, 2017; Knechtle et al, 2016). Thus, the present study aimed to evaluate and compare critical speed (CS) and running speed in a 10-km running race (RR) in amateur runners.
METHODS: A cross-sectional study has been performed in 34 runners of both genders (42.4 ± 11.0 years old). Participants underwent anthropometric evaluation and CS determination using distance/time in 400 and 2,000m tests on an official athletics track, in addition to performing an official 10-km RR. In order to analyze the reproducibility between the speeds established in the 10-km RR and the CS, the Intraclass Correlation Coefficient (ICC) and the Cronbachs Alfa were calculated.
RESULTS: We have found a VO2MAX of 49.5±8.1 ml/kg/min and 45.9 ± 7.3 minutes to the 10-km RR. The CS delta analysis overestimated the running speed by 0.55km/h, with Total Error = 0.97 and Standard Error of Estimation = 0.29. The agreement and reproducibility between the speeds was CCI = 0.93 (0.86 - 0.96) and Cronbachs Alpha = 0.96.
CONCLUSION: It has been verified good agreement and reproducibility between the speeds determined by the CS with the real time of a 10-km RR, presenting values considered excellent. Our results corroborate the findings of Santos et al. (2012) study, which associated the VO2MAX and CS with the performances in different surfaces tests in both genders, being noticed that CS was high and significantly associated with all evaluated distances in the study, proving to be an adequate predictor of aerobic performance. Therefore, we conclude that CS determined on a track with only two distances (400 and 2,000 m) was valid to estimate the running speed of 10-km.

EFFECTIVENESS INDEX OF MECHANICAL ENERGY UTILIZATION IN 400-M RACE

TAGURI, A., KATO, R., TAKESHITA, T., NORO, H., YOSHIDA, T., HATA, K., YANAGIYA, T.
GRADUATE SCHOOL OF JUNTENDO UNIVERSITY

INTRODUCTION: Running efficiently is important for distance runners to run faster. Effective Index (EI) is known as the index of availability of mechanical energy during running, and Enomoto et al. (1999) reported that the faster 5000-m race time, the higher EI was. On the other hand, increasing maximal running velocity is thought as necessary for sprinters to run faster. However, not only higher sprint running speed but also adequate pacing distribution is thought as important to run with higher performance in 400-m race. Therefore, evaluation of running efficiency may also effective to run with higher performance in 400-m race. Therefore, evaluation with EI may also effective to run with higher performance in 400-m race. So, the aim of present was to evaluate 400-m running in the point of view of EI.
METHODS: Subjects were 2 male 400-m sprinters and 2 male 400-m hurdlers (age:19±1.1yrs, height:1.74±5.1m, weight:65.4±3.8kg). They ran 400-m after enough warm up. Running motion was captured with digital high-speed video camera at 240fps from sagittal plane around 150-m and 350-m points. Captured running motion were digitized with motion analysis software. Kinematic variables were calculated and EI was computed by equation. 400-m sprint times were measured by photo determination device.
RESULTS: Higher EI runners showed higher running velocity and faster 400-m times than lower EI runners. Running velocity around 150-m point was higher than 350-m.
CONCLUSION: Results suggest that increasing EI is important for 400-m running. Value of mechanical work is used for calculating EI, therefore examination of differences in running motion is necessary to clarify factors which affect EI.
REFERENCES:

Enomoto Y, Ae M, Fujii N, Okada H. (1999). Jpn J Biomech Sports Exerc, 3 (1) : 12-19.

Conventional Print Poster

CP-PM20 Coaching and development of performance

PROFICIENCY ASSESSMENT OF ADOLESCENT MALE VOLLEYBALL PLAYERS AT ESTONIAN CHAMPIONSHIPS IN 2017

STAMM, R., STAMM, M., TUULA, R.

TALLINN UNIVERSITY

INTRODUCTION: In order to gain maximum experience from competitions, games have to be recorded and players' proficiency has to be analysed (Silva, M. et.al., 2014). The aim of the present study was to find which technical elements were performed significantly better by the winners of sets at the Estonian championships for boys; which activities led to winning of sets.
METHODS: The material consisted of young male volleyball players aged 13–15 years from eight most successful volleyball teams who participated in Estonian Championships in Kiili in 2017 (round-robin system). The proficiency of all the boys was recorded; a total of 28 games were played. Each player's indicators were summed up separately in sets won and lost. The number of boys in sets won was 65 and in sets lost 61. The means and SD of performance of technical elements separately in sets won and sets lost and the value of $p<0.05$ or statistically significant difference between the means were calculated.
RESULTS: At attacks, statistically significant differences between the winners and losers appeared in the number of spikes into the block, total number of spikes and index of proficiency. There were no statistically significant differences in the number of successful spikes and in the number of spikes that remained in play. In serves, there were statistically significant differences in ace serves and difficult serves, in the percentage of difficult serves from the total and the proficiency index of serves. There were no differences in the results of the sets won and the sets lost, in serve errors and weak serves. In reception, there were statistically significant differences in reception errors and the index of proficiency; there were no differences in good and very good receptions. In block, there were no significant differences at all between the winners and the losers, and in defence, there were differences only in the total number of balls played in defence.
CONCLUSION: In children of this age, statistically significant differences appeared in the number of spike errors, not in the number of attacks won. This shows that, to win a set, fewer errors should be made at attack. As for serves, stronger serves should be used more bravely, and the players should not to be afraid of errors, as there were statistically significant differences in ace serves and difficult serves, but not in serve errors or weak serves. Attempts should be made to avoid weak receptions or reception errors. Block did not decide the results of sets. In defence, an attempt should be made to receive more balls, if one wants to win the set.
REFERENCES:
Silva, M.; Lacerda, D.; Joao, P.V. 2014. Game-related volleyball skills that influence victory. Journal of Human Kinetics.
CONTACT: [raini@tlu.ee]

THE DEVELOPMENT OF A HEALTH AND WELLBEING CONCEPTUAL FRAMEWORK AND MEASUREMENT INSTRUMENT IN PROFESSIONAL RUGBY

CHEN, Y., BUGGY, C.J., KELLY, K.

UNIVERSITY COLLEGE DUBLIN

Introduction: Considerable media attention has recently focussed on an increased number of rugby players that have experienced forced retirement due to severe unanticipated injuries. Surprisingly, despite the special employment nature of professional athletes and the unique features of sport culture, no occupational health conceptual framework or related measurement instrument exists in professional sport. In response to this concern, and having regard for possible concerns regarding the application of an occupational health conceptual framework in elite sport, this research is focussed upon the design and development of a health and wellbeing conceptual framework customised to the needs of professional rugby. More specifically, the design of a questionnaire for measuring occupational health values among professional rugby players is proposed, the application of which, if successful, could point the way forward for application in a wider range of sports internationally.
Methods: After reviewing research literature, structured protocols for focus groups and interviews will be designed for qualitative data collection. The population will consist of players registered in professional rugby clubs and will also include the support staff who are involved in the health and wellbeing of rugby players. The questionnaire developed will initially be applied to Irish professional rugby players and subsequently will be applied to a cohort of full-time state supported professional rugby players in China. The responses of each cohort will be compared and contrasted in the context of the two countries socio-economic and political systems and recommendations made for the implementation of an appropriately designed and effective framework.
Results: This poster will present the development of the framework and structured interview instrument including data from a pilot study, possibly with data from the initial interviews and focus groups. Data will show the categorised factors influencing rugby players' awareness of health and wellbeing.
Conclusion: This study aims to utilise the occupational health conceptual framework in the development of a health and wellbeing framework for professional sport, especially rugby. The framework developed will then advance to the design and validation of a quantitative instrument for testing of the conceptual framework.

CULTURAL IDEOLOGIES IN SPORT AND THEIR EFFECTS ON TEAM COHESION AND PERFORMANCE

OTTEN, M.P., LEON, A., GRIFFITHS, M.

CALIFORNIA STATE UNIVERSITY, NORTHRIDGE

The present research investigated cultural ideologies and their effect on team cohesion within a sport setting. Past research has focused on cultural ideologies in business but not sport settings, and studies on diversity in sport have not looked at teams through a cultural ideology lens. Therefore, the current study looked to address those gaps in previous research of cultural ideologies and cohesion in sport. The first hypothesis was that a team with one of two cultural ideologies would have better cohesion than a team with no cultural ideology. It was also hypothesized that team cohesion would act as a mediator between cultural ideology and team success.

Participants (n = 97, in progress; projected n = 200) were a culturally diverse sample of students that were recruited from a local university. Upon arrival, participants were asked to form together as a team of four players and given the team goal, which was to have every member of the team pass the ball (without allowing it to touch the ground) to a different teammate before scoring a basket. Each team member was to score twice, as quickly as they could. A modified Group Environment Questionnaire (GEQ) was used to measure team cohesion across three conditions (colorblind, multicultural, and control). Written prompts, unique per condition, were read by participants and adapted from previous research. A colorblind prompt highlighted the idea that players should come together as a team, regardless of background. A multicultural passage argued that having many cultural groups represented on a team could be a great asset. A control prompt highlighted cohesion and how it is important and can be applied to sport. Performance variables (e.g., task completion time) were then compared across conditions.
The results (in progress) indicate partial support of the hypotheses, showing a relationship between condition and performance, but no mediation by cohesion between cultural ideologies and performance. For these analyses, cultural ideologies (colorblindness and multiculturalism) were combined as a single condition to compare against the control. Thus far, analyses suggest that both 1) having been presented a cultural ideology and 2) higher levels of cohesion were each significant predictors of better performance. These analyses showed that being prompted with a cultural ideology was not a significant predictor, however, of cohesiveness within the team.
The results have positive implications for cultural ideologies and their effect on the team and performance. The hope is that the current sample better represents the diversity of an international league, thus improving upon the external validity of past studies. The influence that cultural ideologies have on cohesion and performance may be important for anyone trying to manage or form a team (e.g., a general manager). A manager might not only consider the diversity of the team, but also how diversity is approached and managed within the team.

NOTATIONAL ANALYSIS OF ELITE BADMINTON SERVICE AND SCORING STRATEGIES IN WOMEN'S SINGLES EVENT

CHO, P.P., LIU, Y.T.

NATIONAL TAIWAN SPORT UNIVERSITY; NATIONAL TAIWAN NORMAL UNIVERSITY

NOTATIONAL ANALYSIS OF ELITE BADMINTON SERVICE AND SCORING STRATEGIES IN WOMEN'S SINGLES EVENT
Cho, P-P.1, Liu, Y-T.2,
1: NTSU (Taoyuan, Taiwan), 2: NTNU (Taipei, Taiwan)
Introduction: Badminton is a racket sport that is characterized by bouts of repetitive movements with medium to high intensity (Lees, 2003). Recording and analyzing shots played in the badminton games provides technical and tactical information of the games. The purpose of the study was to examine the service strategies and scoring strategies of the elite badminton players in women's single event. A notational analysis of the service and scoring strategies was used in the finals of the 2017 All England Open Badminton Championships and the 2017 Badminton Asia Championships.
Methods: One hundred and four rallies were analyzed. Two observers used Simi Scout game analysis system to record the data that include scores, player, type of shots, hitting positions on court, and the results of the rally. Cohen's Kappas for the inter- and intra- observer reliability tests were all above 0.85. Chi square tests of independence and goodness of fit were used for data analyses.
Results: The results showed a significant association between types of serves and serve receptions, $\chi 2(4)=103.00$, $p<.001$, Cramer's V=1.00, where the high serves (86%) were mostly followed by the smash receptions. The type of shots also had a significant association with the rally results, $\chi 2(6)=28.91$, $p< .001$, Cramer's V=.53, the smash shots contributed to the most scores whereas the underarm clears contributed to the most faults that resulted in scoring for the opponent. The type of shots that committed faults had a significant association with the type of faults, $\chi 2(6)=34.32$, $p <.001$, Cramer's V =.57, the underarm clears had the most landing out of bounds whereas the remaining faults were mainly from net shots. The analysis of the type of shots that leading up to the opponent's fault showed a significant difference, $\chi 2(6)=26.97$, $p <.001$, where the net shots had the highest percentage followed by the overhead clears and underarm clears.
Conclusion
The finding that the high serves were mostly followed by smashes supports the common concept that high serves in badminton are considered a defensive strategy. The high serves, however, were still the most frequently used type of serves in elite women's single event. The smash shots in women's singles contribute to the most direct scoring results, which are consistent with those observed in the men's singles (Abián et al., 2014). In addition, the net shots had the highest rate leading up to the opponents' fault also contributes to scoring indirectly.
References: Abián P, Castanedo A, Feng XQ, Sampedro J, Abian-Vicen J. (2014). International J Performance Analysis in Sport, 14(1), 42-53.
Lees A. (2003). J sports sc, 21(9), 707-732.
Contact: 1050402@ntsu.edu.tw. Pei-Pei Cho

THE RELATIONSHIP BETWEEN PHYSICAL AND PHYSIOLOGICAL CHARACTERISTICS AND SIMULATED ARTISTIC SWIM PERFORMANCE.

VIANA, E., FERNANDES, E., LANGFORD, K., KOPTIE, J., BENTLEY, D., SPRENGER, H.

CANADIAN SPORT INSTITUTE ONTARIO

INTRODUCTION: The purpose of this study was to examine the relationship between laboratory performance testing and the results of a simulated ('solo') artistic swimming competition. Highly trained artistic swimmers (n=12, 15.8 ± 0.8 yrs) who were members of a provincial level program completed a series of laboratory and pool-based testing, as well as a simulated competition where artistic swimming 'elements' were evaluated by three trained adjudicators
METHODS: The testing used included (1) a maximal incremental cycle test to exhaustion to determine peak oxygen uptake (VO2peak), (2) a vertical jump (VJ) test for height (cm) (3) the number of pike crunches in 30 sec as a measure of abdominal endurance (4) A pool based tested was performed comprising a 275m swim (overall swim time) containing underwater swimming, freestyle and other form strokes to simulate the length of an artistic swimming competition. Blood lactate (BLA) concentration (mM) was determined 3 min after the swim test and simulated competition using a portable lactate analyser (L-Lactate Pro). The 'boost' and 'barracuda' movements were performed before and after the 275m swim test and the change (delta, Δ) determined.
RESULTS: There were no significant relationship between VJ height (23.9 ± 2.6 cm) and any elements or overall performance during the simulated competition. There was also no significant correlation (r=0.13 to 0.28) between VJ height and pre swim boost (13.45 ± 3.38cm), pre swim barracuda (24.72 ± 7.5cm), post swim boost (11.2 ± 2.4cm) and post swim barracuda (25.9 ± 7.1 cm). VO2peak (48 ± 4 mL. kg.-

1min-1) was positively correlated with six of the nine group elements (R=0.60, r=0.60, r=0.66, r=0.66, r=0.69, r=0.66, p<0.05), the overall performance score (r=0.59, p<0.05), and one of the five solo elements (r=0.59, p<0.05). The BLA obtained three minutes after the simulated competition (8.73 ± 2.07mM) revealed significant negative correlation to all elements during the simulated competition (r=-0.60 to 0.78; p<0.01). There was a decrease in boost (13.4 ± 3.4 vs 11.2 ± 2.4 cm) but not barracuda (24.7 ± 7.5 vs 25.9 ± 7.1 cm) height after the 275m swim. The 275m swim time (181 ± 13 sec) and the heart rate (t .min-1) (172 ± 10) were negatively correlated to overall performance score in the group elements (r=-0.59, r=-0.69 respectively, p<0.05). The lactate concentration measured after the 275m swim (7.19 ± 1.91 mM) was positively correlated with the change in boost height (-0.99 ± 10.85cm) before and after the 275m swim (r=-0.76, p<0.01).
CONCLUSION: These data indicate greater aerobic fitness together with lactate metabolism is correlated with higher scores during simulated artistic swimming competition. In contrast, performance of two important components (boost and barracuda) before and after a 275m swim was not related to any competition elements. Concurrent training for artistic swimming might include a focus on improving aerobic capacity via in water and dryland methods of training.

EVOLUTION OF PEAK PERFORMANCE IN ELITE JUNIOR TO SENIOR FEMALE TRIPLE JUMPERS

NIESSEN, M., HARTMANN, U.

UNIVERSITY LEIPZIG - FACULTY OF SPORT SCIENCE

INTRODUCTION: The female triple jump (TJ) is a young, motion tech- and physically demanding discipline in competitive athletics, starting 1991 at indoor World Championships (WC). After quick improvements the performance evolution in elite TJ seems to stagnate, and the youth world best, junior & senior world records outdoor are untouched since 21-23 yrs. Its questionable whether success at World Youth (WYC) & Junior Championships (WJC) are a criterion for achievements as senior athlete in WC & Olympic Games (OG). Aim is to investigate the competitive success and performance improvement in elite female junior to senior triple jumpers.
METHODS: The data were extracted from a renowned database (www.iaaf.org) through 12/2017. Competition results of finalists (1st-8th place) at WYC (1999-2017; n=80), WJC (1998-2016; n=80), WC (1993-2017; n=104) and OG (1996-2016; n=48) as well as profiles of legally achieved outdoor season bests (SB) of TJs personal bests (PB) ≥15m (G1; n=25 athletes) and of selected finalists of above mentioned champs with PB between 14.50-14.99m (G2; n=41), 14-14.49m (G3; n=40), 13-13.99m (G4; n=70) and <13m (G5; n=11) were empirically analysed. Comparisons of selected age groups, of athletes careers (AC) and champs were made.
RESULTS: The above mentioned champ-final results did not alter significantly within the last 25yrs, except for OG. They showed a low sig. short-term performance increase in 2004. A total of 21 senior G1 won at least 48 medals at WC & OG; 2 of them were elite juniors (2 medals). The AC of G1-5 showed negative quadratic trends with sig. longer AC for G1 & G2. Age at peak competitive performance was 27.1±2.7yrs (G1), 25.4±3.2yrs (G2), and <21yrs (G3-5) ($F(4,307)=79.5$; $p\leq0.001$). G1 attained the PB distance (increase from first world-listed performance: +1.5±0.8m) within 6.3±3.9yrs, sig. earlier than for elite male TJ and G4 ($T(37)=3.7$; $p\leq0.001$). The attrition rate of 9 WYC & 4 WJC medallists was 22%. They reached a PB of 14.0±0.5m within 2.5±1.5yrs after medal success and ended AC near entering age group under 23yrs after 5.8±2.0yrs.
CONCLUSION: The probability of the transition to senior performances (G2) was greater if the junior athlete won a medal. WYC & WJC could be an initiate for entry into elite TJ. But also >64% of G1 were late entrants or sub-elite juniors. The increasing age of WC & OG medallists as well as long ACs till 22 yrs appear to be due to changes in societal expectations & climates and better physical precondition. Maturation in peak performance age in women brought them closer to the peak performance age of male athletes. Further research is needed to accompany athlete's long-term development pathway and identify qualitative factors to extent carefully the TJ performance in women.

SUPERIOR TRAINING SPECIFIC ADAPTATIONS WITH AN 8-WEEK YOAK PUSH-UP TRAINING PROGRAM

LIMA, C., LI, Y., LOW, J., HERAT, N., BEHM, D.

MEMORIAL UNIVERSITY OF NEWFOUNDLAND

INTRODUCTION: There are few progressive metastability training programs in the literature. The purpose of this study was to investigate changes in strength, endurance, muscle activation and neuromuscular efficiency after an 8-week progressive, push-up training program under stable and unstable conditions.
METHODS: Nineteen male and female recreationally-trained participants performed a twice per week, 8-week push-up training program, using either a relatively unstable suspension system or under stable conditions. Participants were tested in two separate sessions pre- and post-training for maximal voluntary isometric contraction , and unstable and stable push-up endurance. Participants were tested during all testing measures for anterior deltoid , biceps brachii , triceps brachii and serratus anterior electromyography activity. The training progression consisted of altering the suspension configurations, push-up height and increasing the number of sets <1-3 sets>.
RESULTS: Both groups increased the number of push-up repetitions by 56% with a greater number of push-ups performed during stable testing condition. The stable trained group when performing push-ups on the Yoak suspension system performed 153.3%, and 33.8% less repetitions than the Yoak trained group when performing push-ups on the Yoak or on the stable floor respectively . Both groups increased MVIC forces <4.8%; p<0.05> from pre to post training. However, the Yoak MVIC forces exceeded the stable group by 9.2% . For neuromuscular efficiency Yoak group decreased <30.4%; p=0.01> and stable group increased <97.8%; p=0.02> BB EMG activity from pre to post-training. AD and SA EMG activity decreased for Yoak group for both testing conditions. Only the stable group decreased <62.2%; p=0.04> SA EMG activity after the Yoak push-ups testing condition. Both training groups demonstrated decreases with the TB fatigue index from pre- to post-training. Nevertheless, Yoak group demonstrated 12.5% and 8.9% lower fatigue index with TB and SA respectively than the stable group.
CONCLUSION: These findings suggest that Yoak training demonstrates superior improvements over stable training for push-up endurance, neuromuscular efficiency, MVIC and fatigue index.

LATERALITY IN BOULDERING: INSIGHTS INTO THE RELATION BETWEEN SIDE DOMINANCE AND PERFORMANCE CAPACITY

DE SOUZA SILVEIRA, R., BLANKE-SCHELLE, R., WIGGERS, N., JULIAN, R., EILS, E.

UNIVERSITY OF MÜNSTER

INTRODUCTION: Side dominance has been suggested to be a determining factor when it comes to sport-specific performance. To date however, there is little evidence on laterality aspects during climbing activities. Therefore, the aim of the current investigation was to assess the relation between side dominance and parameters of strength and endurance capacity during bouldering.
METHODS: 17 right-handed recreational bouldering athletes were assessed on 3 different appointments (48 h pause between days). Day 1, baseline values for grip strength, campus-board propelled reach, and hanging endurance (isometric dead-hang) were collected. During days 2 and 3, participants were randomly assigned to either a dominant right (RB) or a left boulder (LB), and then attempted maximal amount of ascents with 15 sec pause between attempts. The routes consisted of 11 identical (mirrored) movements and holds were set on a 9° overhanging climbing wall. Boulders were set to stimulate each body side as equally as possible. At the end of each boulder bout the measurements performed at baseline were repeated. To determine the differences between all test parameters a paired t-test was implemented ($\alpha = 0.05$) and effect sizes were calculated. All values are presented as mean ± SD.
RESULTS: There were no significant differences in the average amount of boulder ascents 49 ± 47 (RB) and 45 ± 33 (LB). Grip strength (right and left) significantly differed after the RB bouts 38.5 ± 8.0 and 35.6 ± 6.9 kg respectively (P = .007). However, after the LB bouts there were no observed differences 35.0 ± 7.3 and 34.7 ± 7.5 kg (P = .869). Right hand grip strength differed significantly after the LB bouts in comparison to RB (P = .016), with a moderate effect size of .45 and reduced 42 % when compared to baseline. Right hand propelled reach on campus-board was 89.1 ± 14.9 (RB) and 86.4 ± 15.8 cm (LB) (P = .073). Similarly, left hand propelled reach was 90.0 ± 13.8 (RB) and 87.0 ± 17.6 cm (LB) (P = .314). Isometric dead-hang lasted for 45.2 ± 9.9 and 42.2 ± 14.8 sec after RB and LB respectively (P = .180).
CONCLUSION: Throughout the results, common trend was observed that the LB bouts evoked a decrease in values in comparison to baseline (especially for the dominant side) for grip strength, campus-board propelled reach, isometric dead-hang and number of ascents. These findings are indicative of a higher effort when bouldering on the non-dominant side. The current findings also underline the necessity to focus training/strengthening strategies on the non-dominant side when aiming to reduce fatigue, improve strength symmetry between sides and potentially improve performance capacity when bouldering on the non-dominant side. Future analyses should look at objective aspects of fatigue (e.g. blood lactate build up, heart rate and blood-born inflammatory markers), and with that offer a broader interpretation of the relation between laterality and performance capacity during climbing activities.

Conventional Print Poster

CP-PM21 Combat and winter sports; other sports

PHYSIOLOGICAL RESPONSES ON TRAINING AND COMPETITION LOAD IN KARATE KATA DISCIPLINE

CIERNA, D., BARINEC, P.

COMENIUS UNIVERSITY

INTRODUCTION: Blood lactate measurement is one of the most frequently used procedures of indirect load intensity evaluation, regeneration level and prevailing energy metabolism.
METHODS: Our research focused on the physiological response to training and competition load of three Slovak kata female national team members (17.3±0.6 years old, 161.7±7.4 cm, 55.7±1.2 kg). Competitors participated in model training and 5 competitive kata rounds. Blood lactate was measured after each round in the 4th minute of recovery. Heart rate values were measured by Polar H7 device connected to Polar Beat application, blood lactate values were measured by Accutrend device made by Accusport.
RESULTS: Wilcoxon T-test proved that maximum heart rate is higher in competition (190±3.6, T=p≤0.01) compared to training (178±9.4). Friedman Anova did not prove significant mean heart rate increase with progressing competition rounds (p=0.5). Blood lactate level in individual katas is higher (p=0.39) in competion (5.7±2.2) compared to training (5.2±1.8). Blood lactate does not increase significantly with progressing rounds in competition and in training (p=0.294). Kata load is considered to be continual ($\overline{p}$=2:17±0:37), with quick and slow techniques alternation, which makes this load intermittent.
CONCLUSION: Load intensity and prevailing energy metabolism in kata is influenced by kata length, quick to slow techniques ratio, fighting determination, volition effort of competitors, quality of competitors and competition importance. We recommend regular intensity load monitoring during trainings, especially in high-performance training and increasing functional reserves of the organism in intensification and transformation period by means of intermittent load (building lactate resistance).

PHYSIOLOGICAL DEMANDS OF AN INTERNATIONAL TAEKWONDO COMPETITION

MCLAUGHLIN, A., LANGAN-EVANS, C., SADLER, D., MORTON, J.P., LOUIS, J.

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Taekwondo is an Olympic combat, intermittent sport (Bridge et al., 2014). A limited number of studies have investigated the physiological demands of international competition (Bridge et al. 2009). However, these studies were carried out prior to the 2008 Beijing Olympics when the rules of Taekwondo were changed marking the data ecologically invalid. Therefore, we aimed to profile the physiological demands of modern Taekwondo competition at a 2018 international Taekwondo event.
METHODS: 10 Taekwondo athletes (8 male, 2 female) took part in an international Taekwondo competition. Each combat included three 1 min 30 s rounds with 30 s recovery between rounds. Body mass (BM) was measured at the official weigh in (day prior to competition). BM and hydration status were measured fasted on the morning of and immediately after competition. Heart rate (HR) was recorded at 1 sec intervals during each fight. Capillary blood lactate samples were taken from the fingertip no more than 10 min before the fight commenced and immediately after each round. Athletes' rating of perceived exertion (RPE) was recorded for each round using Borg's 0-to-10 scale.
RESULTS: Athletes were tested during 24 fights in total with a bronze and silver medal attained and two QF finishes. BM increases represented 2.84 ± 1.18 kg from weigh in to the morning of the competition and an increase of 1.16 ± 0.91 kg on the day of competition when

heavyweight athletes were removed (n = 3). Mean urine osmolality was 862 ± 165.78 mOsm L-1 and 585 ± 275.32 mOsm L-1 on the morning of and on completion of competition. Mean blood lactate values did not change significantly between pre- and post- (2.04 ± 4.33 vs 2.80 ± 0.88 mmol.L-1) warm up measures. In-fight mean blood lactate values were 3.01 ± 0.86 mmol.L-1 pre-fight, 9.85 ± 4.8 mmol.L-1 after round 1, 13.73 ± 3.70 mmol.L-1 after round 2 and 15.94 ± 4.38 mmol.L-1 after round 3. The mean increase in blood lactate between pre-fight and round 1 was 6.85 ± 4.64 mmol.L-1, between round 1 and round 2 was 3.88 ± 3.05 mmol.L-1 and between round 2 and round 3 was 2.21 ± 3.24 mmol.L-1. Mean RPE scores for round 1, 2 and 3 were 6.32 ± 1.76, 7.48 ± 1.54 and 8.52 ± 1.53, respectively. **HR data is still being analysed but will be presented in July
CONCLUSION: International-level Taekwondo competition elicited near-maximal cardiovascular responses and high blood lactate concentrations and perceived intensity which increased across rounds and thus places a high demand on aerobic and anaerobic metabolism. Furthermore, contemporary Taekwondo appears to produce higher anaerobic lactic contribution and perceived intensity than the erstwhile variety which will inform training practice.

ANALYSIS OF THE MARTIAL ARTS POSTURE KAMAE WITH H-REFLEX

HASEGAWA, K., NAKAJIMA, T., KANOSUE, K.

1> GRADUATE SCHOOL OF SPORT SCIENCES, WASEDA UNIV., SAITAMA, JAPAN. 2> FACULTY OF MEDICINE, KYORIN UNIV., TOKYO, JAPAN. 3> FACULTY OF SPORT SCIENCE WASEDA UNIV., SAITAMA, JAPAN.

INTRODUCTION: In martial arts there is a unique posture, "Kamae", which can be shifted quickly to both defense and offense. It is important to understand the mechanisms of Kamae for coaches and athletes to master this posture appropriately. In the present study, we focused on the effect of Kamae on the characteristics of spinal H-reflex, which is an important reflex for postural control.
METHODS: Subjects were 8 sumo wrestlers from a university team having experiences of sumo more than 10 years. The posterior tibial nerve of the dominant leg was electrically stimulated with a single pulse (pulse width 200 μs, intervals 3 s). H- and M-waves were obtained from the EMG of the soleus muscle. The recruitment curves of the two waves were built by increasing stimulus intensity. The maximum H-wave amplitude was normalized with the maximum M-wave amplitude (%Hmax). The tibial nerve stimulation was applied when subjects kept three different postures, quiet standing, Kamae with an image of a real match (Kamae-image) and Kamae without the image (Kamae-no image). For Kamae-image subjects were instructed to have an image to react to an opponent's attack as quickly as possible. We compered %Hmaxs among those three postures.
RESULTS: In 6 out of 8 subjects, the %Hmax was highest in the Kamae-image task. To the contrary, the %Hmax was smallest in the standing task in 6 out of 8 subjects.
The averages of %Hmaxs were 48 ± 16 % in the standing task, 55 ± 15 % in the Kamae-image task, and 53 ± 14 % in the Kamae-no image task. The %Hmax of the Kamae-image task tended to be higher than that of the standing task (p = 0.062).
CONCLUSION: The %Hmax is an index of spinal excitability (S. Grosprêtre et al. 2012). According to the present results, the image and posture of Kamae tended to increase spinal excitability. Since the motor imagery alone doesn't affect H-reflex(B. Hale, et al. 2003), the enhancement of H-reflex might be caused by the combination of the specific posture and the imagery of preparing at an opponent's attack. The long years of practice might cause this effect.

TIME-MOTION ANALYSIS OF ELITE MALE PENCAK SILAT FIGHTERS

JOEL, P.1, JACKY, S.2, AZIZ, A.R.1, FRANKIE, T.1, IHSAN, M.3

1: SINGAPORE SPORT INSTITUTE (SINGAPORE), 2: NATIONAL INSTITUTE OF EDUCATION (SINGAPORE), 3: ASPETAR (DOHA, QATAR)

INTRODUCTION: Pencak Silat is a South-East Asia martial art that has grown in popularity over the last decade. Combat Silat matches are point based and comprise of three 2 min rounds with 1 min rest between. Despite its popularity, data examining the physical and physiological demands of competition is limited. Increased understanding of such demands would enable optimisation of sport-specific training programs and consequently Combat Silat performance. Therefore, this study aimed to 1) examine the physical and physiological demands of elite male Silat fighters during a match, and 2) determine any differences in these demands between weight classes and rounds.
METHODS: Time-motion analysis of 42 Male category matches from the 2015 SEA Games and 2016 Silat World Championships were analysed for the frequency and duration of individual movements. Movement categories were classified into low, moderate and high movement intensities with work referred to as high intensity movements and recovery as low and moderate intensity movements. Athlete weight classes were classified as light (45-60 kg), middle (60-75 kg) and heavy (75-95 kg). Differences in work duration during matches were compared between weight classes and rounds using magnitude-based Cohen's effect size (ES), assessed using the following criteria: 0.20 = small, 0.50 = moderate, and 0.80 = large.
RESULTS: Mean match time and a work duration of 15:51±04:46 min:s and 1:19±0:30 min:s, respectively. There were 42±15 high intensity movements, accounting for 8±3 % of a match. High intensity movements lasted, on average, 1.89±0.50 s, with a mean recovery period of 17.91±6.29 s; an overall work:rest ratio of 1:9.5. Small-moderate differences were observed between light, middle and heavy weight classes for total mean work duration between light and middle (1:13±0:24, 1:28±0:36, ES: 0.49, CI: 9.87, -12.23), light and heavy (1:14±0:28, ES0.06, CI: 9.44, -10.40) and medium and heavy (ES: 0.43, CI: 10.89, -12.30) with work:rest as 1:9.4, 1:9.2 and 1:9.8, respectively. Furthermore, average work duration progressively increase from round 1 to round 2 (0:17±0:12 mm:s, 0:27±0:13 mm:s, ES: 0.75, CI: 2.10, -3.23), round 1 to round 3 (0:35±0:11 mm:s, ES: 1.55, CI: 4.02, -0.89) and round 2 and 3 (ES: 0.69, CI: 3.53, - 1.76) as well as the frequency of high intensity activity (9.3±6.8 s, 14.0±5.7 s and 19.1±6.4 s). Differences in average work:rest ratios between round 1, 2 and 3 (1:11, 1:9, 1:8 respectively) were also observed.
CONCLUSION: Combat Silat is a high intensity intermittent sport requiring short explosive efforts, but these efforts can vary from 0.76 s to 4.12 s with an average match work:rest ratio of ~1:10 indicating a training emphasis towards anaerobic alactate and aerobic energy system. The increase in work across rounds and range of work:rest ratios, regardless of weight class, is an interesting finding that can be useful to guide training prescription to meet the specific demands of competition for male Combat Silat.

GROSS EFFICIENCY AND PEAK OXYGEN UPTAKE IN VISMA SKI CLASSICS ATHLETES

SAGELV, E.H.1, PEDERSEN, S.1, THOMASSEN, T.O.1, HEITMANN, K.A.1, PETTERSEN, S.A.1, MATHISEN, G.1, WELDE, B.1, STÖGGL, T.2

1UIT THE ARCTIC UNIVERSITY OF NORWAY, 2UNIVERSITY OF SALZBURG, SALZBURG, AUSTRIA

INTRODUCTION: Cross-country skiing (XCS) has been studied extensively, and is unique due to its high demands for endurance capacity and complex regulation and fluctuation of oxygen delivery for both upper and lower body (Holmberg et al., 2007). The Visma Ski Classics (VSC) merges the most traditional long distance XCS events (14-90 km) in Europe and worldwide. To our knowledge, the physical capacities of VSC athletes have not yet been explored. The aim of this study was to examine the gross efficiency (GE) and peak oxygen uptake (VO2peak) of the VSC athletes in diagonal stride (DS) and double polling (DP).
METHODS: Nine male athletes (26±4 yrs, 182±7 cm, 78±7 kg) participating in the Reistad race of VSC volunteered to undergo two laboratory tests with both DP and DS in randomized order while roller skiing on a treadmill (Rodby, Sodertalje, Sweden): 1) Measurements of VO2 (Oxycon Pro, Jaeger GmbH, Hoechberg, Germany) during two submaximal stages (8 and 10 km•h-1, 10.5% inclination) for the calculation of GE and 2) VO2peak during an incremental test to exhaustion at 15% inclination. GE was calculated according to the formula by Sandbakk et al. (2010). Paired sample t-tests were performed to check for differences in GE between and within the two skiing techniques at different velocities, and for differences in VO2peak between DS and DP.
RESULTS: There was a significant difference in GE between DS and DP at 8 kmh-1 (18.5±0.7% vs. 17.2±1.4%, p=0.02), but not at 10 km/h (18.2±1.2% vs. 17.6±1.2%, p=0.48). GE was higher in DP at 10 km/h compared with 8 km/h (diff.:-0.88±0.65%, p=0.003), whereas no such difference was found for DS (diff.:0.29±1.13%, p=0.47). The VO2peak in DP was 90.3% of DS (68.1±4.1 vs. 75.4±5.0 ml/kg/min, p=0.001).
CONCLUSION: VSC athletes have higher GE in DS compared with DP at 8 km/h but not at 10 km/h, and higher in DP at 10 km/h compared with 8 km/h. These findings may be explained by specificity of training, as VSC athletes usually perform a high volume of DP in high speeds, whereas DS is performed in lower speeds. The difference in VO2peak between the techniques may be explained by higher stroke volume, higher arterial desaturation and higher maximal ventilation (Holmberg et al., 2007) and possibly larger proportion of muscle mass used in DS compared to DP.
References: Holmberg et al. (2007).Scand J Med Sci Sports,17(4),437-444
Sandbakk et al. (2010).Eur J Appl Physiol,109(3),473-481
Contact: edvard.h.sagelv@uit.no

DIFFERENCES OF MAXIMAL OXYGEN CONSUMPTION BETWEEN PROGRESSIVE ON-ICE AND CYCLE ERGOMETER TESTS WITH SHORT TRACK SPEED SKATERS

ST-JEAN MIRON, F., WALSH, E., MAROIS, B., COMTOIS, A.S.

UNIVERSITY OF QUEBEC IN MONTREAL

INTRODUCTION: Currently there are no sport-specific tests to directly evaluate the aerobic capacity for short track speed skating athletes on the ice. While cycling assessment tests seem to be favored in this discipline, the aim of this project was to create an on-ice test to estimate skaters VO2max and compare those results to a cycling ergometer VO2max test. We hypothesized that the VO2max results obtained during on-ice skating test would be lower than during the cycling ergometer test. This is because the position that short track speed skaters adopt on the ice impacts cardiovascular response with a restriction of blood flow to the lower limbs.
METHODS: 24 Canadian short track speed skaters, (11 women and 13 men;19.6±3.2 years old; 66.9±6.6 kg; 171.5±6.6 cm) of the provincial level or higher, participated in the study. Skaters took part in two separate (48hrs-7days in between) progressive maximum tests on ice and on a cycle ergometer. Heart rate (HR) and oxygen consumption (VO2max) were continuously monitored during both tests with a portable metabolic analyzer. Blood lactate concentration and perceived effort for cardiovascular effort and leg pain (Borg scale) were measured at the end of both tests.
RESULTS: The maximum speed reached at the end of the on-ice test was 9.7±0.49 m*s-1 and maximum power on the cycle ergometer was 349±56.3 Watts. Both tests were significantly correlated (r=0.85; p<0.001). The relative VO2max reached at the end of both tests was significantly different with 53.0±7.1 and 63.3±6.9 ml*kg-1*min-1 (p<0.001), and in absolute terms with 3.56±0.65 and 4.28±0.79 L/min (p<0.001). respectively. A significant difference was also noted for the perception of cardiovascular effort (15.9±2.1 vs 17.0±2.1, p=0.005). No differences, however, were detected in HRmax reached (193±6.2 vs 195±7.6 bpm, p=0.121, respectively), for blood lactate concentration (13.4±2.1 vs 12.6±3.1 mmol*L-1, p=0.145, respectively) and for the perception of leg pain (18.5±1.1 vs 18.4±1.5, p=0.671, respectively).
CONCLUSION: The on-ice test allows for skaters to reach their physiological maximal skating speed as measured by the HRmax, blood lactate concentration, and the perception of leg pain. Nonetheless, the VO2max reached during the on-ice test was significantly lower, regardless of similar HRmax values. This indicates the importance of muscle recruitment patterns on the metabolic cost of leg exercise. As well, VO2max obtained on a cycle ergometer is not representative of the VO2max obtained on-ice, despite the significant correlation between the maximum on-ice speed and the cycle ergometer power output. Finally, the on-ice test reveals the importance of test specificity because of leg activity dichotomy in speed skating that is not present in cycling.

ASSESSMENT OF ON-ICE BIOENERGETIC COST OF SKATING PERFORMANCE DURING FORWARD, BACKWARD AND AGILITY TESTS IN ELITE YOUTH ICE HOCKEY PLAYERS

LEONE, M., ALLISSE, M., DESJARDINS, P., LÉGER, L., BUI, H.T., COMTOIS, A.S.M.

UNIVERSITÉ DU QUÉBEC À CHICOUTIMI

INTRODUCTION: Introduction The purpose of this study was to evaluate and propose equations to predict the energy expenditure during different skating situations commonly found in game situations (skating forward, backward, with and without controlling a puck, during cornering, stops and starts and changes of direction).
METHODS: Methods Twenty-four (24) male elite ice hockey players of categories Peewee (11-12 years old), Bantam (13-14 years old) and Midget (15-16 years old) participated in this study. Anthropometric measurements were taken and four different on-ice high-intensity and short duration (5-9 s for forward and backward skating and 27-29 s for agility tests) tests were performed on a standard Canadian ice rink. Execution time, heart rate, oxygen uptake and skating strides were measured for each of the tests.
RESULTS: Results A regression equation was extracted for each of the four tests to predict of oxygen cost based on age, body mass, heart rate, skating strides and skating stride index. Correlation coefficients ranged from 0.90 to 0.93 and standard error of estimate (SEE) was between 2.20 and 3.11 ml·kg-1·min-1.

CONCLUSION: To the authors' knowledge, this is the first time oxygen cost has been evaluated and corresponding prediction equations developed for different skating situations involving short-duration and high-intensity efforts. This could be useful to establish the energy cost during different skating situations on individual basis. This information can help coaches to better target their interventions using simple tools, such as video analysis for stride number and heart rate monitors.

PHYSIOLOGICAL LOAD DURING AN ACTIVE VIRTUAL REALITY GAME

PERRIN, T., FAURE, C., NAY, K., CATTOZZO, G., SOREL, A., KERHERVÉ, H., BIDEAU, B., KULPA, R.

UNIV RENNES, M2S - EA 7470, F-35000 RENNES, FRANCE

INTRODUCTION: Strategies to curb the development of pathologies associated with sedentary lifestyles are usually geared toward limiting sitting time and screen use, and increasing energy expenditure (EE) through exercise. Since the early 2000's, active games (AG) have been developed where players use upper limb or whole body motion to interact with a virtual gaming environment. AG have been documented to elicit greater oxygen consumption (VO2, +2-10 mL/min/kg) and EE (+150-250 kJ/min) than seated games (~5-10 mL/min/kg and ~150 kJ/min, respectively). The aim of this study was to evaluate the physiological load of an AG in a portable Virtual Reality (VR) system with stereoscopic vision and head tracking, as these provide greater immersive feeling than 2D screens and might lead to greater physical engagement.
METHODS: Nine healthy males (28±6 yr, 182±5 cm, 86±8 kg) took part in this study. After a habituation phase, participants completed three tests in a randomized order: a submaximal walking test on a treadmill at 6 km·h-1 (W6), one bout of active gaming at body weight (AGBW), and one bout of active gaming with weights amounting to approximately 2.5% of body weight worn on wrists (AGW%). The active game was a free-to-play, upper-body oriented virtual bow and arrow shooting game pre-installed with the VR system (HTC Vive). We measured VO2 and heart rate (HR) and the number of shooting actions continuously, and subsequently calculated energy expenditure based on energy equivalents for oxygen in the standard manner. Effect sizes (ES) for pairwise comparisons were calculated using Cohen's d.
RESULTS: All variables were measured when participants reached a similar level of difficulty in the game (3rd wave of opponents, lasting ~15 min). VO2 in AGW% (20.6±4.5 mL/min/kg) was 22±7% and 21±19% greater than AGBW and W6, respectively. EE in AGW% (657±174 kJ/min) was 27±10% and 48±18% greater than AGBW and W6, respectively. Average HR in AGW% (116±7 bpm) was 16±6% greater than both AGBW and W6. The total number of shooting actions was lower in AGB% (361±81) than AGBW (-10±18%). Large ES were calculated for AGB%/AGBW and AGB%/W6 comparisons, and trivial to small ES for AGBW/W6 comparisons except for EE (large).
CONCLUSION: We observed consistently higher physiological load (VO2, EE, HR) in AGW% compared to AGBW and W6, and EE was also higher in AGBW than in W6. Despite marked differences in EE, similar average HR were measured in AGBW and W6, indicating HR may not provide suitable indicators of EE during AG, which may explain some of the differences in EE we measured in this study compared to the literature. Therefore, the development of whole-body AG in VR with and without extraneous weights provides an exciting avenue to increase EE during leisure or indoor activities, and may pave the way to accompany the development of e-sports and health applications.

IDENTIFYING THE PERFORMANCE CHARACTERISTICS OF ELITE PENCAK SILAT FIGHTERS

JACKY, S.1, 2, CARL T.W.3, SARAVANA, A.P.1, AZIZ, A.R.2, IHSAN, M.4. 1: NATIONAL INSTITUTE OF EDUCATION (SINGAPORE), 2: SINGAPORE SPORT INSTITUTE (SINGAPORE), 3: PORT ADELAIDE FOOTBALL CLUB (ADELAIDE

SSI INSTITUTION

INTRODUCTION: Pencak Silat is a weight categorised combat sport originating from the South East Asian (SEA) region. Historically practiced as self-defense, the growth of this sport has been considerable, with 37 countries reportedly participating at the recent 2016 World Championships. Given its growing popularity, identifying key movement patterns associated with superior performance is fundamental for coaching practices, and the continued development of the sport (Aziz et al., 2002). This study aims to 1) identify performance characteristics associated with successful Silat fighters and 2) to examine the relationship between performance indicators and match outcome using linear and non-linear statistical approaches.
METHODS: Time-motion analysis was undertaken on the Male category matches (n=161) recorded during the 2015 SEA Games and the 2016 Silat World Championships. Preliminary analysis was undertaken to identify all combat techniques, which were then categorised into offensive, defensive and counterattacking movement patterns. Successful performances were identified by comparing the categorised movement patterns between the Semi Finalist (SF) and Non-Semi Finalist (NSF). Additionally, eight performance indicators were collated and analyzed via a linear (binary logistic regression) and non-linear (Conditional Interference (CI) classification tree) statistical approach.
RESULTS: Results from the independent t-test showed that SF tend to use more single strikes compared to NSF ($p < 0.05$). The preferred strike of SF were the single offensive front kick, defensive front and side kick, and counterattacking roundhouse kick ($p < 0.05$). SF also executed more throws and defensive and counterattacking scissor takedown ($P < 0.05$). The most parsimonious binary logistic regression model retained 'catch success', 'defending takedown success', 'defending throw success', 'total sweep success', and 'total takedown success' (delta AIC <0.01; Akaike weight = 0.15) with an average model accuracy of 75%. Conversely, three performance indicators were retained with the CI classification tree with an average classification accuracy of 75%. However, it was the combination of 'total takedown success and 'defending takedown success' that provided the greatest probability of winning (90.3%).
CONCLUSION: The present findings highlight the key fighting characteristics and performance indicators associated with match success. The incorporation of the non-linear CI classification tree may provide coaches with a more practical approach in enhancing match success.
References: Aziz, A. R., Tan, B., & Teh, K. C. (2002). J Sports Sci Med, 1, 147-155.
Contact: jackysds@gmail.com

Conventional Print Poster

CP-PM22 Microbiota; Molecular Metabolism; Proteomics

EFFECT OF ABDOMINAL PRESSURE TRAINING ON THE GUT MICROBIOTA FOR PREVENTING LIFESTYLE DISEASES IN MIDDLE-AGED AND ELDERLY INDIVIDUALS

MATSUO, K.1, KAWAMURA, T.2, FUKUDO, S.3

1.KAWASAKI UNIVERSITY OF MEDICAL WELFARE, KURASHIKI, OKAYAMA, JAPAN., 2. TOHOKU FUKUSHI UNIVERSITY, SENDAI, MIYAGI, JAPAN., 3. TOHOKU UNIVERSITY GRADUATE SCHOOL OF MEDICINE, SENDAI, MIYAGI, JAPAN.

INTRODUCTION: Revealing the association between exercise and the gut environment can substantially contribute to health promotion. Many previous studies evaluating the effect of exercise training intervention in the elderly have focused on skeletal muscle hypertrophy or prevention of atrophy. However, in the present study, we considered the possibility that abdominal pressure training prevents lifestyle diseases by improving the gut environment. Moreover, a recent study reported that lifestyle diseases such as obesity are associated with the type and composition of the gut microbiota. Many studies on exercise training intervention for preventing lifestyle diseases in middle-aged and elderly individuals have been conducted. Recent studies have also suggested that oral bacteria are associated with alveolar pyorrhoea and lifestyle diseases and have relevance with the gut environment. In our study, abdominal pressure training for middle-aged and elderly individuals with exercise habits was conducted for 6 weeks. We examined whether the gut microbiota would change and whether the defaecation status would improve. In addition, the association between the number of oral bacteria and the gut environment was investigated.
METHODS: This study included 16 subjects who regularly attended exercise classes (11 men and 5 women, mean age: 72.5 ± 6.9 years). The changes in gut microbiota were examined before training, after 6 weeks of regular training (e.g. stretching), and after 6 weeks of abdominal pressure training for a total of three times. In addition, the number of oral bacteria was measured, and a Bristol stool scale was used to evaluate the form of faeces into seven types.
RESULTS: All subjects had a different gut microbiota. In addition, there was no change in the gut bacteria after abdominal pressure training. However, there was a significant negative correlation between the number of oral bacteria and the Bacteroides, Prevotella spp. and Clostridium cluster IX in the gut microbiota. Six subjects showed an improvement in the form of faeces upon assessment using the Bristol stool scale.
CONCLUSION: There was no change in the mean levels of gut microbiota after abdominal pressure training in middle-aged and elderly individuals. This result may have been obtained because the gut bacterial flora was basically different in each subject. The results from the survey using the Bristol stool scale suggested that exercise training that enhances the abdominal or intraperitoneal pressure may be effective in improving the defaecation status of individuals who show an improvement in the gut environment.

HIIT-INDUCED TOTAL AND VISCERAL FAT MASS LOSS IS NOT LINKED TO ALTERED GUT MICROBIOTA COMPOSITION IN OBESE RATS

MAILLARD, F.1,2, VAZEILLE, E.2,3, SAUVANET, P.2,4, SIRVENT, P.1, COMBARET, L.5, SOURDRILLE, A.1, BONNET, A.2,4, OTERO, Y.1, DELCROS, G.1, BARNICH, N.2, BOISSEAU, N.1

1. AME2P LABORATORY; 2. UMR 1071 INSERM; 3.INSERM, 3IHP; 4. CHU CLERMONT-FERRAND; 5. INRA, UNH, UMR 1019.

INTRODUCTION: Overweight and/or obese subjects have an increase of visceral adipose tissue and a dysbiosis promoting chronic inflammation and the development of cardiovascular diseases. If numerous studies demonstrated that moderate-intensity continuous training (MICT) can favorably alter gut microbiota composition, little data is available concerning the potential impact of High-Intensity Interval Training (HIIT). However, HIIT has grown in popularity in the last few years as a time-efficient and powerful strategy to reduce total and visceral visceral fat mass. Thus, the aim of this study is to compare the effects of MICT and HIIT programs on gut-adipose tissue cross-talk in obese rats.
METHODS: Male Zucker rats (fa/fa, n = 36) aged of 8 weeks were fairly subdivided into MICT, HIIT or control (CON) group. Trained animals ran on a treadmill (0° slope), 5 days/week during 10 weeks (MICT group: 51 min at 12m.min-1 ; HIIT group: 6x (3 min at 10m.min-1 followed by 4 min at 18m.min-1). Body composition was analyzed by EchoMRI and the weighing of tissue was realized post-mortem. Adipose tissue inflammation was evaluated by secretion of cytokines (IL-6 and KC) measured by ELISA. Gut microbiota was analyzed using 16S rRNA gene sequencing on an Illumina MiSeq Platform. Dosage of tight junction proteins (ZO-1 and occludin; by western-blot) was used as a marker of intestinal permeability. Fecal short-chain fatty acids (SCFA: acetate, propionate and butyrate) concentrations were determined using gas liquid chromatography. Lipid profile (plasma TG, total cholesterol, HDL and LDL) was measured and glycemic control was evaluated through fasting glycaemia, insulinemia and an oral glucose tolerance test.
RESULTS: Results: After 10 weeks, total body mass and lean mass were not different but total fat mass was reduced in HIIT group from week 5 to the end of protocol. Epididymal adipose tissue (reflecting visceral fat mass) was reduced in HIIT group only. Secretion of KC from AT was decreased in MICT and HIIT groups. No change was observed in lipid profile except an increase of LDL in MICT group. Both trainings improved glucose tolerance. Concomitantly, no change was demonstrated in gut microbiota composition (alpha and beta diversities) and fecal SCFA levels in any group. However, ZO-1 was increased in trained groups whereas occludin was more elevated in HIIT group.
CONCLUSION: HIIT is a time-efficient method to decrease total and visceral fat mass that favors inflammatory and metabolic profiles. However, these changes were not associated with change in gut microbiota composition but only to a greater level of tight junction proteins in this group.

IS MUSCLE DAMAGE AFFECTED BY GUT BACTERIA ELIMINATION- AN MRI STUDY.

NUNOMIYA, A., OSANA, S., TAKADA, H., NAGATOMI, R.

TOHOKU UNIVERSITY GRADUATE SCHOOL OF BIOMEDICAL ENGINEERING

INTRODUCTION: Several studies have reported that gut microbiota influence muscle metabolism. Although there is still an on-going debate about the presence of "gut-muscle axis", influence of intestine flora on muscle wasting has been receiving attention. The relationship, however, between gut microbiota and recovery from muscle damage has been little studied.

Until now, the time course analysis of muscle recovery from damage required distinct mouse for each time point for muscle histological examination. Magnetic resonance imaging (MRI) may allow the assessment of muscle damage and recovery of a same individual mouse.
The purpose of the study was, therefore, to examine the effect of gut bacterial elimination with antibiotics on the recovery of cardiotoxin induced muscle damage using MRI.
METHODS: Ten male C57BL/6 mice were divided into control group (n = 5) and antibiotics treatment group (n = 5). To deplete gut bacteria, 0.2 ml of antibiotics cocktail was administrated to mice in antibiotics treated group via a feeding needle for consecutive 7 days. Control group received 0.2 ml of sterile distilled water in the same way. Following antibiotics treatment, 50μl of cardiotoxin (CTX) was injected into each left tibialis anterior (TA) muscle of all mice. Saline buffer was injected in to right TA muscle as control. Three days, 1 week and 2 weeks after CTX injection, MRI acquisitions with MSME (T2 and proton density weighted: PD_T2) were performed. Body weights were recorded daily during antibiotics treatment, and were measured again 3 weeks after the CTX injection.
RESULTS: Body weight gains after antibiotics treatment in antibiotic treated group (0.458 ± 0.35 g) was significantly less than control group (1.778 ± 0.24 g) ($P < 0.05$). We observed the distinct contrast MRI images corresponding to muscle damage in both control and antibiotics treated groups 3 days after the CTX injection. The signal intensities were weakened but the damage was still distinguishable 1 week after the CTX injection. After 2 weeks, the contrasted area had visibly been shrunk. The recovery period considered from PD_T2 image was almost the same between control and antibiotics treated groups. The average weight of injured TA muscle/control TA muscle (left/right) after 3 weeks were smaller in the antibiotics treated group, but the difference was not statistically significant.
CONCLUSION: Non-invasive MRI technique was found to be feasible for tracking the course of muscle damage and recovery. Using this technique, we found no effect of gut bacteria elimination on the course of muscle recovery.

THE IMPACT OF THE COMETITIVE PHASE ON THE GUT MICROBIOTA AND CYTOKINE PROFILE IN AMATEUR LEVEL COMPETITIVE CYCLISTS

SZURKOWSKA, J.1, KAROLKIEWICZ, J.1, GALECKA, M.2, BARTNICKA, A.2

1: POZNAŃ UNIVERSITY OF PHYSICAL EDUCATION , 2: INSTYTUT MIKROEKOLOGII

INTRODUCTION: Gut microbiota plays a crucial role in the preservation of intestinal barrier, the modulation of inflammatory signaling and in the protection against infections. Professional athletes as well as amateur level sportsmen are the most sensitive to respiratory and gastrointestinal tract infections. In cyclists gastrointestinal problems most likely result from the redistribution of blood flow from the gut to the peripheral circulation for cooling purposes. The detailed information on the profile of the gut microbiota and cytokines can allow a better understanding of the relationship between the digestive and immune systems of the amateur level competitive cyclists.
METHODS: The study was conducted in 30 men, aged 20–44years: 15 cyclists with the mean training experience of 5 ± 2 years and 15 untrained (control group). The only significant difference between the groups was found in the level of VO2max ($p<0.001$). Subjects enrolled to the study fulfilled all inclusion criteria, and did not present any of the exclusion criteria (determined by both questionnaire and interview). During the study, cyclists underwent two series of measurements, before and after the competitive phase of the annual training cycle. The control group participated only in the first measurement, before the competitive phase. Blood samples were collected for the biochemical analyses. The consistency and pH of feces and quantitative assessment of the main aerobic and anaerobic bacteria, yeasts and fungi of the gut were measured in the feces samples. Dietary energy and macronutrients intake were assessed on the basis of a three-day food diary completed by each study participant.
RESULTS: There were no significant differences between the surveyed cyclists and the control group in the pH of feces and in the amount and composition of faecal microbiota, however in the cyclists some changes in abundances of Clostridium spp. and Lactobacillus spp. were found. Significant differences in cytokine profile (IL-4,IL-12, TNF-alpha) and the dietary macronutrients intake were observed between the two groups. In the cyclists group, in spite of the significant changes in the applied training loads and the dietary macronutrients intake, there were no differences in the pH of feces and quantitative assessment of the faecal microbiota, between beginning and the end of the competitive phase. The significant increase in the level of IL-4 ($p<0.01$) and the decrease in TNF- alpha level ($p<0.05$) were observed after the competitive phase of the annual training cycle
CONCLUSION: The main competitive phase didn't affect the gut microbiota but caused the change in the cytokine profile in amateur level competitive cyclists.

L-TYPE AMINO ACID TRANSPORTER 1 PLASMA MEMBRANE TRANSLOCATION ON CULTURED MYOTUBES DURING PROLONGED ELECTRICAL STIMULATION

TAKADA, H., NUNOMIYA, A., OSANA, S., NAGATOMI, R.

TOHOKU UNIVERSITY GRADUATE SCHOOL OF MEDICINE

INTRODUCTION: Diet and exercise are major factors to modulate protein synthesis and breakdown in our daily life (Manal A, et al., 2012). Leucine, one of the branched chain amino acids, is known to not only be incorporated in structural proteins but also stimulates protein synthesis. Leucine is considered to activate protein synthesis through activation of mammalian target of rapamycine (mTORC1). In skeletal muscle, leucine may be oxidized during exercise and induces protein synthesis through mTORC1 pathway after exercise (Dohm L, et al., 1980). leucine is transported into the cell through L-type amino acid transporter 1 (LAT1). LAT1 forms a heterodimeric protein complex with a glycosylated heavy subunit (CD98) responsible for import of large neutral amino acids, such as leucine. Expression of LAT1 is known to be up-regulated by an increased demand of intracellular leucine. We have previously identified that expression of LAT 1 mRNA in muscle tissue was increased after electrically induced contraction in mice (Takada, unpublished observation). In order for LAT1 to be functioning, LAT1 needs to be translocated to plasma membrane, but whether ES could induce membrane translocation is unknown. Therefore, this study was aimed to identify LAT1 plasma membrane translocation after ES.
METHODS: All experiments were performed on cultured C2C12 myotubes (7 days after differentiation) and mouse primary culture myotubes (7 days after differentiation). C2C12 myotubes were divided into ES for 30 min groups and ES for 24 hour groups, non-ES (control) groups, (Method: 1). C2C12 myotubes and primary myotubes were divided into ES groups and control (Method: 2). ES was performed as below : 1 Hz, 2 msec, 40 V, non interval, 24 hours or 30 min. After ES, samples were fixed for immunocytochemistry. LAT1 translocation was measured by immunocytochemistry of LAT1 and CD98, lamp2. Lamp2 is protein of lysosome membrane.
RESULTS: ES for 24 hours caused LAT1 to aggregate into the cytoplasm in C2C12. However, 30 min of ES did not aggregate LAT 1 into the cytoplasm (Method: 1) . Similarly, electrical stimulation for 24 hours caused LAT1 to aggregate in the cytoplasm . However, the aggregation of LAT1 at C2C12 was more aggregated than the primary culture (Method2).

CONCLUSION: Aggregation of LAT1 observed after 24 hours of electrical stimulation was not seen with 30 min of ES. These results suggest that stimulation time to cells may alter behavior of LAT1. Furthermore, the behavior of LAT1 24 hours after ES in C2C12 was greater than that of Primary culture, suggesting that the behavior of LAT1 by ES depends on cell type. Our future research will show its mechanism of behavior of LAT1 after ES.

RESPONSE OF BRAIN-DERIVED NEUROTROPHIC FACTOR TO HIGH-SPEED AND LOW-RESISTANCE CYCLING EXERCISE IN HEALTHY ADULTS: A RANDOMIZED CONTROLLED TRIAL

TOSHIAKI, M., NISHIWAKI, E., UHO, T., MIZUTANI, R., TAKEDA, C., FUJIOKA, H.

HYOGO UNIVERSITY OF HEALTH SCIENCES

INTRODUCTION: Brain-derived neurotrophic factor (BDNF) is well known as one of the essential mediators responsible for the beneficial effects of physical exercise on preventing cognitive impairment. Moderate- to high-intensity during physical exercise is required to increase blood BDNF levels (Coelho et al., 2013), however there are many people who cannot perform such a high-intensity physical exercise because of orthopedic problems or frailty. Although high-speed and low-resistance physical exercise (HLE) has been considered as one of the exercise methods to improve muscle functions and physical performances (Bellumori, et al., 2017), the response of blood BDNF levels to HLE has been unknown. The purpose of this study is examining the response of blood BDNF levels to HLE in healthy adults.
METHODS: Seventeen healthy adult men randomly performed three experimental sessions; a 40-min cycling exercise at a workload of 40% peak oxygen uptake and a pedaling cadence of 50-60 rpm (Standard Exercise; SE), a 40-min cycling exercise at a workload of 40% peak oxygen uptake and a pedaling cadence of 90-100 rpm (HLE), and a session of complete rest for 40 min (CON). Heart rate was monitored throughout each session, and blood examinations for serum BDNF and lactate levels were performed before and after each session. All variables were analyzed using two-way repeated measures analysis of variance with session and time as within-participant factors.
RESULTS: There was a significant interaction between session and time for BDNF levels ($p < 0.05$), and HLE significantly increased BDNF levels compared to CON ($p < 0.05$) whereas SE had no significant changes in BDNF levels compared to CON ($p > 0.05$). Heart rate and lactate concentration in HLE were significantly higher than those in CON and SE, respectively (all $p < 0.05$).
CONCLUSION: Our main finding was that HLE could increase blood BDNF levels. This result suggested that the HLE might improve cognitive function through the increase of serum BDNF. However, the heart rate significantly increased during the HLE protocol performed in the present study. Therefore, it is necessary to examine the reasonable pedaling cadence and to establish the optimal HLE protocol for elderly people in the future.

STUDY OF THE PROTEIN SYNTHESIS IN MUSCLE CELLS USING NON-CANONICAL AMINO ACIDS

OSANA, S., NUNOMIYA, A., TAKADA, H., SUZUKI, N., AOKI, M., NAGATOMI, R.

TOHOKU UNIVERSITY GRADUATE SCHOOL OF MEDICINE

INTRODUCTION: Skeletal muscle mass is considered to be regulated by the balance between synthesis and degradation of proteins. It has been reported that muscle protein synthesis is induced by resistance training (Drummond MJ et al., J Appl Physio 2009), and intake of amino acids (especially leucine) also induces muscle protein synthesis (Volpi E et al., Am J Clin Nutr 2003). The metabolism of muscle proteins is, therefore, an important index to evaluate the effect of exercise and nutrition on skeletal muscle. In previous studies, metabolism of skeletal muscle protein is evaluated by surface sensing of translation (SUnSET) method using puromycin (Goodman CA et al., FASEB J 2011) and tracer method using stable isotope-labeled amino acids (Phillips et al., Am J Physiol 1997). However, the former is unsuitable to detect the long-term protein metabolism due to toxicity, and the latter had only shown the rate of turnover. In this study, we used a methionine analog azidohomoalanine (AHA), the incorporation of which may be visualized by conjugation of azide bound dye, to evaluate long term muscle protein metabolism.
METHODS: Mouse C2C12 myoblasts were cultured in growth medium (GM; 10% fetal bovine serum and 100mg/ml penicillin streptomycin solution) for proliferation. We replaced GM with serum free DMEM, and then cultured for 18 hours to synchronize the cell cycle. Next, we replaced the culture medium with fresh one containing AHA with or without protein synthesis inhibitor cycloheximide (CHX). Cells were harvested at 1, 4, 8 and 18 hours after the replacement of fresh media. AHA incorporation was evaluated by signal intensity of fluorescence activated cell sorter (FACS) and western blot analysis (WB).
RESULTS: AHA was detected in C2C12 myoblasts by FACS and WB. The survival rate of cells cultured with AHA was not significantly different from control cells. Additionally, signal intensity of AHA gradually increased as the culture time increased. CHX addition significantly reduced the AHA incorporation.
CONCLUSION: AHA loading to cultured cells was capable of tracking amino acid incorporation into muscle proteins.

Conventional Print Poster

CP-SH01 Education and Pedagogics-children and adolescents

RELATIONSHIP BETWEEN CHILDREN'S PREFERENCES FOR PHYSICAL EDUCATION, ENJOYMENT OF PHYSICAL ACTIVITY, EXPERIENCES AND ENVIRONMENT, AND MASTERY OF MOVEMENT SKILLS IN JAPAN AND SOUTH KOREA

IKEDA, T.1, HAN, N.2, CHOI, T.2, AOYAGI, O.3

1 FUKUOKA PREFECTURAL UNIVERSITY, 2 JEJU NATIONAL UNIVERSITY, 3 FUKUOKA UNIVERSITY

INTRODUCTION: Children's physical fitness levels are decreasing in Japan and South Korea, and inactivity among Asian children has been cited as a reason for this decline (Muller et al., 2013; Tomkinson et al., 2012). Children's preferences for physical education depend on their experiences, environment, and/or mastery of movement skills (Sugihara, 1988), and several factors regarding children's joy of exercise have been extracted (Tokunaga & Hashimoto, 1980). The purpose of the present study was to investigate the relationship between children's preferences for physical education (PPE), enjoyment of physical activity (EPA), experiences and environment (EE) and mastery of movement skills (MMS) in Japan and Korea.

METHODS: The research participants were 1,520 children (758 Japanese children, 758 boys) aged 10–12 years in Japan and Korea. All participants completed a questionnaire related to their PPE (12 types), EPA (21 items), EE (14 items) and MMS (10 items). Factor analysis and structural equation modeling (SEM) were applied to investigate the factors determining all 57 items and the factor relations.
RESULTS: Factor analysis extracted 14 factors, 10 of which could be interpreted as follows: 1) Jumping and gymnastics; 2) Swimming; 3) Running; and 4) Ball games for PPE, 5) Performing and 6) Watching for EPA, 7) Environment and 8) Negative experiences for EE, and 9) Axis and 10) Limb for MMS. The results of SEM showed a covariate relationship between PPE and EPA conforming to the model in each group based on country and gender (all GFIs and CFIs were over .900). The Korean model (AIC = 154.4) provided a better fit than the Japanese model (172.2), and the girls' model (179.3) provided a better fit than the boys' (195.1). The models of the causal relationship (Cause = EE and MMS, Results = PPE and EPA) showed the characteristics of each country. In the Japanese model (GFI = .935, CFI = .894), EE significantly affected PPE (Path Coefficient: beta weights [PC] = .13, $p < .01$). On the other hand, in the Korean model (GFI = .936, CFI = .908), EE (PC = 2.20, $p < .01$) and MMS (PC = 2.17, $p < .01$) significantly affected PPE.
CONCLUSION: Akizuki and Kanbayashi (2016) reported gaps in physical fitness among children in Korea owing to problems in the physical education curriculum. Their findings are supported by the results of the present study, namely that MMS affects PPE among children in Korea, and that MMS does not affect PPE among children in Japan. The present study indicated the differences between Japan and Korea on PPE and their relating factors.

TEACHER PSYCHOLOGICAL NEEDS SUPPORT, GENDER AND AUTONOMOUS MOTIVATION IN PHYSICAL EDUCATION STUDENTS

CASTILLO, I.

UNIVERSITY OF VALENCIA

Teacher psychological needs support, gender and autonomous motivation in Physical Education students
Isabel Castillo.1, Jorge Zamarripa.2, Inês Tomás.1, Octavio Álvarez.1, Maritza Delgado.2 & Maria Marentes.2
1. University of Valencia (Spain)
2. Autonomous University of Nuevo Leon (Mexico)
Introduction: The purpose of this study was to consider if the interaction between the perception of Physical Education (PE) teachers' support of their students' needs of autonomy, competence and relatedness, teachers gender and students gender predicts autonomous motivation during PE classes. We argue that to the extent that PE teachers affect the motivation levels of their students, these effects are likely to be moderated in part by teacher gender and student gender. Extending previous research in the school domain, we hypothesize that student gender and teacher gender will interact favorably when student and teacher genders match, but unfavorably when they do not.
Method
Participants were 724 secondary school students (389 males, 335 females), between 11-17 years old (M = 13.7; SD = 1.09) across 40 secondary schools from Nuevo Leon (Mexico) who volunteered to participate in this study. 569 participants informed that the gender of their PE teacher was male, and 155 that it was female.
Results: The results using moderated regression analysis showed that the effect of students' perceptions that the teacher created context supporting their autonomy, competence and relatedness on students' autonomous motivation depends on the extent to which the student and the PE teacher are males or females. Concretely, students' perception of teacher support positively predicted students' autonomous motivation in both genders, but this relation was higher for females. Moreover, students' perception of teacher support positively predicted students' autonomous motivation for both, males and females teachers, but this relation was higher when the teacher was a female. Finally, when female PE teachers teach male and female students the relation between teachers' psychological needs support and autonomous motivation is higher than when male PE teachers teach male and female students.
Conclusion
In contrast to predictions on gender stereotypes and the matching hypothesis, our results revealed that students' perceptions that the PE teacher supported their psychological needs were higher in PE classes taught by female teachers, regardless of the students gender, than in classes taught by male teachers. Indeed, the effect of teacher support on students' motivation was much larger for female students than for male students. The findings hold implications for educational intervention, suggesting that teachers in general and PE teachers in particular, should focus on supporting students despite their gender as it is relevant to promote autonomous motivation, which in turn has numerous positive cognitive, behavioral and affective consequences.
Contact: e-mail: Isabel.Castillo@uv.es

THE IMPACT OF PARTICIPATION IN A GAME OF TAG, AN ACTIVITY PROMOTING HELPING BEHAVIOR, ON HELPING BEHAVIOR-RELATED SELF-EFFICACY AND SUBJECTIVE ADJUSTMENT TO THE CLASSROOM AMONG CHILDREN

UENO, K.

KAGAWA UNIVERSITY

Introduction: With recent social issues such as breakdowns in classroom discipline, bullying, and social withdrawal, there are increasing expectations about the role of physical education, which generalizes fair play in sports from the gym to the classroom. Ueno (2017) developed a game of tag that promotes children's helping behavior. In this tag game, helping other children avoid the catcher without regard for personal safety is evaluated as fair play. Accordingly, this study aimed to examine the impact of participation in the game of tag, an activity promoting helping behavior, on helping behavior-related self-efficacy and subjective adjustment to the classroom among children.
Methods: Sixty elementary school children played one round of two types of tag in a PE class. In the first class (i.e., regular tag), children had to run around and avoid being caught. In the other, which was developed by Ueno (2017) and named "Nakama-oni," the catcher could touch only those children who were running alone and not those who held hands with each other (a child could hold hands with only one other child at a time). This feature of the game was intended to elicit helping behavior. Children were told before the game that there is significant value in helping others avoid the catcher without regard for personal safety. Children's helping behavior-related self-efficacy and subjective adjustment to the classroom were assessed before and after the game using the scale for helping behavior-related self-efficacy (Ueno, 2017) and a subjective adjustment scale for elementary school children (Emura and Okubo, 2012).
Results: Two-way repeated measures ANOVA and simple main effect tests were conducted on the both scales' scores. About helping behavior-related self-efficacy, a significant interaction effect was found between timing and the type of tag. The results of the simple main

effect tests showed that the scale score after Nakama-oni was significantly higher than it was either before Nakama-oni or after regular tag. About subjective adjustment to the classroom, a significant main effect was found between before and after the games of tag.
Discussion: From the results of helping behavior-related self-efficacy, findings suggest that experiences of helping others, even in a game of tag, may enhance helping behavior in daily living by increasing self-efficacy. From the results of the subjective adjustment to the classroom, tag games, in which classmates play with each other, enhance subjective adjustment to the classroom among children regardless of whether they include helping behavior.
References: Emura, S, Okubo. (2012). Jpn J Dev Psychol, 23(3), 241-251.
Ueno, K. (2017). Proc Conf Jpn Sport Psychol, 44, 134-135.
Contact: ueno@ed.kagawa-u.ac.jp

DEVELOPMENT OF TRAINING FOR NURSERY TEACHER USING RECOGNITION OF DIFFERENT EVENTS ON INFANT PHYSICAL EDUCATION

SAKON, S.

NIIGATA UNIVERSITY OF HEALTH AND WELFARE

Development of Training for Nursery Teacher using Recognition of Different Events on Infant Physical Education
Sakon, S.1, Nishihara, Y. 1: NUHW (Niigata, Japan)
Introduction: The basis of development of personality that is to be maintained for their entire life is founded in the childhood through daily life mainly consisting of playing. It is very high technique to prepare materials, teaching tools and environment that enrich and support children's play when they request new play and/or activities. Thus, nursery teachers and other school teachers are required to prepare the environment and have abilities to make appropriate judgment in order to respect childrens identity and to take flexible actions for various events on the site. The purpose of this study was to extract the ability of nursery teachers for recognizing different events on the scene of physical education and to develop the teaching skill improvement program.
Method
In order to extract event recognition on the scene of infant physical education, we viewed physical education (video) through child's play, observed and evaluated events on the site, and extracted "recognition of different events" and "recognition of identical events" by sufficiently experienced nursery teachers (7) and inexperienced nursery teachers (7). The obtained event recognition was categorized to "knowledge of the contents of teaching materials (hereinafter referred to as the "contents of teaching materials")," "knowledge of teaching method (hereinafter referred to as the "teaching method")," and "knowledge of children," and comparative review was performed. The contents of teaching materials (video) were as follows. Children sing and dance along with the song by the teacher (at three levels of speeds). Children pretend to be the specified thing and wait quietly – (1) pretending to be a stone and staying still, (2) pretending to be a sticker and adhering to the floor, and (3) pretending to be an animal and moving freely, and the teacher tries to push, pull, etc. the children with the force competing with theirs. Children try to resist the force that the teacher tries to move them. Interactive stimulation to neural transmission and peripheral nerves, development of concentration power and improvement in ability to wait calmly is expected.
Results: As for identical events recognized from the experienced nursery teacher and inexperienced nursery teacher, it was confirmed that "the teacher exploits children's concentration power" in terms of the contents of teaching materials and that "children stay calm for a long period of time." Not many points were noticed in the teaching method of inexperienced nursery teachers.
Recognition of different events was categorized into "the fun of the activity is transmitted to children," "their identity and desire is exploited" and "children put power into their peripheral nerves in finger tips" in terms of the contents of teaching materials, and "leading of simultaneous motio

LONGITUDINAL TRANSFORMATION OF SPRINT MOTION CAUSED BY ADOLESCENT AWKWARDNESS IN THE EARLY ADOLESCENCE

KOKUDO, S., KONDO, R., KAWAKATSU, S., UEDA, K.

KOBE UNIVERSITY

INTRODUCTION: The adolescent awkwardness of sprint was investigated from the speed decline (Bounen & Malina(1988)) and the motion deterioration through the age difference with cross-sectional data (kokudo(2017)); however, the longitudinal change of sprint motion caused by adolescent awkwardness is unclear. The purpose of this study was to investigate the longitudinal transformation of sprint motion in the early adolescence.
METHODS: The subjects was 157 children (81 boys and 76 girls) of 4th - 6th grade of elementary school in 2016. Their intermediate (25-35m of 50m sprint) sprint speed (SS) were measured by sensor timer and their sprint motions(SM) was recorded with digital video camera on May 2016 and May 2017. Observational sprint motion causal model, which includes 38 checkpoints, was developed based on the biomechanical findings and the descriptive checkpoints of previous studies (e.g. Knudson & Morrison (2002)). Their forms were played in slow motion or frame-by-frame, and 2 investigators evaluated the checkpoints.
Categorical factor analysis on pooled two years of data and oblique rotation by promax criteria was applied in order to identify SM factors and factor scores. Children were classified into two groups, improved group(Gi) and stagnant group(Gs) in SS change(SSC). Repeated ANOVA was applied in each SM factor score in order to investigate the difference of SM between 2016 and 2017 by SSC and sex.
RESULTS: As the result of factor analysis, 6 factors were extracted and 52.8% of total variance was explained by these factors. The factors were interpreted F1: leg grounding preparation and drive motion, F2: weighting motion, F3: arm-swing motion, F4: grounding and push direction, F5: free leg swing motion and F6: pinching motion, respectively. Since SSC showed a bimodal distribution at 0.2 m / sec., the SSC group was divided into Gi (54 boys, 42 girls) and Gs (27 boys, 34 girls) at 0.2 m / sec. Significant interaction between repeated measurement and SSC ($F = 6.07$, $p < 0.05$) was found on F1 Score; the F1 score of the Gi was increased though that of Gs was decreased. Significant main effect of the sex ($F=9.31$, $p<0.01$)) and SSC group ($F4.08$, $p<0.05$) was found on F3 score; the boys score was higher than girls and the score of Gi was higher than Gs both 2016 and 2017.
CONCLUSION: Adolescent awkwardness in sprint motion occurs in leg grounding preparation and drive motion, and it affects stagnation of sprint speed improvement.
References: Bounen, G and Malina, RM(1988), Growth and Physical Performance Relative to the Timing of the Adolescent Spurt, Exercise and Sport Sciences Reviews,16: 503-540
Knudson, D, Morrison, S(2002) Qualitative Analysis of Human Movement (2nd Ed.), 147-187, Human Kinetics

Kokudo,S(2017) Deterioration of the Sprint Motion Caused by Adolescent Awkwardness for Elementary School Children, 22nd annual meeting of ECSS abstracts, 178
Supported by Grant-in-Aid for Scientific Research(C), (16K01596) Japan.

THE ACTIVATICS PROGRAM TO INCREASE PHYSICAL ACTIVITY OF HIGH SCHOOL PE STUDENTS*

RAMIS, Y., PONS, J., BORRUECO, M., VILADRICH, C., CRUZ, J.

UNIVERSITAT AUTONOMA DE BARCELONA

ACTIVATICS is an action-research project aimed at improving the physical activity (PA) levels of adolescents, elderly and former elite athletes. In the case of adolescents, this project is framed on Self-Determination Theory (SDT; Ryan & Deci, 2000), and built upon Su & Reeve's (2011) systematic review on the effectiveness of SDT-based interventions to enhance motivation towards PA. We designed an intervention program to improve motivational skills of High School PE teachers which consisted on three phases: (a) a review of previous knowledge on the field of PA interventions, (b) the organization of focus groups both with experts on PA promotion and with PE teachers and students, (c) the development of a tailored education package adapted to motivations and objectives of the PE teachers attending the program. A total of 11 PE teachers, responsible of 57 high school PE groups, followed the program consisting of a 3hr workshop, a self-monitored phase and a 2,5hr follow-up session. The workshop primarily focused on providing recommendations to fulfill autonomy-supportive styles (i.e., provide meaningful rationales, acknowledge negative feelings, use of non-controlling language, offer choices, and nurture inner motivational resources. The workshop final exercise assessed (a) the understanding of the contents of the session, (b) perceived ability to implement changes on sessions, and (c) behavioral commitment to effectively include changes to their teaching style. On the self-monitored phase, PE teachers established their own individual objectives for subsequent classes. The diaries included information about the success of the implementation as well as perceived barriers or acknowledgement from their students. The follow-up session allowed PE teachers to share their experiences with both peers and the educator and to reset new goals for their PE classes. We will discuss the effectiveness of the program focusing on the satisfaction of the teachers regarding the resources provided in the program.

* This study was funded by the Spanish Ministerio de Economía y Competitividad (DEP2014-52481-C3-1-R)

THE FEASIBILITY OF WALKING INTERVENTIONS FOR PROMOTING PHYSICAL ACTIVITY WITHIN THE SCHOOL ENVIRONMENT

CARLIN, A.1, MURPHY, M.H.1, GALLAGHER, A.M.2

ULSTER UNIVERSITY

INTRODUCTION: Physical activity (PA) levels have been shown to decline as children move into adolescence, with this decline most notable amongst females. Schools have the potential to contribute to daily PA in adolescents. The aims of this study were to firstly evaluate the experiences of adolescent females who participated in a peer-led school-based brisk walking intervention (the WISH study) and secondly, to evaluate the potential for schools to further promote PA through walking programmes delivered within the school setting.
METHODS: A sample of female participants who participated in the WISH study (Carlin et al., 2018) were randomly selected from 5 post-primary schools to participate in focus group discussions to explore their experiences of the intervention. Discussions were audio-recorded, transcribed verbatim and analysed thematically. In addition, an online survey was distributed to all post-primary schools (n=208) in Northern Ireland to assess the current provision of extra-curricular PA and to evaluate the feasibility of the WISH study within the school setting. The questionnaires were completed by a member of staff familiar with the schools extra-curricular provision of PA (excluding PE staff).
RESULTS: In total, 6 focus groups were conducted comprising a total of 45 adolescent females (mean age 13.1 years). Helping participants overcome current barriers to PA, support from friends and peers and the provision of activities that met the needs of adolescent females within the school setting were all highlighted as possible strategies to promote PA. Walking during the school day was viewed as an acceptable form of PA, providing opportunities to be active with friends, and helped participants overcome a number of barriers previously associated with PA during school recess. 59 post-primary schools completed the online survey. Responding schools identified adolescent females and 'non-sporty' pupils as sub-groups that would benefit most from participation in a school-based walking programme. The majority of responding schools did not currently offer walking programmes. A number of barriers were identified by schools in relation to walking, for example, safety concerns and supervisory/staffing issues.
CONCLUSION: This study has highlighted that the delivery of a walking programme within the school setting is feasible. Incorporating strategies such as social support and peer mentoring may be effective in promoting PA during school recess. Positive experiences identified in this study should be reinforced when recruiting adolescent females onto future PA interventions, and the barriers identified by schools in relation to safety and staffing concerns should be addressed.
References: Carlin A, Murphy MH, Gallagher AM. (2018). Trials. 18,21.
Contact: a.carlin1@ulster.ac.uk

FAMILY STRUCTURE INFLUENCE ON PHYSICAL ACTIVITY OF PORTUGUESE ADOLESCENTS WITH OVERWEIGHT RISK – FAMILY IN MOVE PROJECT

LAGOA, M.J.1,2, AIRES, L.2,3 , SÁ, C.1,2, VIANA, J.L.1,2, SILVA, G.1,2

UNIVERSITY INSTITUTE OF MAIA, ISMAI

INTRODUCTION: Children's physical activity (PA) behaviours are decreasing worldwide and Portugal follows the same trend; few adolescents attain health recommendations for PA intensities. Family is an important agent that can have a positive influence on the promotion of adolescents' health-related PA behaviours. Therefore, the aim of this study was to analyse the effect of family structure on adolescents' PA.
METHODS: Portuguese adolescents (n = 285, mean age 12.8±1.8 years) took part in a school-based project, named Family in Move. This project aims to identify barriers, motivations and family perceptions, reported by parents and adolescents, and in particularly related to healthy lifestyles. The family's demographic information and grandparents' support were measured by questionnaire, as was the Adolescents' PA; the overall maximum possible number of points of PA questionnaire was 22 and total score as a PA index (PAI) was used. The weight and height of adolescents were measured and body mass index (BMI, kg/m2) was determined by Cole cut-off points. Paren-

tal weight and height were self-reported and BMI was also determined. To analyse the effect of family structure on adolescents' PA, univariate analysis of covariance, controlling for gender, with Bonferroni adjustments was performed.
RESULTS: Only 22% of these 285 Portuguese adolescents are active, including 55% girls and 45% boys. 22% of the adolescents were overweight and 5% were obese, but 84% are at risk of being overweight, because at least one parent was obese. Most adolescents living with both parents (83%) and with siblings (58%). In addition, most families were emotionally supported by grandparents (58%). Few families reported daily support (39%) and financial support (15%) by grandparents. "Adolescents living with both parents" and "grandparents' support" variables had no significant effect on the adolescents' PA. Furthermore, the adolescents' PA was significantly higher in those living with siblings ($F = 4.03$, $p<0.046$, $\eta 2= 0.05$).
CONCLUSION: Our results showed that family structure had a favourable effect on adolescents' PAI through the siblings influence. Therefore, a family environment specifically on siblings may be an important element to consider in interventions for adolescents active life promotion.
Contact: mjlagoa@ismai.pt

THE EFFECTS OF PHYSICAL EDUCATION COURSES ON UNIVERSITY STUDENTS' EXERCISE EFFICACY AND SCHOOL ADAPTATION

SHIMIZU, Y.1, MIYAZAKI, M.2, ANNEAR, M.1, TAKANASHI, M.1, YAMAUCHI, H.1
1:INTERNATIONAL CHRISTIAN UNIVERSITY , 2:J.F.OBERLIN UNIVERSITY

Introduction: Lack of exercise is widespread in Japan and some young adults are reluctant to exercise because of negative past experiences in school sports and physical education (PE). Currently, undergraduate physical education courses are compulsory at 66% of Japanese universities. This study examines the veracity of a hypothetical model for students' PE course evaluation and their self-efficacy for physical activities and school adaptation. It assesses the relationship among factors concerning PE instruction and students' attitudes towards exercise and campus life.
Methods: Subjects included 515 university students enrolled in PE courses (male: 149, female: 366, mean age=20.49, SD=1.21) who voluntarily answered a questionnaire composed of items from the Teaching Evaluation Scale for Physical Education Courses (TESPEC), Adaptation Scale for Physical Education Courses (ASPEC), Benefit Scale for Physical Education Courses (BSPEC), Self-Efficacy Scale for Physical Activities (SESPA) and School Adaptation Scale (SAS). Covariance structure analysis was conducted to confirm the acceptability of the hypothetical model and the relationship among the factors of the scales.
Results: The results of analysis showed that our hypothetical model yielded acceptable fit indices with teaching evaluation influencing exercise self-efficacy and school adaptation, mediated by adaptation to and perceived benefits of PE classes (GFI: 0.933, AGFI: 0.887, CFI: 0.954, RMSEA: 0.080). Among the mediating variables, direct effects were found from teaching evaluation to adaptation to PE classes (pass coefficient: 0.66, $p<0.001$), which in turn influenced perceived benefits of PE classes (pass coefficient: 0.90, $p<0.001$). Furthermore, perceived benefits of PE classes had direct effects on exercise self-efficacy (pass coefficients: 0.20, $p<0.001$) and school adaptation (pass coefficients: 0.39, $p<0.001$). .
Discussion: The results indicate that the hypothetical model can be used in predicting students' exercise self-efficacy and university adaptation and that instructors' perceived teaching skills and communication styles in university PE courses have an impact on students' exercise behavior as well as their adaptation to university. This implies that improving PE class experience for students is one of the ways to ameliorate negative attitudes towards exercise. Further research is needed to assess what types of interventions are most efficacious and which elements of PE classes (e.g. making friends in team sports) affect students' adaptation to university.
Contact: syasuo@icu.ac.jp

Conventional Print Poster

CP-PM23 Hormones and metabolism and inflammation

AEROBIC EXERCISE TRAINING REDUCES PLASMA 3-HYDROXYISOBUTYRATE LEVEL IN OVERWEIGHT AND OBESE MEN.

KANAE, M.1, TORU, Y.1, JIYEON, P.1, TERUO, M.2, AKIRA, H.2, NOBUTAKE, S.1, SEIJI, M.1
1.UNIVERSITY OF TSUKUBA, 2.TOKYO MEDICAL UNIVERSITY IBARAKI MEDICAL CENTER

INTRODUCTION: Obesity is a major public health problem all over the world and strongly relates to insulin resistance, which is a crucial risk factor for type 2 diabetes mellitus. Recent studies suggested that a higher circulating level of 3-hydroxyisobutyrate (3-HIB; a catabolic intermediate of valine), which was observed in obesity, caused insulin resistance. Aerobic exercise training has been recognized as an established strategy for preventing type 2 diabetes mellitus. However, its mechanisms have not been fully clarified. The purpose of the present study was to examine the effect of aerobic exercise training on plasma 3-HIB level in overweight and obese men.
METHODS: Twenty-one overweight and obese men completed a 12-week aerobic exercise training program under the supervision of exercise instructors (walk/jog, 60-80%HRmax, 30-60 min/day, 3 days/week). Participants were asked to maintain their dietary habits during the intervention. Before and after the exercise program, step counts, peak oxygen uptake, body mass index, body fat percentage, and plasma hemoglobin A1c (HbA1c) were measured, and 75-g oral glucose tolerance tests (OGTT) were performed. Plasma glucose, serum insulin, and plasma 3-HIB were measured at 0 min, 60 min, and 120 min after glucose loading.
RESULTS: After the 12-week aerobic exercise training, step counts and peak oxygen uptake increased significantly, whereas body mass index, body fat percentage, HbA1c, and plasma 3-HIB level decreased significantly. At the points of 60 and 120 min in the OGTT, plasma glucose level was significantly lower after than before the training, although there was no difference in plasma insulin level between before and after the training. Before the training, plasma 3-HIB level significantly and gradually decreased at 60 and 120 min-points in the OGTT. After the training, plasma 3-HIB level was maintained by 60 min after the glucose ingestion, and then, significantly decreased after 120 min to the equal level of the same point in the before training.
CONCLUSION: In result of the 12-week aerobic exercise training, plasma 3-hydroxyisobutyrate level significantly decreased accompanied with the improvements of body composition, physical activity and blood marker of diabetes in overweight and obese men. Furthermore, the response of plasma 3-hydroxyisobutyrate level significantly changed during OGTT after the training in the subjects. The decreased 3-hydroxyisobutyrate level in blood may be a part of mechanisms underlying prevention of the onset of diabetes by aerobic exercise training.

PHYSICAL ACTIVITY AND SALIVA CORTISOL CONCENTRATIONS DURING MILITARY FIELD TRAINING

OJANEN, T., VASANKARI, T., HÄKKINEN, K., KYRÖLÄINEN, H.

FINNISH DEFENCE RESEARCH AGENCY

INTRODUCTION: Military field training (MFT) exposes soldiers to both physical and psychological stress. These stressors have been shown to lead changes in both hormonal profile and physical performance (Tanskanen et al. 2011). The purpose of this study was to investigate changes in volume and intensity of objectively measured physical activity and changes in daily variation of saliva cortisol concentrations during MFT.
METHODS: A total of 167 (age 20±1yrs., height 180±7cm, body mass 74.5±10.7kg) male soldiers participated in the study. The measurements were made during the years of 2014-2016 in MFTs. Physical activity was measured with a 3-dimensional accelerometer placed on the waist. The activity data were analyzed by using a mean amplitude deviation (Vähä-Ypyä et al. 2015). The saliva samples were collected in Salivette tubes, a total of six times per day (06:00, 09:00, 12:00, 15:00, 18:00 and 21:00), before MFT (PRE), during a shooting training day (ST) and during a normal MFT day (MFT). In addition, body composition, maximal isometric force of the upper and lower extremities, muscular endurance tests with a standing long jump and the 12-min running test were measured in order to identify possible relationships with physical activity and saliva cortisol concentrations.
RESULTS: The mean (±SD) time for light physical activity (MET 1.5-3.5) was 3:28±0:56 h:min and for moderate physical activity (MET 3.5-6.0) 1:22±0:41 h:min in the PRE measurement day. The respective values for the ST day were 4:43±1:34 h:min and 2:02±1:07 h:min, and for the MFT day 4:03±1:21 h:min and 2:03±0:57 h:min. The mean (±SD) number of steps for PRE, ST and MFT were 12237±5140; 15030±5367; 14406±5102. The saliva cortisol concentration values were the lowest during the PRE day and the highest during the ST day in all measurement points.
CONCLUSION: The present study showed the highest values in physical activity and saliva cortisol concentration during the ST day. Morgan et al. (2002) found that soldiers who were exposed to stressful situations had higher saliva cortisol concentrations than soldiers who were not exposed to stressful situations. Similar findings were also observed in the present study. Physical activity was the same for the ST and MFT days, but ST had higher saliva cortisol concentrations. The results suggest that live-ammo shooting exercises are more stressful to soldiers mentally than normal MFT.
References: Tanskanen M, Kyröläinen H, Uusitalo A, Huovinen J, Nissilä J, Kinnunen H, Atalay M, Häkkinen K. (2011) J Strength Cond Res, 25(3), 787-797.
Vähä-Ypyä H, Vasankari T, Husu P, Mänttäri A, Vuorimaa T, Suni J, Sievänen H. (2015). Plos One, 10(8).
Morgan CA, Rasmusson AM, Wang S, Hoyt G, Hauger RL, Hazlett G. (2002). Biol Psychiat, 52, 136-142.

CHANGES IN SALIVARY CORTISOL LEVELS AND SUBJECTIVE CONDITION DURING 2016 AFC U-23 CHAMPIONSHIP PERIOD

NAKAMURA, D.1, NAKAMURA, M.1, HAYAKAWA, N.2

1 JAPAN INSTITUTE OF SPORTS SCIENCE , 2 JAPAN FOOTBALL ASSOCIATIONS

INTRODUCTION: In international football competitions, players have to play matches with only 2~4 days recovery days in between. Therefore, it is very important for team to monitor training load during the competition to prevent fatigue
To date, several studies indicated the usefulness of monitoring internal training load, such as hormonal response, heart rate variability, but there is few data available on changes in these variables during actual international football competition.
Thus, the aim of this study was to examine the changes in cortisol response and subjective fatigue of players during 2016 AFC U-23 Championship (Qatar).
METHODS: Twenty-three U-22 Japan national team football players were participated in this study. To monitor internal load, saliva cortisol level, body weight, and subjective condition were measured in the morning during 2016 AFC U-23 Championship period. Saliva cortisol level was measured using lateral flow device (LFD), and subjective conditions were evaluated using visual analogue scales (VAS). Before conducting this measurement, the validity of the device was checked by examining correlation coefficient between enzyme immunoassay (EIA) and LFD in salivary cortisol level.
RESULTS: The correlation coefficient between EIA and LFD in salivary cortisol level was $r = 0.82$ ($p < 0.01$).
Salivary cortisol levels of some players were increased after the matches, and returned to the original value after a few days of recovery during the competition period. However, there were some players who showed successive increase in the salivary cortisol levels when the number of matches was increased.
CONCLUSION: There was a relationship between the external load (match playing time) and changes in internal load (salivary cortisol and VAS) for some players, but not for all players. This might be explained by a different response against external load among individuals. These results from our present study indicated that the monitoring salivary cortisol level was useful tool to detect internal load of the players during international competition period. Also, internal training load should be evaluated individually since each player show different response to an external load.

THE RELATIONSHIP BETWEEN SALIVARY CORTISOL AND TRAINING LOAD IN ELITE RUGBY UNION PLAYERS

TIERNAN, C.1, LYONS, M.1, COMYNS, T.1, NEVILL, A.2, WARRINGTON, G.1

UNIVERSITY OF LIMERICK, UL, IRELAND, 1. UNIVERSITY OF WOLVERHAMPTON, WLV, ENGLAND, 2.

INTRODUCTION: Increased physiological stress can have negative effects on performance, particularly if there is an imbalance between training load (TL) and recovery (Meeusen et al. 2013). Salivary cortisol (sC) has been found to be a marker of physiological stress (Lindsay et al. 2015). There is limited research comparing weekly TL and sC levels in Rugby Union. The aim of this study was to investigate the association between weekly sC and TL in elite Rugby Union players.
METHODS: Nineteen male elite Rugby Union players (19.7 years±1.1, 184.5 cm±7.7, 96.2 kg±12.5) volunteered to take part in a 10-week pre-season study. Players provided saliva swabs twice a week (Monday and Friday morning). Session rate of perceived exertion (sRPE) was taken after every training session and TL was calculated by sRPE x session duration. Multi-level analysis, using MLwin software, was performed to analyse the association between sC and TL.
RESULTS: No significant association ($p>0.05$) was found between Monday sC and TL of the previous week ((0.00050 (0.00088) ng.ml) (Beta (Standard Error)) or between Friday sC and TL of the same week ((0.00079 (0.00071) ng.ml). Compared to baseline, a significant increase

(p<0.05) was found for Monday sC in weeks 4, 6, 8 and 9, and TL in weeks 2, 4, 6, 7, 8, 9 and 10. No significant weekly differences (p>0.05) were found with respect to Friday sC.
CONCLUSION: The results from this study found no association between TL and sC. This may be due to the large individual player variability in sC and may also indicate the expertise of the coaches in terms of appropriately regulating TL (Agostinho et al. 2017). The weekly differences indicate the changes in Monday sC and TL over the pre-season period, highlighting the importance of week by week analyses. The results imply that sC does not reflect weekly TL when assessed over a 10-week period. Future research is needed to investigate whole season variations in weekly sC and TL in Rugby Union players.
References: Agostinho M, Moreira A, Julio U, Marcolino G, Antunes B, Lira F, Franchini E. (2017). J Exerc Rehabil, 13, 68.
Lindsay A, Lewis J, Scarrott C, Draper N, Gieseg S. (2015). J Sports Sci, 33, 882-891.
Meeusen R, Duclos M, Foster C, Fry A, Gleeson M, Nieman D, Raglin J, Rietjens G, Steinacker J, Urhausen A. (2013). Med Sci Sport Exercise. 45(1), 186-205.
Contact: Caoimhe.tiernan@ul.ie

THE EFFECT OF PRIOR EXERCISE ON MEASURES OF RESTING METABOLIC RATE IN TRAINED MEN.

BONE, J.L., BURKE, L.M.
AUSTRALIAN CATHOLIC UNIVERSITY

INTRODUCTION: Resting energy expenditure (REE) is one tool that can be used to support the diagnosis of low energy availability. However to accurately measure REE and to be able to detect changes between measurements, it is important to investigate how certain variables may artificially increase the REE, potentially masking evidence of a supressed metabolic rate. One such variable is exercise. The REE following exercise has been reported to last up to 39 or 72 h in homogeneously trained populations(1,2). The aim of this pilot study was to profile REE when measured at 12 h intervals up to 48 h post exercise in a heterogeneous group of athletes undertaking self-selected training sessions.
METHODS: Ten trained males (age 30.3±6.2 y; weight 81.5±11.6 kg; height, 187.8±6.9 cm) from a variety of sports participated in this study. Participants undertook a standard training session of their choosing on Day 0, either in the morning or afternoon. The next morning they presented for their 1st REE (post-exercise-day) and DXA with no exercise being permitted following the REE on Day 1. Participants returned on Day 2 for their 2nd REE (post-rest-day). They then repeated this process the following week, however with the training session completed at the other time of day. Participants were assigned to train either in morning or the afternoon in the first week and in the alternative time in the second week. This provided REE approximately 24 and 48 h post exercise following morning training session and 12 and 36 h post exercise following the afternoon training session. The training session and diet was replicated from week to week. REE was determined following a minimum 8 h overnight fast using indirectly calorimetry as previously described(3). Linear mixed modelling was used to determine the difference between the different time points. The typical error for REE is 478 kJ/d.
RESULTS: There was a statistically significant decrease in REE of 345 kJ/d when measured 48 h post exercise compared to 12 h. There was a trend for REE to be lower with increasing rest from exercise. All differences between time-points were within the typical error for the outpatient protocol.
CONCLUSION: There was a trend for REE to decrease with increasing rest period from exercise. However, no clear effects of acute exercise on subsequent morning measures of REE could be detected in participants from a mixed sport population undertaking self-selected training sessions.
REFERENCES:
1) Dolezal, BA, et al (2000) Muscle damage and resting metabolic rate after acute resistance exercise with an eccentric overload. Med Sci Sports Exerc, 32, 1202-1207
2) Tremblay, A, et al (1988) Effect of a three-day interruption of exercise-training on resting metabolic rate and glucose-induced thermogenesis in training individuals. Int J Obes, 12, 163-168
3) Bone, JL, & Burke, LM (2017) No difference in young adult athletes resting energy expenditure when measured under inpatient or outpatient conditions. Int J Sport Nutr Exerc Metab, In press., 1-15

BREAKING UP PROLONGED SITTING AND POSTPRANDIAL GLUCOSE IN ACTIVE YOUNG MALE ADULTS WITH CENTRAL OBESITY

WONGPIPIT, W., LEUNG, M.L.E., CAO, X.Z., FU, X., YU, J., WONG, S.H.S.
THE CHINESE UNIVERSITY OF HONG KONG

INTRODUCTION: Greater time spent on sedentary is associated with an increased risk of morbidity and mortality independent of time spent in moderate-to-vigorous-intensity physical activity (MVPA) (Wilmot et al., 2012). In previous studies, frequent breaking up prolonged sitting protocols have been used (i.e., 2-min light-intensity walking every 20 minutes of sitting or 3-min light-intensity walking every 30 minutes (Dunstan et al., 2012; Dempsey et al., 2016). Practically, some people may prefer breaking up prolonged sitting less frequently (i.e., 6-min light-intensity walking every 60 minutes) (Bond et al., 2014). The purpose of this study was therefore to determine whether 3-minute walking every 30 minutes of sitting is comparable to 6-minute walking every 60 minutes of sitting in influencing postprandial glucose among young men with central obesity.
METHODS: This study used a randomised crossover design. Thirteen physically active centrally obese men (mean age: 25.08 ± 3.2 years; body mass index: 29.36 ± 3.46 kg/m2; waist circumference: 98.12 ± 8.04 cm; % body fat: 28.58 ± 4.37%) were recruited. Physical activity levels and sedentary time were measured using an ActiGraph accelerometer and an activPAL, respectively, during 7 days of screening and washout periods. Consumed standardised meals calculated using Mifflin and St.Jeor's formula (Mifflin et al., 1990) (Carbohydrate = 55%, Fat = 30%, and Protein = 15%). There were three main 7-hour conditions separated by 6-14 days washout: uninterrupted sitting (SIT); sitting + half hourly bouts of walking (3.2 km/h for 3-min) (3-MIN); sitting + hourly bout of walking (3.2 km/h for 6-min) (6-MIN). Plasma glucose was measured 30 minutes after the meal and hourly using an enzymatic-amperometric method. Plasma glucose was changed to the net total area under the curve (tAUC) using the Trapezoidal method. Two-way ANOVA with repeated measures was used to examine differences among three conditions over time for plasma constituents. The Bonferroni post-hoc test was used for multiple comparisons where appropriate.
RESULTS: During screening visit, the averages of MVPA and sedentary time were 53.63 ± 21.76 minutes per day and 559.68 ± 90.70 minutes per day, respectively. Compared with SIT, both interrupted conditions did not significantly reduce tAUCs for glucose (SIT mean 38.32 ± 2.13 mmol.h/L vs. 3-MIN 38.67 ± 2.23 and 6-MIN 38.84 ± 2.96) (P = .316).

CONCLUSION: These data demonstrate that breaking up prolonged sitting with both 3 minutes and 6 minutes of light-intensity walking every 30 minutes and 60 minutes of sitting, respectively, may not be able to influence postprandial plasma glucose in physically active young male adults with central obesity. It is possible that breaking up prolonged sitting with activities of greater intensity than light-intensity walking or longer duration may positively enhance postprandial glucose metabolism.

ACUTE AND CHRONIC INFLAMMATORY RESPONSES DURING A SEASON TRAINING IN YOUNG SWIMMERS

NAFPAKTITOU, D.1, PHILIPPOU, A.2, VAGIAKAKOS, G., VAGIAKAKOS, N., MANTALOUFAS, M., CHROUSOS, G.3, KOUTSILIERIS, M.2, PLATANOU, T.1

NATIONAL & KAPODISTRIAN UNIVERSITY OF ATHENS

INTRODUCTION: It is well established that prolonged strenuous exercise suppresses some aspects of immune function, while intense exercise training not accompanied by sufficient rest periods may induce chronic, low-level systemic inflammation. These exercise-induced negative effects can be counteracted by the production of inflammatory and anti-inflammatory cytokines which influence many immune cell activities. Swimming exercise training is heavy and demanding and may lead to immunosuppression and associated chronic fatigue.
METHODS: To investigate the acute and chronic effects of a full season swimming training on serum C-reactive protein (CRP), interleukin (IL)-1beta and IL-10, both at rest and after a maximal exercise bout, twelve well-trained male swimmers (14.08±1.0 yrs) were recruited. Measurements were carried out at the beginning of the training season (T1) and pre- and post the taper of each of the two competitive periods (i.e., T2, T3 for the first macrocycle, and T4, T5 for the second macrocycle, respectively). At each of the above time points, blood samples were collected pre- and 1 hour post a maximal, 400m swimming testing. Serum IL-1beta and IL-10 levels were measured by ELISA using a commercially available kit, while CRP was analyzed by electrochemiluminescence. Adjustment for exercise-induced plasma volume changes was performed before all data analyses.
RESULTS: Pro-inflammatory biomarkers CRP and IL-1beta had similar pre-testing responses, exhibiting a significant decrease between T1 and T4 ($p = 0.034$ and 0.023, respectively) and a no significant increase between T4 and T5 ($p>0.05$). However, a significant pre-testing decrease of IL-1beta between T2 and T4 was also observed. There were no significant differences among the post-testing responses either for CRP or IL-1beta throughout the experimental period. Significant pre-post testing differences were found for the anti-inflammatory cytokine IL-10 T1 ($p = 0.001$) and T2 ($p = 0.028$). Also, post-testing IL-10 levels were significantly different between T1 and T3 ($p = 0.055$), while pre-testing values exhibited no significant differences throughout the experimental period; however, there was a tendency to increase from T2 to T5, and to remain constant at T1 and T2.
CONCLUSION: These findings indicate that acute (pre-post testing) inflammatory responses are greater during the first swimming training macrocycle, while prolonged training may activate an adaptive mechanism, which attenuates the magnitude of these responses. Interestingly, long-term exercise training induced an increase in serum IL-10 and a decrease in IL-1beta and CRP at rest, showing an adaptive anti-inflammatory change. Our findings confirm the notion that IL-1beta and IL-10 are reciprocally related, exhibiting a biphasic training-induced pattern, with large acute systemic post-exercise changes, i.e., elevation of IL-10 and decrease of IL-1beta, and low-grade chronic changes during long-term exercise training.
The authors would like to express their sincerest appreciation to the A. G. LEVENTIS FOUNDATION for supporting this research.
nafpaktid@phed.uoa.gr

AGES VALUES AND EATING HABITS BETWEEN REGULAR AND ATHLETE FEMALE UNIVERSITY STUDENTS: A COMPARATIVE ANALYSIS

NAKAJIMA, S.1, KOIZUMI, K.2, CHO, C.2

1> KYORITSU WOMENS JUNIOR COLLEGE, 2> JAPAN WOMAN'S COLLEGE OF PHYSICAL EDUCATION. JAPAN

INTRODUCTION: Advance glycation end products (AGEs) are harmful substances produced by excessive proteins and sugars in the human body. Reportedly, the excessive accumulation of these substances accelerates the ageing process and contributes to multiple diseases, such as arteriosclerosis and diabetes. Studies have established a correlation between AGEs accumulation and food intake. However, little information is available regarding AGEs in younger populations than in elderly population in Japan, which comes with a higher risk of lifestyle-related diseases. In this study, we aimed to elucidate the association between food intake and AGEs value by investigating the food intake of female university students and then evaluating their AGEs values. Furthermore, we investigated the variation in AGEs values between regular and athlete female university students.
METHODS: We evaluated AGEs values using a TruAge scanner by obtaining measurements from the front part of the left forearm. This nonintrusive method assesses in vivo AGEs accumulation by exposing and exciting accumulated AGEs to light (mild ultraviolet exposure). Then, we used the specific fluorescence of AGEs to evaluate the level of AGEs accumulation under the skin. Further, we conducted a food intake survey according to the Food Frequency Questionnaire.
RESULTS: In regular female university students, we obtained higher scores on items regarding the attitude about food, and the awareness of food indicated better dietary habits and a correlation between the two. However, both items did not correlate with AGEs levels as a single item. Moreover, the lipid ratio, animal protein ratio and grain energy ratio did not correlate with AGEs levels. The ratio of green and yellow vegetables was negatively correlated, indicating that the consumption of large amounts of green and yellow vegetables decreased AGEs levels. Although there was no correlation between muscle mass and AGEs levels, AGEs levels tended to be lower with higher muscle mass.
CONCLUSION: Our findings suggest that good dietary habits, maintained muscle mass and exercise might be associated with AGEs levels. Nevertheless, further extensive studies are warranted because data obtained from university students can be a useful comparison against that collected from middle-aged or elderly individuals, who tend to exhibit higher AGEs accumulation values.

VITAMIN D STATUS OF ELITE ATHLETES IN SINGAPORE AND ITS ASSOCIATION WITH MUSCLE FUNCTION AND BONE HEALTH

HUANG, L., ANG, S., TEO, C., LUM, D., JOSEPH, R., FAIRBAIRN, K.

SINGAPORE SPORT INSTITUTE

INTRODUCTION: Despite residing in a tropical country, Singaporeans may still be at risk of Vitamin D deficiency. Indeed, 91% of male Qatari athletes and 82% of Spanish athletes have presented with insufficient Vitamin D status (Hamilton et al. 2010; Valtuena et al. 2014). Due to common sun avoidance habits in Singapore, local athletes, especially indoor sport athletes, may have low Vitamin D status.
Emerging research suggests that vitamin D may regulate skeletal muscle function and modulate immune and inflammatory functions. A recent study conducted among professional soccer players found that vitamin D supplementation in vitamin D deficient athletes significantly improved sprint and vertical jump performances (Close et al. 2013). Currently, the vitamin D status of athletes in Singapore is unknown.
The primary aim of this study is to determine the prevalence of vitamin D deficiency among Singaporean athletes participating in indoor and outdoor sports in Singapore while the secondary aims are to examine vitamin Ds relationship with skeletal muscle functions and bone density.
METHODS: Serum 25(OH) D concentrations were measured from n = 92 athletes (52 indoor & 40 outdoor athletes) from various indoor and outdoor sports in Singapore. Skeletal muscle strength and performance were assessed using the isometric mid-thigh pull (IMTP), drop jump test and 30 m sprint test. Bone Mineral Density was measured using dual-energy x-ray absorptiometry (DEXA). Independent t-test, Mann Whitney-U and Chi-Square tests were used to determine differences between indoor and outdoor sports.
RESULTS: Mean serum 25(OH)D of indoor and outdoor sport athletes were 28.6 ± 8.9 ng/ml and 39.2 ± 13.2 ng/ml respectively ($p < 0.05$). Significantly more indoor sport athletes (62%) were insufficient in vitamin D compared to outdoor (28%) ($p < 0.05$). Muscle strength and performance outcomes were not different between groups except for peak force generation. Peak force and rate of force development from the IMTP were 1869 ± 546 N and 7156 ± 3408 N/s respectively for the indoor group and 2079 ± 470 N and 6444 ± 3270 N/s respectively for the outdoor group ($p = 0.027$; $p = 0.343$). Sprint times and reactive strength indices of indoor and outdoor sport athletes were 4.84 ± 0.5 s and 1.12 ± 0.9 and 4.72 ± 0.6 and 1.08 ± 0.3 respectively ($p > 0.05$). z-scores reflecting bone mineral densities were higher among outdoor sport athletes (1.39 ± 0.9) compared to indoor sport athletes (1.02 ± 0.8) ($p < 0.05$).
CONCLUSION: To our knowledge this is the first time that Vitamin D status has been assessed in Singaporean athletes. Despite residing in a tropical country, there is a high prevalence of vitamin D insufficiency among elite Singaporean athletes. Routine monitoring of vitamin D levels among indoor athletes should be in place to ensure optimal health and performance.
References:
Hamilton et al. (2010) Public Health Nutr, 13 (10), 1528-34
Valtuena et al. (2014) Nutr Hosp, 30 (1), 121-131
Close et al. (2013) J. Sp Sci, 31 (4), 344-353

ACUTE EFFECT OF RESISTANCE EXERCISE AND SUBSTANTIAL BREAKFAST ON MUSCLE BREAKDOWN IN HEALTH YOUNG MEN

KUME, W., YOSHIKAWA, M., YASUDA, J., HASHIMOTO, T.

RITSUMEIKAN UNIVERSITY

INTRODUCTION: Few studies have investigated on the optimum timing of resistance exercise (RE) in the day. A previous study found that muscle hypertrophic effect of RE in the morning was less than evening, although the mechanism remains unknown 1). In the morning, RE-induced muscle breakdown (MB) could be abundant due to malnutrition such as the fasting state 2). On the other hand, testosterone (T) and cortisol (C) were reported to be associated with muscle synthesis (MS) and MB, and thus T/C ratio may affect RE-induced muscle hypertrophy 3). However, responses of T, C, and MB against RE and substantial breakfast (BF) are not evident. The purpose of this study was to examine the acute effect of the order of substantial BF with RE on the responses of T, C, and MB in healthy young men.
METHODS: In this crossover study, twelve healthy men were divided into three conditions: 1) BF before RE condition (Pre), 2) BF after RE condition (Post), and 3) RE without BF condition (No). They performed 5 types of multiple RE at 70% repetition maximum intensity 4). In all conditions, RE was performed from 8:30 to 9:30. The time of BF in the Pre was at 7:00, while the time of BF in the Post was at 9:30. The standard Japanese lunch menu with 21 g of whey protein and 200 ml of milk (total energy, 1019 kcal; protein, 53.4 g [21%]; fat, 25.1 g [22.2%]; carbohydrate, 139.5 g [56.8%]) was provided as a substantial BF. Whole saliva samples were collected at 7:00, 10:00, and 12:00, and used for T and C measurements. Urinary samples were collected at 7:00, 10:00, 12:00, 15:00, and 18:00, and urea nitrogen (UN), creatinine (Cre), and 3-methylhistidine (3-MH) concentrations were measured.
RESULTS: 3-MH and UN, which are markers of MB, were normalized by Cre. The area under the curve (AUC) of 3-MH was significantly higher in Pre than that in No ($P < 0.01$). On the other hand, there was no significant difference between Post and No in the AUC of 3-MH. The AUC of UN was significantly higher in Pre than that in Post ($P < 0.05$) and No ($P < 0.01$). The T/C ratio of Post was significantly higher at 12:00 than at 10:00 ($P < 0.05$), while the T/C ratio in other conditions did not change throughout the experiment.
CONCLUSION: These results suggest that an acute effect of dietary intake before RE in the morning may not be effective for muscle hypertrophy.
1) Küüsmaa M et al. Appl Physiol Nutr Metab. 41: 1285-1294, 2016.
2) Lemon PW et al. J Appl Physiol. 48: 624-629, 1980.
3)Hayes LD et al. Chronobiol int. 27 (4): 675-705, 2010.
4)Hansen S et al. J Med Sci Sport. 11:347-354, 2001b.

Conventional Print Poster

CP-PM24 Physical activity promotion sedentarism

EFFECTS OF PHYSICAL ACTIVITY PROMOTION AMONG UNIVERSITY STUDENTS: THE #STUDIOXLAVITA PROJECT

D'ELIA, M.1, CAMELIO, S.1, BRUSEGHINI, P.2, CREMA, C.3, FAGONI, N.2, RONCHINI, C.2, TABONI, A.1, VINETTI, G.2,3, FLAMMINI, A.3, FERRETTI, G.2

UNIVERSITY OF BRESCIA

INTRODUCTION: Sedentariness is a major health problem in our time and physical activity promotion is an imperative commitment for healthcare systems. Recommendations from WHO indicate a minimum of 150 minutes of moderate intensity aerobic exercise as weekly standard for adults. Strategies to increment PA practice are implemented in different settings, such as house care, school, University and workplace. The project #studioxlavita <#SXLV> was launched by the University of Brescia in 2016 with the aim of collecting data about undergraduates lifestyle and encourage healthy behaviours. In particular we focused on PA assessment and promotion in a University-based setting.
METHODS: Two consecutive surveys were sent to all students . Q0 included the short form of the International Physical Activity Questionnaire , the Kessler Psychological Distress Scale and additional questions on several lifestyle aspects. Among responders, we selected 40 students who agreed to take part in one of the following 15-week practical sport courses: ultimate frisbee, muscle strengthening and dance fitness. Before and after being engaged in practical sport courses, students underwent cardiopulmonary exercise test and skinfold thickness measurements, in order to assess peak oxygen consumption and percent body fat . Finally, to assess possible lifestyle changes, we sent them additional surveys at the end of the practical sport courses and 30 days after . Paired t-test was used to analyse significant differences.
RESULTS: 27 students <16 female, 11 male; age: 22.7±3.7> concluded sport activity courses and filled in Q1. Of them, 20 completed also Q2. Overall courses attendance was 57%. At T1 , normalized $\dot{V}O_2$peak increased with respect to T0 <37.0±6.9 vs 35.2±7.4 ml/min/Kg, p=0.03>. Conversely, percent body fat decreased <16.5±6.4 vs 18.3±7.5, p=0.01>. In Q1, 20 students declared to have a more active lifestyle since the beginning of the courses. In Q2, IPAQ-SF-derived total weekly energy expenditure was higher than in Q0, although not significant <5,839 ±7,035 MET*min vs 2,770±2,457 MET*min, p=0.1>. Q2 showed a reduced K6 scale score with respect to Q0 <13.8±4.6 vs 15.8±4.9, p=0.03>.
CONCLUSION: With the sport activity courses established in #SXLV we gave students the opportunity to comply with WHO recommendations. After courses, they appeared to practice more PA, have a higher maximal aerobic capacity, a lower percent body fat and a lower grade of psychological distress than before courses. Simple activities as those proposed by #SXLV are sufficient to reduce sedentariness and improve the quality of life of students.

LIFESTYLE ASSESSMENT AND IMPROVEMENT WITH FOCUS ON LEISURE TIME PHYSICAL ACTIVITY AMONG UNIVERSITY STUDENTS: THE #STUDIOXLAVITA PROJECT

CAMELIO, S.1, D'ELIA, M.1, BRUSEGHINI, P.2, CREMA, C.3, FAGONI, N.2, RONCHINI, C.2, TABONI, A.1, VINETTI, G.2,3, FLAMMINI, A.3, FERRETTI, G.2

UNIVERSITY OF BRESCIA

INTRODUCTION: Sedentariness, smoking, alcohol abuse and unbalanced feeding are harmful for health, leading to chronic diseases and increasing mortality rate. For young adults, University is a new social and cultural context: parents' imprinting could be easily altered, new lifestyles take shape and personal choices emerge. Intervention programmes to advance awareness on harmful lifestyle and promote healthy habits are essential. The #studioxlavita project, launched in 2016 by the University of Brescia with these purposes, investigated students' lifestyle, with special emphasis on physical activity .
METHODS: We developed two consecutive facultative surveys, of 15 <1st level> and 52 items <2nd level>, addressed to all the University's students. Questions were about leisure time physical activity , use of fitness technology, relationship with friends, classmates and parents, feed, physical appearance, body self-perception, physical and mental health, use of certain substances or products , night-time rest and beliefs concerning healthy behaviours. In the 2nd level survey we also adopted the Kessler Psychological Distress Scale and the short form of the International Physical Activity Questionnaire to estimate the amount of PA carried out in the last 7 days. Students who filled in both questionnaires received a personal report including the aggregate data analysis, a comparison with other investigations and indications about healthy habits, according to recommendations and guidelines.
RESULTS: 3,436 out of 15,688 students filled in the1st level survey. Of them, 778 accepted to participate in the 2nd level survey, and 456 completed it. 1st level survey revealed that 72% of the students practised LTPA <45% regularly and 27% occasionally>. LTPA is largely performed <44% of the student> in non-competitive form, with recreational and/or health purposes. According to IPAQ-SF categorical score, 24%, 34% and 42% of the students performed low, moderate and high levels of PA, respectively. In 2st level survey, 76% of the students wished to practise more PA; 42% would participate in practical sport courses.
CONCLUSION: University is an ideal setting for promoting lifestyle change among a captive audience. Intervention programs to increment PA are acclaimed by students. The students from University of Brescia reported higher LTPA practice than the national average people between 18 and 34 years <47%, data from Italian National Institute of Statistics, 2015>, although this parameter was assessed with different methods.

ASSESSING PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOR USING ACCELEROMETERS IN A YOUNG UNIVERSITY POPULATION IN THE UNITED ARAB EMIRATES

DALIBALTA, S., DAVISON, G.

AMERICAN UNIVERSITY OF SHARJAH

INTRODUCTION: Physical inactivity is inextricably linked to the onset of cardiovascular disease (CVD) and diabetes. Data suggests that nearly 58% of the UAE population is physically inactive and only 22% of secondary school graduates and 26.3% of university graduates get the sufficient amount of exercise recommended to stay healthy (DHA, 2009). As a result, the prevalence of overweight and obesity in children in the UAE is over 30%; one of the highest in the world (Malik et al., 2007). The aim of this study was to obtain the first data set

that assesses body composition as well as compares physical activity and sedentary behavior between genders using accelerometers in a young university population in the UAE.
METHODS: Upon approval by the Institutional Review Board, 125 students attending the American University of Sharjah, 55 males and 70 females, participated in this study. The study took place between January-December 2017. Students were from different ethnic backgrounds and had an average age of 20 years old. Using a body composition analyzer (TANITA, Japan), we obtained an accurate measure of weight, body fat, fat percentage, Fat Free Mass (FFM), muscle mass, bone mass, BMI as well as a segmental distribution of muscle and fat mass. In addition, subjects were asked to wear an accelerometer device (ActiGraph wGT3X-BT, UK) for 7 consecutive days. Summary measures of physiological parameters as well as physical activity and sedentary behavior values were compared between males and females using a sample T-test (Minitab software).
RESULTS: Analysis of body composition revealed that males had statistically higher values of weight, BMI, muscle mass, and fat free mass although females had a statistically higher fat percentage (29.4%) compared to 18.8% in males ($p \leq 0.05$). Time spent in sedentary behavior was similar in both males and females and calculated as an average of 8374 minutes. This translates to approximately 85.6% of their time spent sedentary. Their physical activity was primarily in the light exercise range (10.9%), although males spent a significantly greater amount of time in moderate and vigorous intensity exercise with MVPA values of 403.7 minutes (4.1%) compared to 294.8 minutes (3%) in females ($p \leq 0.05$). Males also took a greater number of steps per day (8410.7 steps) compared to females (6899.3 steps) and expended 528.9 kcal/day compared to an average of only 281.4 kcal/day in females ($p \leq 0.05$).
CONCLUSION: This data demonstrates that this young UAE population is extremely sedentary with an alarming average of 12.4 hours a day. Although males have a lower fat percentage and appear to spend more time in moderate and vigorous intensity exercise, they still do not meet the minimum recommendations of exercise to stay healthy. This data highlights the need for further research and targeted interventions in order to reduce the risks of CVD and obesity in this highly susceptible population.
Dubai Health Authority. DHA announces results of survey that highlights the prevalence of cardiovascular diseases (CVD) risk factor. 2014; https://www.dha.gov.ae/EN/Media/News/pages/dhaannouncesresultsofsurveythathighlightstheprevalenceofcardiovasculardiseases(cvd)risk.aspx
Malik M & Bakir A. Prevalence of overweight and obesity among children in the United Arab Emirates. Obes Rev. 2007;8(1):15-20.

ASSOCIATIONS BETWEEN SEDENTARY BEHAVIOUR AND PHYSICAL CAPABILITY WITHIN THE WORKPLACE

SOUTHALL-EDWARDS, R., TAYLOR, M., GLADWELL, V.
UNIVERSITY OF ESSEX

INTRODUCTION: Physical capability is vital for conducting tasks of daily living and in older populations is associated with improved quality of life. Detecting reductions in physical capability in adults, may highlight individuals at risk for future adverse health outcomes. Research into associations between physical capability and sedentary behaviour (SB) is limited and has been confined to older populations. The purpose of this research was to investigate associations between physical capability and SB, in adults within the workplace, who spend large periods of their time sitting.
METHODS: Forty-two (19 male) healthy adult volunteers (aged 42.1 ±1.9 years), had their SB measured over a six-day period using accelerometry. Physical capability was assessed using tests of dynamic balance, grip strength and walk speed. Regression analyses were run to determine if time spent in overall daily SB, was associated with measures of physical capability; the effect of prolonged (>15 mins) SB was also considered.
RESULTS: Overall daily (β:0.98) and prolonged (β:0.81) SB were independently associated ($p<0.05$) with balance in males but not females ($p>0.05$). For males, overall daily SB explained 40% and prolonged SB 42% of the variance in balance scores. Grip strength and walk speed were not independently associated ($p>0.05$) with any measures of SB.
CONCLUSION: Spending more time in SB throughout the entire day was associated with impairing the balance of males. Grip strength and walk speed were not associated with SB, however, they were reduced compared to population norms. This may highlight how in these adults, working in an occupation requiring large periods of inactivity, that a range of physical capabilities are impaired. The workplace has been considered as a potential environment to help reduce SB and increase physical activity. Interventions should be designed to improve physical capability and not just focused on reducing SB and together this may decrease the risk of future adverse health outcomes and improve quality of life, especially in later years.

COMPARISON OF PHYSICAL ACTIVITY AND STEP COUNTS BETWEEN ACTIGRAPH ACCELEROMETERS, PACER PHONE APP AND YAMAX PEDOMETER IN FREE LIVING YOUNG ADULTS.

MCKEE, D.P., WALLACE, S.H., RUTHERFORD, P.W.
STRANMILLIS UNIVERSITY COLLEGE

INTRODUCTION: Coupled to the general consensus that increased levels of physical activity lead to enhanced health outcomes there has been an increased interest in the assessment of physical activity (PA) in both researchers and the general population. This has led to a greater range of objective measures of PA including research and consumer grade devices. What is less clear is the comparability of these devices even when they purport to assess the same dimensions of PA e.g. moderate and vigorous PA (MVPA) or accumulated steps. This investigation was therefore designed to compare MVPA and steps assessed by Actigraph GT3x accelerometers, Pacer PA app for mobile phones and the Yamax SW200 pedometer
METHODS: 23 adults (11M) aged 21-27 yrs wore an Actigraph GT3x (AG) accelerometer and a Yamax SW200 pedometer (Yamax) on an elasticated belt over their left hip for one day from 10am until their bedtime. They also assessed PA via the Pacer phone app (Pacer) for the same period. Raw data from the AG was downloaded and converted to minutes of MVPA via propriety software using the cut points of Troiano et al (2008), MVPA and steps from Pacer, and Yamax steps were recorded by participants at the end of the day. Mean scores were compared via ANOVA (steps) or T-Test (MVPA). Correlations were calculated between variable pairs. All analysis were carried out using SPSS (IBM v 24) with alpha set at 0.05.
RESULTS: Mean (SD) minutes of AG and Pacer MVPA were 44.0 (18.1) and 58.0 (25.7, $p< 0.05$, $r= 0.79$). Daily steps were: AG, 6375 (2292); Pacer, 5629 (2369); Yamax, 7077 (2648). All three measures of steps were significantly different from each other ($p< 0.05$) and strongly correlated ($r= 0.81$ to 0.97).
CONCLUSION: As evidenced by the inter-variable correlations there are strong relationships between the various measures of MVPA and between the daily step counts but there are also substantive differences between mean scores. These findings indicate that in terms of both MVPA and daily steps results from different devices are not comparable.

THE EFFECT OF PHYSICAL ACTIVITY AND SUNLIGHT EXPOSURE ON KOREAN JUVENILE MYOPIA

JI, C., KIM, S.

KOREA UNIVERSITY

INTRODUCTION: East Asian region ranked second behind the West Pacific region concerning the population of the refractive index disorder in the world. Three phenomena are noticeable in Asian countries. First, the rate of increase in myopia prevalence in East Asian is faster than the world average. Second, the age range of myopia is expanding to children and adolescents. Third, high levels of myopia associated with vision impairments are increasing. The exact medical or socio-environmental cause for refractive error remains yet to be found. It seeks to analyze proneness using big data.
METHODS: This study used data collected during health interviews carried out as part of the fourth Korean National Health and Nutrition Examination Survey. The subjects, in total 1,410 adolescents aged 12 to 18 years, were classified into two groups based on the amount of sunlight exposure and physical activity. PA is classified as dynamic group<>3,000MET/week>, moderate group<3,000-600MET/week>, inactivity group<<600MET/week> using the formula from the International Physical Activity Questionnaire. Sunlight exposure data were classified as "less than 5 hours" compared to "5 hours or more".
RESULTS: First, when the practice rate of moderate intensity PA and walking <5times/week and 30min/week> is "Nonparticipation", each myopia prevalence<≤-0.75 Diopter> odds is 1.78 times and 1.54 times higher than "Participation". Second, when the PA is "Inactivity" or "Moderate", each myopia prevalence odds is 1.55 times and 1.64 times higher compared to "Dynamic". Also, each high myopia<≤-6.0> prevalence odds is 2.36 times and 2.66 times higher, and each moderate myopia<≤-3.0 and ≥6.0> prevalence odds is 1.79 times and 1.98 times higher. Third, when the amount of sunlight exposure is "Less than 5 hours", myopia<≤-0.75> prevalence odds is 1.61 times higher, and high myopia<≤-6.0> prevalence odds is 2.74 times higher compared to "5 hours or more".
CONCLUSION: It was found that insufficient PA and sunlight exposure affect the development of myopia. Physical activity and sports activities in the outdoors in adolescence, which is a period of accelerated development of nearsightedness, will help to reduce the rate of myopia. Recently, a typical high myopia prevalence rate in Asia is associated with a decrease in outdoor activities. These results provide a sound basis for reducing the prevalence of myopia. If it complies with the national policy, it is thought that it helps the decrease of the medical expenses of the youth and the health promotion.

OUTDOOR EXERCISE IS MORE EFFICIENT THAN INDOOR EXERCISE IN SENIOR CITIZENS. PHYSIOLOGICAL EVIDENCE FROM THE HERO PROJECT

AHNESJÖ, J., BERGMAN, P.

DEPARTMENT OF SPORT SCIENCE

INTRODUCTION: Introduction: Physical exercise has been proven beneficial for health in all ages. In elderly, physical exercise, may contribute to prolonged life with maintained high quality and less costs associated with health care for society. In this study we explore if exercise out of doors may provide extra benefits as compared to exercise indoors and we measure power output, lactate levels and perceived effort in 49 senior citizens performing 20 minutes of moderate physical activity.
METHODS: Method
The HERO project is a randomized cross-over experiment with three different treatments . The study sample consisted of 49 healthy senior citizens. They performed 20 minutes moderate intensity physical activity on an ergometer bike in all three conditions. Before immediately after and at minutes 10, 20, 30, 60 and 120 we sampled blood lactate. Power output was computed at 7 occasions during the 20 minutes of cycling, as was the rating of perceived exertion . Data was analyzed using mixed linear models.
RESULTS: Results: Our findings show that there were no differences between the two indoor treatments in any of the measured variables. In the outdoor treatment, however, there were significant effects on blood lactate levels and power output but not in perceived exertion, suggesting that exercise out of doors makes the test person more efficient although the experience of effort stay unaffected.
CONCLUSION: Discussion/conclusions
Our results support the notion that the outdoors may provide extraordinary conditions for exercise, not only because it appear to results in more exercise/effort, the outdoors is also an "arena" with high availability and most often totally for free.
Previous results from the HERO project also suggests that white blood cell counts are affected by the outdoor treatment, something that may be related to the observed increased power output herein.

DETERMINATION OF FRAMEWORK CONDITIONS FOR THE DEVELOPMENT OF A TARGET-GROUP SPECIFIC HEALTH EXERCISE TRAINING FOR SENIORS OVER 70 YEARS

LANGKLOTZ, M., SCHULZ, H.

CHEMNITZ UNIVERSITY OF TECHNOLOGY

INTRODUCTION: Health exercise training developed for the special needs of the elderly can counteract the age-related decline in conditional, coordinative and cognitive abilities. The content of a training can additionally be derived from the reasons for or against sporting activity or the organizational requirements for participation in the offer. The aim of the analysis of needs was therefore to check to what extent the information and wishes of the respondents are suitable for the development of health exercise training in a foreign-organized setting.
METHODS: 316 people (P) (75±6 years, 63% female, 88% without help in everyday life/ 6% need help (family/friends)/ 2% home care service) voluntary participated in a survey (self-filled questionnaire). They were questioned about their physical (PA) and sporting activity (SA) (85% PA and SA/ 9% only PA/ 2% only SA/ 4% neither PA nor SA), their reasons against and for SA (based on the motives of the BMZI-HEA; possible answers from 1 = is not true to 5 = is very true) and the organizational requirements for the SA.
RESULTS: For the reasons against SA, the 39 items were answered by 32±2 of the 42 athletic inactive. The main reasons with a median of 4 were due to the impaired health and many low-intensity activities in everyday life. Other reasons were: long time sporting inactivity, fear of falling, do not feel like it, too many other commitments/leisure activities, missing accompaniment (median 3).
Each of the 36 reasons for SA was answered by 258±15 P. The field of everyday life competence took the highest rank (median 5). This was followed by: physical health/fitness, cognitive functioning, positive movement experiences (each median 4). In addition, 97% of 264 P stated that it is important or very important to enter a sports offer specialized on the skills needed at a higher age.
77% (of 353 nominations) of the offer should be foreign-organized (30% commercial establishment, 39% association, 8% other educational institutions). 85% (of 230 P) would take part in the sports offer together with strangers, 98% (of 226 P) in a group, 91% (of 234 P)

mixed (female/male), 97% (of 234 P) inside und 98% (of 227 P) together with P over 70 years. The offer should take place mainly one or two times a week (44% or 37% of 225 P) with a duration of 60 min each (62% of 224 P). Most P want a year-round offer (77% of 210 P), preferably Monday till Thursday (78% of 538 n.), in the time until 13/14 oclock (50% of 194 P).
CONCLUSION: Regarding the reasons against SA could be counteracted with a health exercise training especially in the areas of impaired health, low-intensity activities, long time sporting inactivity or fear of falling. The reasons for SA can be implemented very well in terms of content. Also in the area of the formal organization of the offer, it can be seen that exist optimal prerequisites for foreign-organized health training for persons over the age of 70 in a mixed group.

„INCLUSION AND SPORTS WITH HANDICAP" - A PROJECT TO BRING PUPILS CLOSER TO INCLUSION AND DISABILITY

SCHULZ, A.

UNIVERSITY OF ROSTOCK

Introduction: Inclusion is a much debated topic in politics, society and science. To bring it closer to pupils we started the project „Inclusion and Sports with Handicap" in cooperation with a local integrated school. The purpose was to raise the children`s awareness for people with disabilities and for an inclusive education system. The combination of contact with handicapped people, simulation of different disabilities, access to information and trying sports for people with disabilities was shown to be the most effective method for changing the attitude towards people with disabilities (Cloerkes, 2007) and was applied in this project.
Methods: In ten lessons within six weeks 32 participants aged 15-16 received information and opportunities to discuss and reflect. They further tried different sports for handicapped people including wheelchair basketball, blind football, athletics (wheelchair racing, running with visual impairment, running without the support of the arms), obstacle courses with a wheelchair and simulation of visual impairment. Experts for these disciplines who also shared their experience of living with an impairment supported this project. For measuring changes in attitude towards peers with disabilities we analysed written questionnaires at the beginning and end using the „Chedoke-McMaster Attitudes Towards Children with Handicaps Scale" (CATCH) which is one of the most complete instruments in this field (Vignes et al., 2008).
Results: Out of the 32 data sets 21 were analysed, 11 were excluded because of incomplete data in both questionnaires before and after the project. While before starting the project 38.1 % of the respondents strongly agreed that they would not mind if a handicapped child sits next to them, 76.1 % strongly agreed after the project. Similar effects were found in other items concerning affective, behavioural and cognitive components of attitude. Specific results of several attitude-changing effects are presented at the poster.
Conclusion
Even after a relatively short period of six weeks the attitude towards people with disabilities changed measurable. Pupils came in contact to people with an impairment and empathized with them. In conclusion, a comparably short sensitization period is sufficient to raise children`s awareness for people with disabilities and inclusion.
References: Cloerkes, G. (2007). Soziologie der Behinderten. 3. Auflage. Heidelberg: Universitaetsverlag Winter.
Vignes, C., Coley, N., Grandjean, H., Godeau, E., & Arnaud, C. (2008). Measuring children`s attitudes towards peers with disabilities: A review of instruments. Developmental Medicine & Child Neurology, 50, 182-189.

A RAPID REVIEW OF THE EVIDENCE REGARDING PHYSICAL ACTIVITY FOR DISABLED ADULTS: RECOMMENDATIONS FOR PUBLIC HEALTH

KIRBY, N., SKINNER, B., LUCAS, R., SMITH, B.

UNIVERSITY OF BIRMINGHAM

A RAPID REVIEW OF THE EVIDENCE REGARDING PHYSICAL ACTIVITY FOR DISABLED ADULTS: RECOMMENDATIONS FOR PUBLIC HEALTH
Kirby N.1, Skinner B.1, Lucas R.1, Smith B.1, 1: University of Birmingham (UK)
Introduction: People with disabilities are typically less active as they face unique barriers to access, inclusion and participation in physical activity (PA; Rimmer & Braddock, 2002). Current PA recommendations for able-bodied people do not address these barriers. Therefore, recommendations that are inclusive and applicable for all disability groups are urgently needed. This rapid review aims to address the quality and level of evidence for the relationship and effectiveness of PA to improve disabled adult's health, the outcomes of investigations of FITT (frequency, intensity, time, type) principles, and the safety of PA for disabled adults.
Methods: Four databases (Medline, Web of Science, SportDISCUS, and Cinahl) and grey literature were searched using MeSH terms and free texts in February 2018. Inclusion criteria were articles from 2007-2018 focusing on adults in one or a combination of the outlined disability groups (visual impairments, hearing impairments, cerebral palsy, spinal cord injury (SCI), amputation, restricted growth or learning and/or intellectual disability (ID)) and the relationship and effectiveness of PA to improve health. Results from the UK or comparable contexts were prioritised, with other articles showing a high level of evidence also included. Exclusion criteria were articles that did not focus on PA or did not differentiate results between able-bodied and disabled people. A total of 1081 articles were identified and screened, with 247 articles meeting the inclusion criteria for this rapid review. Outcomes were grouped into aerobic, muscular strength/endurance, functional skills, disease risk/prevention, safety, and social, community, or individual wellbeing.
Results: The level of evidence for the relationship and effectiveness of PA to improve disabled adult's health, the outcomes of investigations of FITT principles, and the safety of PA for disabled adults is reported. Evidence-based exercise recommendations and guidelines for PA among disabled people are provided. Common themes include individualised prescriptions, coping strategies, mechanical assistance for exercise, community-based programs, gait or mobility improvements, injury prevention, leisure time PA and aerobic capacity. The results also highlight that the majority of studies investigate SCI, ID, and amputees, and thus future research needs to examine other disabled groups.
Discussion: Final results and recommendations are presented following the close involvement with end-user expert groups. Data will be used in the dissemination of guidelines and PA strategies to disabled people.
References: Rimmer JH, Braddock D. Health promotion for people with physical, cognitive and sensory disabilities: an emerging national priority. Am J Health Promot 2002;16:220–4, ii.

Conventional Print Poster

CP-PM25 Recovery and fatique; Muscle strength and performance

ELDERLY WOMEN PRESENT DIFFERENT RATINGS OF PERCEIVED EXERTION IN RESPONSE TO MAXIMAL INCREMENTAL TESTING AS COMPARED WITH YOUNG WOMEN

VIEIRA, D.C.L.2,4, NASCIMENTO, D.C.1, ERNESTO, C.3, PRESTES, J.1

1: UCB , 2: UDF , 3: FACIPLAC , 4: UNB .

INTRODUCTION: The ratings perceived exertion (RPE) is a helpful tool utilized during incremental tests to help identify physiologic markers and may be used in populations of different ages. However, it is not yet known if there are differences between young and older women. In this sense, the objective of this study was to compare the rating perceived exertion response between young and elderly untrained subjects at different intensities during a maximal incremental test.
METHODS: Nine young women (YW) and eleven older women (OW) performed an incremental treadmill test with rating perceived exertion measured at each minute by using the 6-20 Borg's scale. RPE were compared between groups on three different intensities zones: low intensity (LI), corresponding to RPE at 50% of the time between start the test and ventilatory threshold (VT), moderate intensity (MI), corresponding to RPE at 50% of the time between VT and respiratory compensation point (RCP) and high intensity (HI), corresponding to RPE at 25% of the time between RCP and finish of the test. Moreover, RPE at VT and RCP were also compared between YW and OW.
RESULTS: RPE at LI, VT, MI, RCP and HI for YW were: 8.11±1.05, 10.89±2.57, 13.11±2.42, 15.56±1.94 and 16.00±2.00, respectively. RPE at LI, VT, MI, RCP and HI for OW were: 8.72±1.27, 9.91±1.64, 11.27±1.79, 13.27±1.56 and 14.54±1.63, respectively. There were no differences between groups on RPE at LI (p=0,33) and VT (p = 0,31). However, on MI (p=0,05) and RCP (p=0,01), older individual showed lower RPE than young individuals. Althougth, no statistical difference was found between groups on RPE at HI. There was a tendency to OW show lower RPE at this point (p = 0,09).
CONCLUSION: Despite the exact mechanism associated with differences on RPE between YW and OW still unclear. Speculatively, a lower cerebral blood flow in older individuals during exercise (Ogoh & Ainslie, 2009) would cause impairments on cognitive function affecting RPE (Groslambert & Mahon, 2006). In summary, the results of this study suggest that OW have lower RPE at MI, RCP and HI than YW.
References: Ogoh S & Ainslie PN. (2009). J Appl Physiol,107(5),1370-80. Groslambert A & Mahon AD. (2006) Sports Med,36(11),911-28.
Contact: denisclvieira@hotmail.com

RELATIONSHIP BETWEEN MATCH WEEK LOAD, PERCEIVED LOAD AND MARKERS OF WELLNESS DURING THE FIFA WORLD CUP 2018 QUALIFYING STAGE

MCMAHON, G., MARTIN, D., KENNEDY, R., WALSH, P., MCCANN, R.

ULSTER UNIVERSITY

INTRODUCTION: Previous research has demonstrated that there is a strong relationship between total load, changes in load and markers of wellness in professional soccer players (Buchheit et al. 2013; Thorpe et al. 2017). However, currently no data exists on these relationships at international level. Therefore, the aim of this study was to look at the relationships between acute load, changes in load and markers of wellness in the immediate pre-match preparation phase of World Cup 2018 qualifying matches in international level soccer players.
METHODS: Training load (TL; 10Hz GPS Units,) Perceived load (PL; session RPE x time [mins]), and markers of wellness (sleep quality, sleep duration, muscle soreness, physical fatigue, mental fatigue and mood state) were collected daily at match day minus 4 days (MD-4), minus 3 days (MD-3), minus 2 days (MD-2) and 1 day (MD-1) prior to international World Cup 2018 Qualifying matches during 2016-2017 (n=8). Wellness markers were scored individually and also summated for a total wellness score.
RESULTS: There were significant correlations (P <0.01) between TL and PL at MD-4 (r=.49), MD-3 (r=.69), MD-2 (r=.58) and MD-1 (r=.48). TL was significantly greater (P<0.01) at MD-4 compared to MD-2 and MD-1, with no significant difference between MD-3. TL MD-3 was significantly greater than MD -2 and M-1, TL MD-2 was significantly less than MD-4 and MD-3 and greater than MD-1 (all P <0.01). There were no significant differences (P >0.05) in total or individual wellness score at any time point. Despite significant within-day correlations (P <0.01) between TL, PL and individual wellness marker scores at each time-point, there were no correlations between changes in TL and PL, and wellness markers at any time point.
CONCLUSION: At international level, soccer players' perceptions of load are sufficiently sensitive to detect changes in measured load. Despite significant variation, different volumes of load were not sufficient to alter players' perceptions of wellness at any time point. This may be due to the nature of training and prioritisation of freshness in close proximity to an international match.
References:
Buchheit M, Racinais S, Bilsborough JC, Bourdon PC, Voss SC, Hocking J, Cordy J, Mendes-Vilaneuva A, Coutts AJ. (2013) J Sci Med Sport, 16 (6) 550-555.
Thorpe R, Strudwick A, Buchheit M, Atkinson G, Drust B, Gregson W. (2017) Int J Sport Physiol Perf, 12 (Supl. 2), 107-113.
Contact:
g.mcmahon@ulster.ac.uk

MOTIVATION, PAIN, ENERGY EXPENDITURE AND ENERGY INTAKE DURING A 35 KM ROAD MARCH WITH LOAD CARRIAGE OF SWISS ARMY SOLDIERS

OESCHGER, R.1, ROOS, L.1, WYSS, T.1

SWISS FEDERAL INSTITUTE OF SPORT MAGGLINGEN SFISM

INTRODUCTION: During military service, loaded marching is a common and physically demanding task. Studies showed that endurance training programs with a progressive increase in intensity and duration can improve the soldiers' endurance performance and decrease injury and attrition rates (Roos et al., 2015). However, little is known about the effect of different levels of cardiorespiratory fitness on the soldiers' responses during a long distance march. Therefore, the aim of the present study was to compare soldiers in the lowest (ltVO2peak) and highest tertile of peak oxygen uptake (htVO2peak) concerning motivation, pain or physical complaints, rating of perceived exertion (RPE) as well as energy expenditure and the energy uptake during a 35 km road march with additional load carriage.

METHODS: One week previously to the march, 41 soldiers performed a progressive endurance run to assess VO2peak, data on marching day was collected with pre and post march questionnaires. Total energy expenditure (TEE) of the soldiers during the march was calculated according to Ainsworth et al. (2011), provisions were available ad libitum.
RESULTS: The main outcomes were that soldiers of htVO2peak (mean VO2peak = 61.6 ± 2.2 ml•kg-1•min-1) were significantly more motivated to perform (t (39) = -4.728, p < 0.001, d = -1.514) compared to soldiers of ltVO2peak (mean VO2peak = 45.9 ± 4.4 ml•kg-1•min-1) while RPE and pain values were similar in both. The locations of pain after the march were primarily the feet (52.4% and 60.0%) and shoulders (19.0% and 40.0%) for htVO2peak and ltVO2peak, respectively. When excluding soldiers that aborted the march, those in ltVO2peak reported a lower energy uptake in form of solid food than soldiers in htVO2peak (Med = 853.5, IQR = 366.0 kcal vs. Med = 1327.0, IQR = 858.5 kcal; U = 234.0, p = 0.021) The comparison of the TEE revealed no differences between the groups (M = 4289.6 ± SD = 699.0 kcal and M = 3980.7 ± SD = 387.4 kcal).
CONCLUSION: The htVO2peak group was capable to take in 33.3% whereas the ltVO2peak group was able to refuel only 19.9% of their TEE with solid food. The negative energy balance is considerable in both groups but the results of this study suggest that soldiers with a high cardiorespiratory fitness are more motivated in advance and have better capabilities to refuel their energy stores during a long-lasting and mentally challenging military task.
REFERENCES:
Roos L, Boesch M, Sefidan S, Frey F, Mäder U, Annen H, Wyss T. (2015). Mil Med,180(3), 329-336.
Ainsworth, B.E., Haskell, WL, Herrmann, SD, Meckes, N, Bassett DR, Tudor-Locke C, Greer JL, Vezina J, Whitt-Glover MC, Leon AS. (2011). Med Sci Sports Exerc, 43(8), 1575-1581.
CONTACT:
Regina.Oeschger@baspo.admin.ch

EFFECTS OF PROPHYLACTIC NAP ON PHYSICAL FITNESS/EXERCISE ABILITY AND EXECUTIVE FUNCTION IN HEALTHY TRAINED YOUNG MALES

TANABE, K., NAKAZATO, K., NOI, S.
NIPPON SPORT SCIENCE UNIVERSITY

INTRODUCTION: It has been widely reported that diurnal sleepiness impair various performance. Prophylactic nap is one of the effective strategies to improve for diurnal sleepiness induced by circasemidian rhythm. The purpose of this study was to examine the effects of different length prophylactic naps on physical fitness/exercise ability and executive function. We hypothesized that nap including slow wave improved both physical fitness/exercise ability and executive function because sleep with slow wave is thought to decrease brain energy metabolism dramatically and to play important role in cerebral restoration and recovery.
METHODS: Seven healthy trained males (mean age = 21.1, S.D. = 0.4) participated in four experimental conditions (counter balanced design): sitting rest of 90 minutes from 12:30 (con group); nap of 30 minutes from 13:30 (nap30 group); nap of 60 minutes from 13:00 (nap60 group); nap of 90 minutes from 12:30 (nap90 group). Physical fitness/exercise abilities were assessed by grip/back strength (muscle strength), postural control (balance ability), darts task (psychomotor skill), Wingate test (anaerobic power). Simple reaction time task (SRT), choice reaction time task (CRT), modified flanker task (mFl) were used for assessing executive function. Changes in oxyhemoglobin in the prefrontal cortex during executive function tests were monitored with near-infrared spectroscopy. These performance tests began at 15:00.
RESULTS: All nap groups did not improve on all physical fitness/exercise tests. The nap30 group showed significantly shorter reaction time (RT) of SRT and CRT than those of the con group (p < 0.05). The nap60 group improved only in RT of SRT. The nap90 group produced improvement of RT in all executive function tasks. The increases in oxyhemoglobin during executive function tasks in the nap30 and 90 groups were matched with improvement of each executive function tasks, but the changes in oxyhemoglobin of nap60 group were not observed in all function tasks.
CONCLUSION: The 90-minutes is the most effective nap duration to improve executive function tasks and activate prefrontal cortex in the afternoon. These findings are meaningful for understanding performance optimization in athletes regarding countermeasure diurnal sleepiness by circasemidian rhythm. In sports situations, it is possibilities that afternoon performance is more improve by 90-min nap in reaction time.
Contact: 16n0006@nittai.ac.jp

EFFECTS OF LOW-LEVEL LASER THERAPY (LLLT) AND LIGHT-EMITTING DIODES (LEDT) APPLIED DURING COMBINED TRAINING ON PERFORMANCE AND CLINICAL OUTCOMES: RANDOMIZED PLACEBO-CONTROLLED TRIAL

MACHADO, A.F.1, CUSTODIO JUNIOR, A.1, ESPINOZA, R.M.C.P.P.1, HIDALGO, R.B.R.1, LEAL-JUNIOR, E.C.P.2, PASTRE, C.M.1
1. SÃO PAULO STATE UNIVERSITY; 2. NOVE DE JULHO UNIVERSITY

INTRODUCTION: Previous studies have shown positive results of phototherapy on improving performance and accelerating recovery; however, the effects of phototherapy adjusted to a model of training remain unclear. The aim of this study was to analyze the effects of phototherapy associated with a combined training on clinical and functional outcomes.
METHODS: This is a randomized placebo-controlled trial by stratified sample that involved 39 healthy male participants. Participants performed a 12-week (24 sessions) training program divided in two phases. Phase 1: six weeks of combined training with sprints and squats. After stratified randomization (based on adaptation capacity) participants were allocated into three groups: phototherapy, placebo, and non-treatment control. Phase 2: new six-week training (load adjusted) with recovery strategy applied between sprints and squats. Phototherapy (low-level laser therapy – LLLT and light-emitting diode therapy – LEDT; dosage total per site: 30J) was applied in six areas of quadriceps muscle bilaterally. Maximal voluntary isometric contraction (MVIC), squat jump and sprint test were assessed on baseline, six and 12-weeks post-training. Muscle soreness and perception of recovery were assessed in the training sessions with higher energetic spending during both training phases (sessions 9 and 21). Statistical analysis was conducted in SPSS. The ANOVA repeated measures (Greenhouse-Geisser corrections when required) was used to analyze functional outcomes, and the paired samples T-test and one-way ANOVA (Bonferroni's post-hoc) were used to clinical outcomes.
RESULTS: A large effect for time for squat jump and sprint test [P<0.01; SJ (ES=0.187); sprint (ES=0.251)] and moderate effect for MVIC was observed [P=0.032; MVIC (ES=0.091)]. There were no significant group and interaction effects (time x group) for functional outcomes (P>0.05). No differences from phase 1 and 2 were observed in clinical outcomes (P>0.05). The findings of this study suggested that all recovery strategies acted in a similar way concerning functional and clinical outcomes. The present results agree with those reported by

Vieira et al. 2012 and Ferraresi et al., 2011 that observed a significant effect time after a program training but no differences between groups.
CONCLUSION: In conclusion, no evidence was found to reduce muscle soreness, as well as to improve perception of recovery and performance when phototherapy is associated with combined training.

EFFICACY OF MICROCURRENT TO MAXIMISE EXERCISE OUTCOMES AND ATTENUATE DELAYED ONSET MUSCLE SORENESS IN RESISTANCE-TRAINED ATHLETES: A PILOT STUDY

SEIJO, M., LARUMBE-ZABALA, E., KARSTEN, B., NACLERIO, F.
UNIVERSITY OF GREENWICH

INTRODUCTION: Microcurrent based treatments have been recently proposed as a suitable strategy to maximize exercise and recovery outcomes in athletes. This study aimed to analyse the potential benefits of regularly wearing a new commercially available microcurrent device (Arc4health, UK) during the post-workout time after performing resistance training in male recreational athletes. Variables measured where changes in body composition, upper and lower strength, muscular thickness and delayed onset muscle soreness (DOMS).
METHODS: According to individual baseline body composition and maximal strength values, twelve participants (24.7±6.3 yr) were pair-matched and consequently randomly assigned to one of the following experimental groups: microcurrent (MC, n=6) or sham (SH, n=6). Both groups trained 3 non-consecutive days per week over a period of 8 weeks (24 total sessions), with a moderate to high resistance training (10 to 6 Repetition Maximum) routine. A microcurrent or a sham device was used for 3 h immediately after training or in the early morning during non-training days. Assessment of fat, fat-free mass (via Air Displacement Plethysmograph), upper and lower body strength and muscular thickness (via ultrasound) were performed at pre and post intervention. DOMS via VAS scale was measured at 12, 24 and 48 h after performing an exhaustive 100 repetitions concentric eccentric lower body protocol.
RESULTS: Both groups similarly improved body composition from the baseline, decreasing total and relative body fat and increasing total and relative fat-free mass ($p<0.05$). Furthermore, upper and lower body dynamic strength increased in both groups with no differences between groups. Elbow flexor thickness increased only for the MC group ($p=0.001$) while triceps, vastus medialis and vastus lateralis thickness improved in both groups ($p<0.05$). Nonetheless, the MC showed higher ($p<0.01$) elbow flexor and triceps muscle thickness compared to the SH condition. DOMS was significantly reduced in the MC ($p<0.01$) but not in the SH group at all time points (12h, 24h and 48h). Furthermore, DOMS at 48h was significantly lower in the MC compared to the SH group ($p=0.050$).
CONCLUSION: Wearing a commercially available microcurrent device Arc4health during 3h post workout may maximises upper body hypertrophy outcomes and reduces DOMS in recreationally trained males following 8 weeks of resistance training. Even though no differences were observed for strength, body composition and lower body hypertrophy, the present pilot study highlights the potential benefits of microcurrent technology to optimise recovery and training outcomes for athletes.
REFERENCES: Curtis D; Fallows S; Morris M & McMakin C. (2010). The efficacy of frequency specific microcurrent therapy on delayed onset muscle soreness. J Bodyw Mov Ther,14:272-9
Ohno Y; Fujiya H; Goto A; Nakamura A; Nishiura Y; Sugiura T; Ohira Y & Goto K. (2013). Microcurrent electrical nerve stimulation facilitates regrowth of mouse soleus muscle. Int J Med Sci,10:1286-94

MUSCLE MASS AND HANDGRIP STRENGTH IN ELDERLY COMMUNITY-DWELLERS: A COMPARATIVE DESCRIPTIVE ANALYSIS BETWEEN RURAL AND URBAN REGIONS IN TAIWAN

WU, H.J., TSAI, C.C., CHEN, L.H.
NATIONAL TAIWAN SPORT UNIVERSITY

INTRODUCTION: Taiwan is one of the most rapidly aging regions in the world. Ageing is known to be associated with decline in muscle mass (MM) and muscular strength (MS), specifically handgrip strength (HGS), the risk factor of sarcopenia. Preventive screening for MM and HGS is essential for older adults, however, little is known regarding differences in those above-mentioned muscle-related measures between rural and urban elderly in Taiwan.
METHODS: We used secondary data from I-Lan Longitudinal Aging Study (ILAS) (Liu et al., 2013) as rural reference sample. The other 470 between 50-85 years old were recruited as urban samples from two Taipei Lohas EXPO occasions in Sept., 2017 and Jan., 2018. Demographics, MM (bioelectrical impedance analysis, BIA, Inbody 720) and HGS (TKK-5401, Japan) data were collected. Appendicular skeletal MM (kg, ASM) was divided by squared height (ASM/ht2). Cutoff value for low HGS was defined as male <22.5kg, female <14.5kg (Wu et al., 2009). Urban samples were divided into three age groups as 50-64 (late middle age, LM), 65-74 (young-old, YO), and >75 (old-old, OO) complied with the reference data. Descriptive statistics was conducted to compare divergence in MM and HGS between I-Lan and Taipei City.
RESULTS: The number and mean age in rural and urban samples were 532 (64.6±9.5 y/o, male 53.0%) and 453 (66.2±7.1y/o, male 31.6%). Across all age groups, samples from rural area held higher BMI and higher MM (ASM/ht2) than urban samples. Both rural and urban data showed an age-related decline rate in MM (ASM/ht2) and HGS, with rural OO held the highest HGS decline rate than their younger groups. Meanwhile, prevalence of low HGS was also higher in rural samples in both genders as compared to their counterparts (28.0% vs. 4.2% in male, 34.0% vs. 3.9% in female).
CONCLUSION: Although higher in BMI and MM, rural sample held a much greater low HGS rate in both genders. Study showed MS decline with age preceded the loss of MM (Manini and Clark, 2011). Muscle quality, normally defined as strength per unit MM, may be another consideration when justified the MM-MS relationship (Mitchell et al.,2012). Since HGS is another strong predictor of cardiovascular mortality (Leong et al., 2015), further more study may be needed to clarify this urban-rural discrepancy in rate of low-HGS, specifically for the elderly reside at rural community in Taiwan.
References: Liu L K, Lee W J, Liu C L, Chen L Y, Lin M H, Peng L N, & Chen L K. (2013). Geriatr Gerontol Int , 13(4), 964-971.
Wu S W, Wu S F, Liang H W, Wu Z T, & Huang S. (2009). Appl Ergon, 40(4), 811-815.
Manini T M, & Clark B C (2011). J Gerontol A Biol Sci Med Sci, 67(1), 28-40.
Mitchell W K, Atherton P J, Williams J, Larvin M, Lund J N, & Narici M. (2012). Front Physiol, 3, 260.
Leong D P, Teo K K, Rangarajan S, Lopez-Jaramillo P, Avezum Jr A, Orlandini A, ... & Rahman O. (2015). Lancet, 386(9990), 266-273.
Contact: Justine0113@gmail.com

CORRELATION BETWEEN PHYSICAL MATURENESS AND SPRINT PERFORMANCE IN YOUNG TRACK AND FIELD ATHLETES

DUCA, M., FORMENTI, D., TRECROCI, A., CAVAGGIONI, L., ALBERTI, G.

UNIVERSITÀ DEGLI STUDI DI MILANO

INTRODUCTION: Sprint performance is a key factor in both track and field and team sports. Young athletes with the same age display large variability in terms of physical matureness, which may impact performance. This study aims to investigate the relationship between physical development and sprint performance in young track and field athletes.
METHODS: 8 male track and field athletes (age 14.1±0.7 years, height 1.60±0.08 m, weight 51.1±9.7 kg) took part in present study. Mechanical effectiveness (DRF), Velocity (V0), total and relative force and power (F0t, F0r, Pt, Pr) were assessed for each participant over a 20 m sprint using Samozino's method (Samozino et al. 2016). Relationship between those variables and maturity offset (MO) (Mirwald et al. 2002) and height reached in countermovement jump with free arms (CMJa), measured using a photocell system (Optojump, Microgate, Bolzano, Italy), were investigated using Pearson's correlation coefficient after normality check.
RESULTS: CMJa is inversely correlated with sprint performance over 20 m (r=-0.732, p=0.039) and directly correlated with V0 (r=0.848, p=0.008). MO is linearly correlated to 20 m and V0 (r=-0.789, p= 0.020 and r=0.743, p=0.035, respectively), besides to F0t (r=0.918, p=0.001), Pt (r=0.942, p=0.000) and Pr (r=0.821, p=0.012).
CONCLUSION: Evidence from this study confirms that a strong correlation between jump and sprint performance stands, as was reported in adult sprinters (Kale et al. 2009). This study informs that MO is equally correlated to sprint times as CMJa and is also powerful at predicting F0t, Pt, and Pr (R=84%, R=88%, R=67%). From those findings it can be understood how physical matureness influences force and power capabilities in youths and therefore sprint performance. Conversely, mechanical effectiveness is not correlated to MO. Those findings show how, while total force produced could be dependent on physical matureness, the ability to apply this force effectively into the ground is not. These results help better understand underlying factors affecting sprint performance and lead selection and training practice.
REFERENCES:
Kale, M., A. Asci, C. Bayrak, and C. Acikada. 2009. "Relationships among Jumping Performances and Sprint Parameters during Maximum Speed Phase in Sprinters." J Strength Cond Res 23(8):2272–79.
Mirwald, Robert L., Adam D. G. Baxter-Jones, Donald A. Bailey, and Gaston P. Beunen. 2002. "An Assessment of Maturity from Anthropometric Measurements." Medicine and Science in Sports and Exercise 34(4):689–94.
Samozino, P. et al. 2016. "A Simple Method for Measuring Power, Force, Velocity Properties, and Mechanical Effectiveness in Sprint Running." Scandinavian Journal of Medicine and Science in Sports 26(6):648–58.
CONTACT:
e-mail: marco.duca@unimi.it

Conventional Print Poster

CP-PM26 Brain, Bone, Liver and adipose tissue / mixed studies

MORPHOLOGICAL RESPONSES OF ADIPOSE AND HEPATIC TISSUE TO A FATTY-DIET AND SEDENTARY LIFESTYLE MODEL IN RODENTS.

BOVOLINI, J.A.1, ROLIM FILHO, N.1, ANDRADE, M.A.2, DUARTE, J.A.1

<1> SPORT FACULTY OF PORTO UNIVERSITY; <2> FEDERAL UNIVERSITY OF PERNAMBUCO;

INTRODUCTION: Sedentarism and diet are recognized risk factors for a panoply of metabolic pathologies, mostly through overweight and obesity. In fact, changes in adipose tissue, especially the adipocyte expansion, has been pointed out as a triggering factor for metabolic imbalances in obese individuals. As well, the liver is an organ highly reactive to metabolic environment changes, being its phenotype deviation a good indicator of metabolic disorders. Given the noxious skill of obesity and the hepatic reactivity to this unbalance environment, this work aimed to evaluate the hepatic and adipose tissue morphological responses, particularly the adipocyte expansion, to a fatty-diet and sedentarism model in rodents.
METHODS: 28 Wistar rats were divided into four groups: sedentary standard diet (SSD, n=7), active standard diet (ASD, n=7), sedentary high-fat diet (SHFD, n=7) and active high-fat diet (AHFD, n=7). The rats were fed with a standard or a high-fat diet (70% calories from fat; Research Diets, Inc.) for 21 weeks. The active groups had free access to the voluntary running wheel while the sedentary groups remained restricted to their cage space. At the protocol end, the animals were weighed, euthanized and samples from retroperitoneal adipose tissue (RAT) and liver were collected. For histological analysis, the samples were stained with Hematoxylin-Eosin to analyze hepatic fat deposition and adipocyte cross-sectional area (CSA), and with Sirius Red to assess collagen deposition. The NIH ImageJ, Image Pro Plus 6 (USA) and GraphPad Prism 7 (USA) software were used for images evaluations and statistical analysis.
RESULTS: After 21 weeks, both groups HFD-fed showed a decrease in relative BW (P <0.05 vs. SSD). Both groups showed similar hepatic weights with a marked deposition of lipids and collagen (P <0.05 vs. standard diet groups). Despite BW losses, HFD-fed groups showed a higher RAT (P <0.05 vs. standard diet groups). In line, the ASD and AHFD groups presented, respectively, the lowest (P <0.05 vs. SSD, SHFD, AHFD) and higher (P <0.05 vs. SHFD, AHFD) adipocyte CSA. No difference in adipocyte CSA was observed between HFD and SSD.
CONCLUSION: The results demonstrate the experimental model efficacy in inducing morphological changes in both adipose and hepatic tissue. The adipocyte CSA was associated with deleterious hepatic morphological alterations. Results also suggest an additional harmful effect of a sedentary lifestyle in adipocyte CSA and liver morphology, given the exacerbation of those items in the sedentary animals.
Funding: Study was supported by Capes (Ministry of Education, Brazil) and CIAFEL (UID / DTP / 00617/2013, Portugal).

THE EFFECT OF EXERCISE-INDUCED FACTORS ON ADIPOSE BROWNING

SEVERINSEN, M.C.K., PEDERSEN, B.K., SCHEELE, C.

RIGSHOSPITALET, CENTRE FOR PHYSICAL ACTIVITY

INTRODUCTION: Brown fat represents a tissue that, when activated, increases energy turnover and insulin sensitivity as well as glucose and fatty acid clearance. Brown fat may therefore be involved in the protection against obesity and lifestyle related diseases such as type

2 diabetes. During the past decade, functionally competent brown fat has been identified in adults, which has been shown to negatively correlate to obesity. Brown fat is activated by cold exposure via adrenergic stimulation and is mediating non-shivering thermogenesis through mitochondrial uncoupling protein (UCP)-1. Little is however known about how brown fat tissue is maintained during adulthood and to which degree lifestyle contributes to preservation and activation of brown fat. It has, however, been suggested that brown fat biogenesis is increased by stimuli from other organs, such as the muscle and the liver. As brown fat is sympathetically it might be stimulated by exercise. Furthermore, skeletal muscle progenitors and brown fat progenitors share a common origin and might also be induced by similar growth factors, which are increased during muscle contraction. If we can identify pathways for increasing the proportion of brown fat cells, we might be able to counteract obesity and obesity-related diseases.
METHODS: We hypothesized that factors released to the circulation during exercise would have browning effect on adipose tissues. We collected visceral and subcutaneous adipose biopsies from humans and isolated fat precursor cells, which we differentiated into lipid droplet containing adipocytes in vitro. To investigate if exercise factors could have a differential effect on subcutaneous compared to visceral adipocytes, we stimulated our cell cultures during differentiation.
RESULTS: Our ongoing studies show that IL-6 induced an increase in UCP-1 expression of adipocytes isolated from visceral, but not subcutaneous adipose.
CONCLUSION: Our present results may suggest that muscle-released IL-6 during exercise may be involved in mediating muscle-adipose cross-talk, not just with regard to lipolysis as previously shown, but also with regard to browning.

EXERCISE TRAINING INDUCED CHANGES ARE RELATED TO ADDIPOSE TISSUE CHARACTERISTICS IN ELDERLY WOMEN

STEPAN, M., MATOUS, M., DADOVA, K., SONTAKOVA, L., HLADOVA, J., STICH, V., KRAUZOVA, E., SIKLOVA, M.
3RD MEDICAL FACULTY, CHARLES UNIVERSITY IN PRAGUE

INTRODUCTION: Regular physical exercise has been proven to improve an individual health status, namely increasing cardiorespiratory fitness status and insulin sensitivity. In this study we aimed to investigate if these changes might be associated with changes in adipose tissue (AT) characteristics in elderly women.
METHODS: We recruited a group of 23 elderly non-diabetic women (mean age 69.7 years ± 3.5 years, average BMI 26.07 ± 3.78), generally healthy (without any previous history of malignancy, or any other systemic non-compensated illness. We excluded women regularly taking peroral antidiabetic drugs, anti-inflammatory medication and betablockers). All women have undergone a 4month long training program containing of three one hour supervised training sessions per week, two of which consisted of resistance training sessions and one aerobic session (usually intervals of Nordic walking of various intensity levels). At the beginning and at the end of exercise training intervention each subject underwent a bicycle spiroergometry, and a battery of senior fitness tests to determine their cardiorespiratory fitness level, X-ray densitometry (DXA) to analyze body composition and hyperinsulineamic-isoglycemic clamp to determine sensitivity to insulin. Free fatty acid levels were measured in plasma.
RESULTS: After exercise intervention we observed a statistically significant decline of subject's weight by 0.6kg (±9.16kg, p=0.043), which was associated with a significant decrease in fat mass by 1.22kg (±5.9kg, p=0.001) and an increase in fat free mass by 0.6kg (±4.52kg, p=0.027) on average. Insulin sensitivity determined as glucose disposal value significantly improved from average 5.34 mg/kg/min to 6.45 mg/kg/min (±2.46 mg/kg/min, p=0.016). In response to the intervention we observed a significant drop in plasma values of free fatty free acids from 1.48 mmol/l to 1.21 mmol/l (±0.42mmo/l, p=0.002), which suggests decrease in lipolysis in AT. Cardiorespiratory fitness level determined by maximum oxygen consumption (VO2max) during bicycle ergometry increased from 21.4 ml O2/kg/min to 22.9 ml O2/kg/min (±4.33ml O2/kg/min, p=0.01). Multiregression analysis has shown a significant correlation of VO2max with fat mass and glucose disposal (insulin sensitivity) (p=0.007 r=-0.543; p=0.001 r=0.646, respectively), while VO2max did not show statistically significant correlation to fat free mass (p=0.153).
CONCLUSION: Exercise intervention had beneficial effects on subject's cardiorespiratory capacity, physical performance and insulin sensitivity, which was associated with decrease in fat mass and lipolysis in adipose tissue. The declined levels in free fatty acids might also contribute to decreased storage of fatty acids into ectopic fat depositions. Interestingly, the cardiorespiratory fitness improvement was strongly associated with fat mas decrease but not with muscle growth (fat free mass increase) in elderly women.

PROFILING OF HIGH-INTENSITY EVENTS IN ELITE CHINESE FEMALE FIELD HOCKEY MATCHES

CAI, X.1,3, LOMBARD, W.2, MAO, L.1, SPENCER, M.4, CHEN, X.1,3
1: SUS , 2: UCT , 3: NBU , 4: NSSS

INTRODUCTION: Physical performance in field hockey (here on in referred to as hockey) is determined by many different factors. Recently, the development of small wearable inertial measurement units (IMUs) has provided new possibilities to profile the physical demands in different team sports, especially in the high intensity events (HIEs) aspect of competition and training. Therefore, the aim of this study was to profile the position-specific HIEs in elite female hockey matches with the use of IMUs.
METHODS: Sixteen matches analyzing 22 elite Chinese female hockey players (height: 168.5±4.6 cm, body mass: 62.4±5.3 kg) were record by using IMUs (OptimEye S5, Catapult Sports, Australia) during the 2016-2017 Chinese national competition season. Players were categorized in three different playing positions: strikers, midfielders and defenders. Mean speed (MS), PlayerLoadTM (PL), accelerations (Acc), decelerations (Dec), changes of direction (CoD) and the sum of later three, HIEs, were extracted from raw-data files using the manufacturer's software (OpenField, version 1.14.0). All Acc, Dec, CoD and HIEs $>$2.5 m/s2 were analyzed. Data were reported as mean±SD. Multiple paired t-test was used to compare data between different positions. Significance was set at P≤0.05.
RESULTS: The mean on-field time for individual players was 48.8±15.8 min and the mean PL and MS when combining all playing positions were 9.4±1.3 PL/min and 108.6±12.3 m/min respectively. The mean HIEs, Acc, Dec and CoD combined for all players were 1.1±0.3 HIEs/min, 0.2±0.1 Acc/min, 0.2±0.1 Dec/min and 0.7±0.2 CoD/min respectively. Defenders showed significantly lower PL and MS (8.7±1.2 PL/min, 100.7±11.9 m/min) than strikers (9.7±1.4 PL/min, 114.2±10.6 m/min) and midfielders (9.8±1.0 PL/min, 111.9±9.2 m/min) ($P<0.01$).
CONCLUSION: The mean playing time reported in the present study was similar to data from international hockey matches (48.8 ± 15.8 vs. 44.7±11.0 min), yet PL and MS from the present study was lower than that of elite international players (9.4±1.3 vs. 11.2±2.1 PL/min; 108.6±12.3 vs. 113.3±13.5 m/min; McMahon et al.). Competition level (national vs. international) is the most likely reason for these differences (Jennings et al.). Although HIEs have not been previously reported in hockey matches, compared to elite female handball players, the present study showed considerably lower HIEs (1.1±0.3 vs. 3.9±1.6 HIEs/min; Luteberget et al.). Competition level and player density (hockey: 251.4 vs. handball: 66.7 m2/total number of players; Davies et al.) in different sports are probably the two main reasons for these discrepancies. The present study was conducted on elite Chinese national level female hockey players, and further research should focus on the HIEs' performance of elite international level hockey players.

THE EFFECTS OF HEAD AND NECK COOLING DURING INTERMITTENT TREADMILL EXERCISE IN THE HEAT.

NAUGHTON, M.1, BAYNE, F.1, TYLER, C.J.1, JUDELSON, D.A.2

1. UNIVERSITY OF ROEHAMPTON, LONDON UK. 2. NIKE INC., BEAVERTON, OREGON, USA

INTRODUCTION: Intermittent exercise performance is compromised in hot and humid environments due to elevations in actual and perceived heat strain. Cooling interventions can improve exercise performance in the heat, particularly as exercise duration increases, due to alterations in pace-selection and/or pacing profile and the effectiveness of a cooling intervention appears to be related to the magnitude of actual or perceived cooling. The head and neck are disproportionately thermally sensitive and might be a practical and effective site to cool. The aim of the present study was to examine the effects of repeated application of head and neck cooling on exercise pacing during intermittent exercise in the heat.
METHODS: Participants (n=10) completed two ~112 min intermittent Basketball simulation exercise protocols of self-paced walking, jogging, running, and sprinting on a non-motorised treadmill (Woodway Curve) in the heat (36°C, 50% relative humidity). One trial was conducted with head and neck cooling (COOL), the other trial was conducted without head and neck cooling (NON-COOL). Trial order was randomized and counterbalanced. The protocol was interspersed with rest periods mimicking the work-to-rest ratios of basketball. Core temperature (TGI), forehead skin temperature (TH), heart rate (HR), rating of perceived exertion (RPE), thermal comfort (head [TCHEAD]) and body [TCBODY]), and thermal sensation (head [TSHEAD] and body [TSBODY]) were recorded throughout, with mean speeds for each jog, run, and sprint bout recorded. Each dependent variable was averaged over the quarter. Two-way (group x quarter) ANOVA were performed and effect sizes were calculated (Hedges g and r).
RESULTS: TH, RPE, TCHEAD, TCBODY, TSHEAD, TSBODY, and mean jogging speed were significantly improved in COOL ($p < 0.05$). Post hoc analysis revealed these differences were primarily observed in the latter stages of the protocol (i.e. Quarter 3, and 4) with a large effect observed for TH ($g \geq 0.8$), TCHEAD, TSHEAD, TSBODY ($r > 0.5$) in Quarter's 2, 3, and 4, and a moderate effect ($r = 0.3$-0.5) on RPE favoring COOL was observed in Quarter's 2, 3, and 4. There were no significant differences between COOL and NON-COOL for mean running or mean sprint speed, HR, or TGI ($p > 0.05$), with small to moderate effects on HR, mean running and sprint speed favoring COOL.
CONCLUSION: Head and neck cooling reduced forehead skin temperature and improved perceptions of exertion, thermal comfort and sensation, and mean jogging speed. The attenuated perceptual response had small to moderate effects on performance, however these were mainly non-significant. Inspection of performance data showed a consistent trend whereby exercise performance improved in the final stages for COOL, whilst performance deteriorated for NON-COOL, suggesting that COOL improved the ability to pace during intermittent exercise in the heat.

MUSCLE MEMORY WITH A RAT CLIMBING MODEL

EFTESTØL, E.1, JUVKAM, I.1, OCHI, E.2, GUNDERSEN, K.1

UNIVERSITY OF OSLO

INTRODUCTION: Previous work from Prof. Kristian Gundersens lab have shown that myonuclei obtained during hypertrophic stimuli are not lost after a prolonged period of atrophy, and we hypothesize that these extra myonuclei can aid in later muscle re-growth when re-introduced to hypertrophic stimuli (Egner et al., 2013). This mechanism is dubbed "muscle memory". Briefly, mice received a supraphysiological supplementation of the anabolic-androgenic steroid (AAS) testosterone propionate, leading to an increased myonuclear number and muscle growth. After a washout period without AAS, muscle size was back to baseline, but the myonuclear number was still increased. When subjected to a second hypertrophic stimulus by overloading the lower leg muscles by synergist ablation, muscles previously treated with AAS had a much more pronounced growth than controls without the history of AAS treatment. We hypothesize that the muscle memory mechanism is important also during more physiological relevant training, detraining and retraining. Thus, the aim of the present study was to test the muscle memory hypothesis with a rat climbing model.
METHODS: 4-week-old male Sprague Dawley rats were housed in cages designed with the walls and ceiling covered with a climbing mesh, and the food supply in the middle of the ceiling. Thus, the rats had to climb in order to feed and were thereby trained (1. training). After 5 weeks in climbing cage, rats were housed in normal cages for 10 weeks (detraining). Age-matched rats in standard cages were used as ground controls. After detraining, both detrained and ground-control rats were subjected to one of two different retraining regimes: 1) 2 weeks in climbing-cages or 2) 2 weeks overload of soleus by synergist tenotomy of gastrocnemius in order to maximize the hypertrophic response and thereby potential differences between groups. The soleus and tibialis anterior muscles were frozen in melting isopentane in liquid nitrogen, cryosectioned, stained with the myonuclei-specific antibody PCM1 (Winje et al., 2018), dystrophin antibody to visualize the fiber border and DAPI to visualize all nuclei, followed by analysis of myonuclear number and myofiber cross-sectional area.
RESULTS: The 1. training led to a significant increase in both myonuclear number and myofiber cross-sectional area of both the soleus and tibialis anterior muscles compared to ground-controls. After detraining, cross-sectional area was back to the level of the ground-control, but the myonuclear number were still significantly elevated. Preliminary results indicate that retrained rats had a stronger hypertrophic response compared to age-matched ground controls performing the training for the first time.
CONCLUSION: Our results support the muscle memory hypothesis under more training-relevant conditions.
REFERENCES:
Egner IM, Bruusgaard JC, Eftestøl E, Gundersen K. J Physiol. 2013 Dec 15.
Winje IM, Bengtsen M, Eftestøl E, Juvkam I, Bruusgaard JC, Gundersen K. Acta Physiol (Oxf). 2018 Jan 13.
einar.eftestol@ibv.uio.no

FREQUENCY OF DIRECTIONAL CHANGE IS AN IMPORTANT MEDIATOR OF THE PHYSIOLOGICAL RESPONSE IN SHORT DURATION INTENSE SHUTTLE RUNNING PROTOCOLS

MAASAR, M.F.1, HULTON, A.T.2, SHARPLES, A.P.3, DRUST, B.1

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Pitch area is often manipulated to achieve specific training goals in team sports. Limited information exists on the role that changes in movement pattern (i.e. changes in direction (COD), accelerations/decelerations) may play in differences in exercise intensity under these conditions (Hill-Haas et al. 2009). The purpose of this study was to investigate the impact of an increase in COD on the physiological responses observed in an intense shuttle running protocol.
METHODS: Ten recreational active male team sports players (age: 24+/-2 yrs; height: 1.8+/-0.0 m; weight: 74.0+/-7.9 kg) were recruited to participate in this study. Participants were required to attend 2 pre-test trials; (1) to complete a yo-yo intermittent endurance test and to

familiarize with the centiMax 100RPE scale; (2) estimate maximal shuttle running speed for a 5m (COD5), 10m (COD10) and 15m (COD15) shuttle run. The three experimental trials involved the completion of a 30m shuttle run protocol using either a 5 (COD5, 5mx6, 50 total turns),10 (COD10,10mx3, 20 total turns), or 15m (COD15, 15mx2, 10 total turns) shuttle distance. Ten repetitions (300m total distance) and running intensity (mean intensity 3.3 +/- 0.2 m.s-1; the max speed for COD5) was controlled. All CODs were performed at 180degrees. A minimum of 20 min rest was allocated between running protocols to allow recovery. Participants performed all running condition in randomized, counterbalanced study design. The physiological demand of each protocol was estimated using post shuttle heart rate (PostHR) and post exercise blood lactate (BlaPost). Subjective "load" was also recorded using differential RPE (dRPE) for breathlessness (RPE-B) and leg muscle (RPE-L) as well as session (RPE-S). 'Movement load' was estimated using moderate to high inertial movement analysis for acceleration (IMAaccel) and deceleration (IMAdecel), Player Load (PL) and Player Load 2D (PL2D).
RESULTS: COD5 generated a significant higher PostHR response when compared to COD15 (p= 0.021). COD5 was also significantly higher for BlaPost (p=0.001) in comparison to COD10 and COD15.The dRPE (RPE-B, RPE-L, RPE-S) were also significantly greater in COD5 and then COD10 and COD15 protocol (p=0.001). IMAaccel were significantly difference between COD5 and COD15 (p=0.036). No significant difference between protocols were recorded on IMAdecel though PL showed a significant differences (p=0.012) between COD5 vs. COD15 protocols. COD5 also recorded the highest response in PL2D when compared to COD10 and COD15 (p=0.002 and 0.001 respectively).
CONCLUSION: These findings suggest that the increasing number of COD in an intense shuttle running protocol increases physiological, subjective and 'movement load' compared to exercise protocols that have fewer COD's. Such information may be important in enabling practitioners to better manage the prescription of both acute and chronic training loads.
Reference:
Hill-Haas, S. V. et al., 2009. J Sports Sci, 27(1), pp.1–8.

CHARACTERISTICS OF 3-D FOOT SHAPE IN JAPANESE SWIMMERS BY USING HOMOLOGOUS BODY MODEL.

SOMA, M.1,2, KASHIWAGI, Y.1, FUJIMORI, T.1, WAKATSUKI, R.1, FUNATO, K.1

1: NIPPON SPORT SCIENCE UNIVERSITY , 2:JUMONJI UNIVERSITY

INTRODUCTION: Univariate anthropometric data have documented the differences in foot shape proportions. However, it has been unknown how different swimmers foot populations have. Constructing the homologous human body model and analysing it by principal component statistical analysis are useful for describing and assessing the specific features of 3-D shape(Chang et al., 2015). The purpose of this study was to compare the morphological foot shape characteristics between Japanese elite swimmers and non-swimmers by quantifying 3-D foot shape established by a Principal Component Analysis (PCA) of Homologous Body Model (HBM).
METHODS: Swimmers (SW; Age; 20.5±3.0yrs, BH; 173.4±4.7cm, BW; 70.0±5.2kg) and non-swimmers (NS; Age; 20.7±2.2yrs, BH; 172.9±5.3cm, BW; 65.1±8.8kg) participated in this study. Foot anthropometry was measured by three dimensional whole foot scanner (INFOOT; I-Ware Laboratory Co. Ltd). Subjects were stand asked to upright with weight distributed equally on both feet. HBM consisted of 20,000 vertex of the same topology, and then it was constructed by fitting the foot polygon date to generic template model based on anatomical landmarks.
RESULTS: The 17 PCs had explained 92.7% of the shape variability, respectively. In particular, PC2 (contribution ratio; 17.9%) explained naviculare bone height and foot arch height and PC4 (contribution ratio; 7.4%) explained ball width and toe length. In normalized HBM as to body height, it showed the larger foot length and foot wide slender was characteristics for swimmer. Homology model of the 3-D body shape enabled to quantify the individual differences and characteristics of foot shape. The following results suggested that morphological characteristics of foot shape could be influenced by daily training. One of the advantages of Principal Component Analysis statistical shape analysis was that it provided intuitive visualization of the shape variation. The shape analysis results revealed the differences that cannot be detected from 1-D and 2-D measurements.
CONCLUSION: Characteristics of 3-D human foot shape using by homologous body model revealed that swimmers had larger foot length and foot wide slender as well on flatter foot shape. Specific foot shape of Japanese swimmers was quantified. Homologous body model is useful for athletes and coaches to identify the foot shape from the view points such as growth, development and training.

Conventional Print Poster

CP-PM27 Cardiovascular: Mechanisms; Clinical populations

OXYGEN UPTAKE AND HEART RATE RESPONSES TO PASSIVE PEDALING EXERCISE USING A TANDEM BICYCLE ERGOMETER

ONODERA, S.1, TAMARI, Y.1, WADA, T.1, YOSHIDA, N.1, HAMADA, H., SAITO, T.1, MURATA, M.2, ARATANI, Y.1, HAYASHI, S.3, TAKAHARA, T.2, YOSHIOKA, A.4, YAMAGUCHI, H.2, KATAYAMA, K.5, OGITA, F.6

1: KUMW , 2: KIU , 3: FCU , 4:OU , 5: NU , 5: NIFS

INTRODUCTION: We have developed a tandem bicycle ergometer of the pist-type braking that two persons can share one load (Onodera at al. 2015,2017). By using this ergometer, when one person performs active pedaling exercise, the other person can be allowed to passive pedaling exercise. This study aimed to clarify oxygen uptake (VO2) and heart rate (HR) responses to passive pedaling exercise at different the number of pedal rotations.
METHODS: Healthy seven adult males were participated in this study as a volunteer (Age; 24 ± 3 year, Height; 172 ± 5cm, Weight; 67 ± 12kg, VO2peak; 44.3 ± 6.6 ml/kg/min). Because we thought that HR and VO2 responses of passive pedaling cyclist would show a similar tendency regardless of active pedaling cyclists, a passive pedaling cyclist in this experiment was fixed by one person and the others were responsible for active pedaling cyclists. The load of cycle exercise was set at 1.5kp and the exercise duration was for 15 minutes. The number of pedal rotations was set at 40 rpm at the beginning, and then it was increased 10 rpm every 3 minutes. The subject, who performed the passive pedaling exercise, also performed the active pedaling exercise by himself using a same protocol. HR was measured throughout the exercise for 15 minutes using the electrocardiograph and VO2 was measured last 1 minute each the number of pedal rotations. The differences in HR and VO2 were detected among the different cadence using the one-way ANOVA. When differences were found to be significant, comparisons were made using Bonferroni's post hoc test. Values of $p<0.05$ were considered as statistically significant.

RESULTS: HR (bpm) (40rpm: 124 ± 13, 50rpm: 142 ± 16, 60rpm: 156 ± 19, 70rpm: 168 ± 22, 80rpm: 182 ± 19, mean ± SD) and VO2 /kg (ml/kg/min) (40rpm: 18.2 ± 2.8, 50rpm: 20.9 ± 3.3, 60rpm: 24.4 ± 4.1, 70rpm: 29.2 ± 4.5, 80rpm: 34.9 ± 4.8, mean ± SD)of active pedaling cyclists increased significantly with an increase in the number of pedal rotations ($p<0.05$). Similar results were observed in the passive pedaling cyclist ($p<0.05$), and VO2 of passive pedaling cyclist corresponded to 23% of that of active pedaling cyclist. It is considered that the increases in VO2 and HR responses to passive pedaling exercise are attributed to the facilitation of the muscular mechanoreceptor reflex.
CONCLUSION: VO2 and HR responses to passive pedaling exercise, which was determined using our tandem bicycle ergometer, increased significantly in the number of pedal rotations. These data suggest that passive pedaling exercise using our tandem ergometer could be applied to the rehabilitation for the people exercise that is not able to do voluntarily exercise.
This study was supported by JSPS KAKENHI Grant Number 15K01509
References: Onodera S., Saito T., Wada T.et al (2015), J Physi Fit Sports Med, 4(2), 249-251.
Onodera S., Saito T., Wada T. et al (2017), Euro J Sports Exerc Sci, 5(2), 23-30.
Contact: Please include your email address at the very end of your abstract [shote@mw.kawasaki-m.ac.jp]

ACUTE RESPONSES OF SELECTED CARDIAC DIMENSIONS DURING REPEATED MULTIDIRECTIONAL AGILITY-LIKE SPRINTS IN TRAINED TEAM SPORT ATHLETES.

DÜKING, P.1, KUNZ, P.1, KOHL, M.2, SPERLICH, B.1
1 UNIVERSITY OF WÜRZBURG, 2 UNIVERSITY OF APPLIED SCIENCES KOBLENZ

INTRODUCTION: Team-sports are characterized by an intermittent exercise profile involving repeated sprints and rapid multidirectional changes-of-direction (COD) following an external stimulus [1-3]. Understanding the acute physiological responses of repeated multidirectional agility-like sprints (RMAS) is paramount to design appropriate interventions for the athlete. While e.g. muscular factors or energy supply mechanisms have been investigated intensively [2], there is little to no data concerning variations in cardiac stroke volume (SV) and cardiac output during RMAS in trained team sport athletes. This is astonishing since SV contributes to cardiac output, and consequently to maximal oxygen consumption and aerobic ATP provision which accounts for approx. 40% of total energy supply during repeated sprints [2]. Therefore, the aim of this study was to evaluate the acute responses during and in between RMAS on SV in trained team sport athletes.
METHODS: After determination of maximal SV (SVmax) in an incremental treadmill test, 14 trained team sport athletes (n=14, VO2peak: 53.4 ± 5.6 ml/min/kg) performed 16 RMAS interspersed with recovery of 12 s duration performed on the SpeedCourt (Globalspeed GmbH, Hemsbach, Germany). The running path of each run was defined by the investigators to ensure standardization between participants. Yet, running path and angles of COD where unknown to the athletes. SV was measured continuously using thoracic bioimpedence (Physioflow, Manatec Biomedical, France). The SV data was separately analyzed for sprints and recovery, and between sprints 1-8 and 9-16.
RESULTS: SVmax during treadmill test was 172.0 ± 32.5 ml. During the RMAS, mean SV was 160.5 ± 3.3 ml and 121.4 ± 2.6 ml during sprints and recovery, respectively. For sprints 1-8, SV was 162.4 ± 2.0 ml and 119.8 ± 1.5 ml, and for sprints 9-16 SV was 158.8 ± 2.9 ml and 122.7 ± 2.3 ml during sprints and recovery, respectively. T-tests analysis revealed a significant difference in peak SV during sprints ($p= 0.03$) and minimal SV during recovery periods ($p = 0.02$) between sprints 1-8 vs. 9-16. There was no significant difference between SVmax during incremental test and peak SV in RMAS ($p = 0.13$).
CONCLUSION: Our findings indicate that RMAS elicits near maximal SV. With increasing number of RMAS, SV decreases with each sprint and increases in the recovery periods. The decreasing SV during sprints could be due to an increase in heart rate which consequently may reduce left ventricular filling time. An increasing SV during recovery periods in between sprints could indicate a diminished recovery from RMAS, however, this needs to be confirmed by future studies. Peak SV during sprints and SV during recovery periods may be useful to describe aspects of cardiovascular load imposed to trained team sport athletes performing RMAS.

THE DIFFERENT RESPONSES IN REGIONAL PULSE WAVE VELOCITY TO WATER IMMERSION AT 30°C

SAITO, T.1, HAMADA, H.2, NISHIMURA, M.3, MURATA, M.4, NISHIMOTO, T.1, YOSHIOKA, A.5, YANO, H.2, ONODERA, S.2
1: KAWASAKI UNIV OF MEDICAL WELFARE , 2: GRADUATE SCHOOL, KAWASAKI UNIV OF MEDICAL WELFARE , 3: TOTTORI UNIV , 4: KIBI INTERNATIONAL UNIV , 5: OKAYAMA UNIV

INTRODUCTION: It has been reported that water immersion increase brachial-ankle pulse wave velocity (baPWV). Although, in japan, swimming pools are commonly maintained at around 30°C, we already showed that even 30°C significantly increased baPWV (Saito et al., 2014). PWV is useful method for evaluating arterial stiffness. However, it is unclear whether or not the increase in baPWV is associated with peripheral and/or central vascular responses. The purpose of this study was to compare changes the regional PWV while resting on land and during water immersion at 30°C.
METHODS: Subjects comprised six healthy adult males. All subjects signed the informed consent forms prior to participation in this study. The subjects remained in a supine position in two different conditions, on land condition and in water condition (water temperature: 30°C). On land condition, we recorded measurements when participants were resting in the supine position for 25 min. After resting in the supine position on land for 10 min, a water tank was used to immerse the subjects' entire body, with the exception of their faces, for 15 min. We measured the heart–carotid PWV (hcPWV), heart–femoral PWV (hfPWV), femoral–ankle PWV (faPWV), baPWV, heart rate, blood pressure (brachial and ankle), rectal temperature, skin temperature and skin blood flow.
RESULTS: The hfPWV, faPWV, baPWV and diastolic blood pressure (ankle) at water condition were significantly higher than that on land condition ($P < 0.05$). There was no significant difference between the land and water condition in any other measurement items.
CONCLUSION: Pulse waves conduct from the central to the peripheral arteries. Previous studies reported that there were significant changes in the lower body PWV, but not aortic PWV, in response to lower limb heat stimulation (Kosaki et al., 2015). In contrast, in younger females sensitive to cold, there is a decrease in blood flow into the toes and a decrease in body temperature and an increase in arterial stiffness both in the lower limbs and the whole body (Yamato et al., 2016). In conclusion, this study suggests that a cold stimulus to the whole body in water immersion at 30°C induces not only increase in faPWV which associated with peripheral vascular reaction, but also increase in hfPWV.
REFERENCES:
Saito T, Takahara T, Nishimura M, Murata M, Yoshioka A, Onodera S (2014). Kawasaki J Med Welf, 20 (1), 9-12.
Kosaki K, Sugawara J, Akazawa N, Tanahashi K, Kumagai H, Ajisaka R, Maeda S (2015). J Physiol Sci, 65(4), 311-316.
Yamato Y, Hasegawa N, Fujie S, Iemitsu M (2016). Menopause & Womens Health Jpn, 24(1), 29-36 (in Japanese).

PHYSICAL ACTIVITY INDEX INFLUENCE ON ALL-CAUSE MORTALITY AND VASCULAR HEALTH MEASURES: FINDINGS FROM THE FRAMINGHAM HEART STUDY

MUGGERIDGE, D.J., RAE, M., FLORIDA-JAMES, G., ROSS, M.

UNIVERSITY OF THE HIGHLANDS AND ISLANDS

INTRODUCTION: Exercise training, and regular physical activity (PA) are known to positively benefit vascular function and reduce all-cause mortality. Endothelial progenitor cells (EPCs) play an important role in maintenance of vascular health, due to their regenerative capabilities. These cells are also predictive of mortality, and are lower in vascular disease states in comparison to a healthy population. Exercise is known to stimulate mobilisation of EPCs into circulation, which may offer a window of vascular protection. It is therefore plausible that enhanced vascular function and reduced mortality may potentially be mediated via increasing the circulating levels of these vascular regenerative cells. Using data collected from the Framingham Heart Study (FHS), we aimed to investigate the relationship between PA levels and EPCs, as well as other key vascular health measures (Peripheral Arterial Tone (PAT), carotid Intima-Media Thickness (CIMT)), and subsequent effects on all-cause mortality risk.
METHODS: 3002 participants' (1352 male/1650 female, age 67 ± 7yrs) data were included from the offspring cohort of the FHS. Data for EPCs (CD34+, CD133+CD34+VEGFR2), PAT and CIMT were assessed from exam7 (Dates 1998-2001). All-cause mortality rates were based on a 10-12 years follow-up period. PA Index (PAI) scores were calculated as previously described and participants were split equally into LOW (24.0 – 34.1) and HIGH (34.2 – 70.9) activity groups. Data was transformed where normality violated. Cox proportional hazard analysis assessed the effect of PAI groups on all-cause mortality. Multiple linear regression assessed the impact of PAI groups on vascular health outcome variables after controlling for age, sex, ethnicity, BMI, smoking, diet and cardiovascular medication.
RESULTS: Following 12 year follow-up, 202 participants died. LOW PAI was associated with an increase in all-cause mortality (Total deaths = 142, hazard ratio 2.512, 95% confidence interval (CI) 1.907 – 3.311, P<0.001) versus HIGH PAI (Total deaths = 60, hazard ratio 0.398, 95% CI 0.302 – 0.5245, P<0.001). Multiple linear regression models explained a small but significant variation in left (L_) and right (R_) CIMT (L_CIMT r2 = 0.222, R_CIMT r2 = 0.218) and PAT augmentation index (r2 = 0.182), but not circulating EPCs (CD34+: r2 = 0.053, CD133+CD34+VEGFR2: r2 = 0.017). The impact of PAI was minimal in all of the models (r2 change all < 0.003, all P>0.1).
CONCLUSION: Physical Activity Index from the Framingham Heart Study is a strong predictor all-cause mortality in the offspring cohort. Whilst vascular measures have been shown to previously influence all-cause mortality, data from the present findings suggest that PAI had little or no effect on the vascular health measures assessed. In conclusion, increases in PAI may benefit mortality rates but this may be independent of effects on vascular health measures.

INFLUENCE AND RELIABILITY OF LOWER-LIMB ARTERIAL OCCLUSION PRESSURE AT DIFFERENT BODY POSITIONS.

PATTERSON, S., HUGHES, L., JEFFRIES, O., WALDRON, M., ROSENBLATT, B., GISSANE, C., PATON, B.

ST MARYS UNIVERSITY

INTRODUCTION: Total arterial occlusive pressure (AOP) is used to prescribe pressures for surgery, blood flow restriction (BFRE) and ischemic preconditioning (IPC). AOP is often measured in a supine position; however, the influence of body position on AOP measurement is unknown and may influence of level of occlusion in different positions during BFR and IPC. The aim of this study was therefore to investigate the influence of body position on AOP
METHODS: Fifty healthy individuals (age = 29 ± 6 y) underwent AOP measurements on the dominant lower-limb in supine, seated and standing positions in a randomised order. AOP was measured automatically using the Delfi Personalised Tourniquet System device, with each measurement separated by 5 min of rest.
RESULTS: AOP was significantly lower in the supine position compared to the seated position (187.00 ± 32.5 vs 204.00 ± 28.5 mmHg, p<0.001) and standing position (187.00 ± 32.5 vs. 241.50 ± 49.3 mmHg, p<0.001). AOP was significantly higher in the standing position compared to the seated position (241.50 ± 49.3 vs. 204.00 ± 28.5 mmHg, p<0.001).
CONCLUSION: AOP measurement is body position dependent, thus for accurate prescription of occlusion pressure during surgery, BFRE and IPC, AOP should be measured in the position intended for subsequent application of occlusion

THE EFFECTS OF AEROBIC EXERCISE TRAINING IN WATER ON ARTERIAL STIFFNESS IN OLDER ADULTS

MATSUI, T.1, TATSUMI, J.1, SAITO, T.2, ONODERA, S.2, KURATO, R.3

1: OTEMON GAKUIN UNIVERSITY, 2: KAWASAKI UNIVERSITY OF MEDICAL WELFARE, 3: KAGAWA UNIVERSITY

INTRODUCTION: It is well known that large elastic arteries stiffen with age, which increases the risk of cardiovascular disease. Physical exercise affects arterial stiffness; especially, moderate intensity aerobic exercise on land leads to a transient decrease in arterial stiffness (Hefferman et al., 2007; Nogami et al., 2011), as does continuous exercise training (Kim HK et al., 2017). However, few studies have reported the effects of exercise in water on arterial stiffness. In addition, the effects of exercise training in water in older adults are unclear. Therefore, we investigated the effects of exercise training in water on arterial stiffness in older adults compared to those of exercise training on land.
METHODS: In this interventional study, 51 elderly subjects were divided into 2 groups: a water-based aerobic exercise training group (WEG: n = 23 (10 male), 70.7 +/- 3.4 yrs) and a land-based one (LEG: n=28 (4 male), 72.3 +/- 4.6 yrs). They performed the trainings twice a week for 3 months. The average total number of participations was 21 in WEG, and 24 in LEG. The exercise duration per time was 45 min, including warm-up exercises. The WEG performed aquatic dance and / or walking in water. The LEG performed aerobic dance and / or other exercises. The brachial-ankle pulse wave velocity (baPWV) were measured in the pre and post training period.
RESULTS: The pre-training baPWV of WEG and LEG were 1822.0 +/- 556.1 and 1804.5 +/- 361.8 cm/sec. The post-training baPWV were 1840.1 +/- 533.8 and 1841.9 +/- 338.6 cm/sec. There were no significant differences in baPWV between the pre and post period in the same group. Additionally, there were no significant differences in baPWV between WEG and LEG in the same period. We examined the subjects who showed absolute changes (from pre to post) in baPWV more than 100 cm/sec and who showed a final value of 1900 cm/sec compared to the pre training period. In the WEG, the subjects who met these conditions showed a significantly negative correlation between baPWV changes and number of training (p <0.05). On the other hand, there was no similar relationship in the LEG group. The number of subjects who showed more than 100 cm/sec improvement in baPWV was 8 (35%) in the WEG and 6 (21%) in the LEG.
CONCLUSION: It is suggested that water-based aerobic exercise training twice a week could be effective in lowering arterial stiffness (measured using baPWV) compared to land-based exercises in older adults.

SUPERVISED EXERCISE TRAINING IMPROVES PHYSICAL FUNCTION IN PATIENTS WITH LOWER EXTREMITY ARTERY DISEASE: PRELIMINARY RESULTS.

LANZI, S., CALANCA, L., MAZZOLAI, L.

DIVISION OF ANGIOLOGY

INTRODUCTION: In lower extremity artery disease (LEAD), supervised exercise training (SET) is recommended as one of the primary baseline measure in patients with intermittent claudication to improve walking capacities and reduce cardiovascular risk. Aim of present study was to investigate the effects of combined SET (Nordic walking and lower limb strengthening) on physical function.
METHODS: Fontaine stage II LEAD's patients following a 3-month SET were investigated. SET consisted in 3 weekly 50-min sessions: twice Nordic walking and once lower limbs strengthening. Ankle-brachial Index (ABI), treadmill pain-free walking distance (PFWD) and maximal walking distance (MWD) were measured before and after SET. Monthly time course evolution of 6-min walking distance (6MWD), physical function of lower extremities [assessed by Short Physical Performance Battery (SPPB) score and stair climbing test (SCT)], and postural stability (assessed by a posturographic platform) were also assessed (pre-SET, 1 month and 2 months, post-SET). Wilcoxon signed-rank test and one-way repeated measures ANOVA (with Bonferroni correction) were used for comparison.
RESULTS: Fourteen consecutive LEAD patients (64.8±2.8 years, 86% men) were analyzed. Following SET, walking performances significantly increased (PFWD: 97.7±14.0m pre- vs. 208.5±46.6m post-SET; P=0.011; MWD: 370.8±59.0m pre- vs. 662.3±127.8m post-SET; P=0.004). ABI did not change significantly (0.89±0.07 pre- vs. 0.86±0.04 post-SET; P=0.86). 6MWD, SCT, and SPPB score significantly improved during SET (P≤0.001, P≤0.001, P=0.011; respectively). 6MWD was significantly increased at 1 month (+8%, P=0.012), 2 months (+9%, P=0.004), and after SET (+10%, P=0.01) compared to pre-training. However, increase was not significant at 1 and 2 months compared to end of SET. Similarly, time during SCT significantly decreased at 1 month (-13%, P=0.003), 2 months (-17%, P=0.001) and after SET (-17%, P=0.006) compared to pre-training, Again, no significant difference was found at 1 and 2 months compared to end of SET. SPPB score tended to slightly increase at the end of SET (+8%, P=0.06) compared to pre-training. No significant difference was found after 1 or 2 months of SET. Postural stability did not change significantly during SET.
CONCLUSION: These results confirm beneficial effects of SET on walking performances. Additionally, they suggest that SET is also effective in improving physical function in LEAD patients. Monthly time course evolution of different physical function measures revealed that these adaptations mainly occur during the first month of SET, suggesting that training adaptations (volume, intensity) may be considered in the second part of SET to further increase benefit.

Conventional Print Poster

CP-PM15 Genomics

PRELIMINARY ANALYSIS OF THE GENOFIT GENOMICS OF HEALTH AND FITNESS STUDY.

RYAN, A., CROGNALE, D., QUINN, E., BUTLER, A., DOLAN, J., PRATT, J., MAGALHAES, T., CARR, R., MORAN, R., O'CONNELL, K., CONROY, J., DEVITO, G., BOREHAM, C., ENNIS, S.

GENOMICS MEDICINE IRELAND

INTRODUCTION: Health, fitness and well-being are influenced by both environmental and genetic components. By integrating genomic and phenotypic data, the GenoFit study aims to identify genetic variants that contribute to various aspects of human health and fitness.
METHODS: Participants (age range 18 – 89 years) complete a detailed lifestyle questionnaire and are physically assessed for general health and fitness measures including adiposity, blood pressure, heart rate, bone mineral density and muscle health. The genomes of all enrolled individuals will be whole genome sequenced to a depth of 30x and genotyped using an Affymetrix precision medicine research array containing over 800,000 markers. The final target sample size is 5,000 individuals.
RESULTS: To date, 277 individuals have been genotyped. Analysis using linear regression for quantitative trait association (PLINK v1.9) have yielded nominally significant (uncorrected $P < 0.05$) association signals for several traits including adiposity, hand-grip and bone density. However, with the current sample size, no loci have reached genome-wide significance.
CONCLUSION: Active sample collection, phenotypic characterization and molecular analysis are ongoing, with the aim of developing a valuable resource for future genomic studies.

ASSOCIATION BETWEEN MAPT POLYMORPHISM BUT NOT APOE PROMOTER AND ELITE RUGBY ATHLETE STATUS.

ANTROBUS, M.R.1, BRAZIER, J.1, HERBERT, A.J.1, STEBBINGS, G.K.1, DAY, S.H.1, HEFFERNAN, S.2, ERSKINE, R.M.3, KILDUFF, L.P.4, WILLIAMS, A.G.1

1: MANCHESTER METROPOLITAN UNIVERSITY , 2: UCD , 3: LJMU , 4: SU .

INTRODUCTION: Incidence and outcomes of concussions have been hypothesised to be genetically influenced. The APOE Promoter G219T (rs405509) polymorphism has been associated with differential promoter activity and unfavourable outcomes after traumatic brain injury. The TT genotype is associated with a 3-fold greater risk of multiple concussions. The TT genotype of MAPT (rs10445337) has also been associated with poorer outcomes after concussion. Rugby has one of the highest incidences of concussion in sport, so it was hypothesised that APOE Promoter TT and MAPT TT genotypes would be less prevalent in elite rugby athletes because those genotypes, previously associated with increased risk, would be less compatible with achieving elite athlete status.
METHODS: Participants were from the RugbyGene project, comprising elite Caucasian male rugby athletes (n = 528; mean (standard deviation) height 1.85 (0.07) m, mass 101 (14) kg, age 29 (7) yr), including 420 rugby union (RU) athletes that for some analyses were divided into forwards and backs and 108 rugby league (RL) athletes. Non-athletes were 592 Caucasian men and women (57% male, height 1.72 (0.10) m, mass 74 (14) kg, age 31 (7) yr). PCR of genomic DNA was used to determine genotypes using TaqMan probes, then groups were compared using $\chi 2$ and odds ratio (OR) statistics.
RESULTS: All genotype data were in Hardy-Weinberg equilibrium. For MAPT (rs10445337), the risk genotype (TT) was underrepresented in rugby athletes (60%) compared to non-athletes (66%), CT more common in rugby athletes (34%) than non-athletes (29%) and little difference in CC genotype frequencies ($\chi 2 = 7.092$, $P = 0.029$; TT genotype frequency OR = 0.80, 95% confidence intervals (CI) = 0.62-1.02). There were no differences in MAPT (rs10445337) genotype frequencies between RU forwards and backs. For APOE Promoter G219T

(rs405509), there were no differences in genotype frequencies between all athletes (RU and RL) and non-athletes (27% TT genotype in players and non-athletes), nor between RU forwards and backs.
CONCLUSION: The MAPT (rs10445337) TT genotype is 6% less common in elite rugby athletes than non-athletes. Therefore, carrying at least one rs10445337 C allele appears to increase the probability of sustained career success in the high-risk concussion environment of elite rugby, perhaps via a greater ability to recover from concussions.

ASSOCIATION OF MMP3 BUT NOT TIMP2 GENE VARIANTS WITH ELITE RUGBY PLAYER STATUS AND RUGBY CODE

BRAZIER, J.1, ANTROBUS, M.R.1, HERBERT, A.J.1, STEBBINGS, G.K.1, DAY, S.H.1, HEFFERNAN, S.2, ERSKINE, R.M.3, KILDUFF, L.P.4, WILLIAMS, A.G.1

1: MANCHESTER METROPOLITAN UNIVERISTY , 2: UCD , 3: LIMU , 4: SU .

INTRODUCTION: Achilles tendon pathology and anterior cruciate ligament rupture are multifactorial conditions for which genetic risk factors have been identified. Single nucleotide polymorphisms (SNPs) within the MMP3 (rs591058, rs679620, rs650108) and TIMP2 (rs4789932) genes have previously been associated with tendon and ligament pathologies. Although not entirely clear, prior literature indicates the risk alleles for Achilles tendon pathology as T (rs591058), G (rs679620) and A (rs650108) for MMP3. However, prior evidence regarding TIMP2 is equivocal. MMP3 is considered an essential regulator of matrix degradation and remodelling within diseased and normal musculoskeletal soft tissues. TIMP2 maintains homeostasis in the extracellular matrix in part by inhibiting MMP function. Given the high incidence and severity of tendon and ligament injuries in elite rugby athletes, we hypothesised that the aforementioned SNPs would be associated with career success.
METHODS: Participants from the RugbyGene project were elite Caucasian male rugby athletes (n = 566; mean (standard deviation) height 1.85 (0.07) m, mass 101 (14) kg, age 29 (7) yr), including 420 rugby union (RU) athletes that for some analyses were divided into forwards and backs and 120 rugby league (RL) athletes. Non-athletes were 589 Caucasian men and women (n = 589, 57% male, height 1.72 (0.10) m, mass 74 (14) kg, age 31 (7) yr). PCR of genomic DNA was used to determine genotypes using TaqMan probes, then groups were compared using X2 and odds ratio (OR) statistics.
RESULTS: The MMP3 rs591058 risk genotype (TT) was less frequent in rugby athletes (28%) compared to non-athletes (33%) (X2 = 7.265, P = 0.026; OR = 1.18, 95% confidence intervals (CI) = 0.86-1.63). No differences were found for MMP3 rs679620, rs650108 or TIMP2 rs4789932 between rugby athletes and non-athletes. When RL athletes were compared to non-athletes, the risk genotype (TT) of MMP3 rs591058 was underrepresented in RL athletes (19%) compared to non-athletes (33%). The MMP3 rs679620 'protective' allele (C) was more frequent in RL athletes (55%) compared to non-athletes (48%) (OR = 1.3, 95% CI = 0.98-1.74). However, for MMP3 rs650108 the 'risk' allele (A) was overrepresented in RL athletes (32%) compared to non-athletes (26%). There were no genotype differences for any gene variant between RU athletes and non-athletes. The 'risk' allele (T) of the MMP3 rs679629 polymorphism and the 'protective' allele (G) of the MMP3 rs650108 polymorphism were less common in RL (45%, 68%, respectively) than RU athletes (54%, 76%, respectively).
CONCLUSION: We provide evidence for elite rugby athletes possessing a protective genetic profile regarding tendon and ligament injury risk. Notably, a less frequent rs591058 TT genotype in athletes suggests a lower risk of injury could therefore enhance career success in rugby. Furthermore, RL players appear to have differing genetic characteristics compared to their RU counterparts, which might reflect some differences in physiological demands.

G-PROTEIN COUPLED ESTROGEN RECEPTOR (GPER) RS3808350 POLYMORPHISM IS ASSOCIATED WITH CENTRAL ARTERIAL STIFFNESS IN HEALTHY JAPANESE PEOPLE

HAYASHI, K.1, IEMITSU, M.2, MURAKAMI, H.3, SANADA, K.2, KAWANO, H.4, GANDO, Y.3, TANAKA, N.5, KAWAKAMI, R.6, MIYACHI, M.3

1: KOKUGAKUIN UNIVERSITY, 2: RITSUMEIKAN UNIVERSITY, 3: NATIONAL INSTITUTES OF BIOMEDICAL INNOVATION, HEALTH AND NUTRITION, 4: KOKUSHIKAN UNIVERSITY, 5: NAGOYA UNIVERSITY, 6: WASEDA UNIVERSITY

INTRODUCTION: The G protein-coupled receptor (GPER) is an estrogen receptor, and has been shown to mediate estrogenic effects on arterial functions such as endothelial function and blood pressure (Han et al., 2013). However, the effect of the GPER gene polymorphism on arterial stiffness in humans remains unclear. In addition, regular physical activity brings higher cardiorespiratory fitness and results in the reduction of arterial stiffening, but the effect of the GPER gene polymorphism on the relationship between cardiorespiratory fitness and arterial stiffness has also not been clarified. The purpose of this study was to clarify the effects of the GPER gene genotype on central arterial stiffness and higher-cardiorespiratory fitness related reductions in arterial stiffness.
METHODS: Seven hundred and fifty Japanese people (18-84 yrs old) participated in a cross-sectional study. Three single nucleotide polymorphisms (SNPs) of the GPER gene (rs11544331, rs3808350, rs3808351) were determined by real-time PCR with the Taqman probe. Central arterial stiffness was evaluated by beta-stiffness index of the carotid artery using ultrasound and applanation tonometry. Brachial blood pressures, blood lipids and glucose levels and VO2peak were also measured. Subjects were divided into high- or low-cardiorespiratory fitness groups based on the median value of VO2peak in each gender and decade.
RESULTS: BMI and blood glucose level of individuals with AA genotype (n=158) in rs3808350 polymorphism were higher than those of individuals with AG (n=368) and GG (n=224) types. There were no differences in age, blood pressures of brachial artery and blood lipid levels among the genotypes in the polymorphism. beta-stiffness index of the carotid artery of individuals with the GG type (7.55 ± 0.20 A.U., Mean ± S.E.) in the polymorphism was significantly lower than those of other two genotypes (AA type: 8.50 ± 0.40, AG type: 8.57 ± 0.20 A.U.) after adjusting for covariates such as gender and BMI ($P<0.05$). However, the rs3808350 had no impact on the difference of beta-stiffness index associated with cardiorespiratory fitness level. Other polymorphisms (rs11544331 and rs3808351) were not associated with beta-stiffness index of the carotid artery and higher fitness related improvement of the carotid arterial stiffness.
CONCLUSION: rs3808350 genotype of the GPER gene is associated with stiffness of central artery in healthy Japanese population but had no impact on the higher fitness-related reduction of arterial stiffness. Reference: Han G et al. (2013) Pharmacol Res, 71, 53-60.

ASSOCIATION ANALYSIS OF COL1A1 AND COL5A1 POLYMORPHISMS WITH MUSCLE STIFFNESS

MIYAMOTO-MIKAMI, E.1, HIRATA, K.1, KIMURA, N.1, FUKU, N.2, MIYAMOTO, N.1

1: NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA , 2: JUNTENDO UNIVERSITY

INTRODUCTION: Muscle stiffness is considered to be one of the primary contributors to joint flexibility (Magnusson et al, 1997) and to influence muscular injury risk (Witvrouw et al, 2003). There is a large individual difference in muscle stiffness (Hirata et al, 2018). However,

genetic determinants of the individual difference remain unclear. Muscle stiffness is influenced by the concentration of intramuscular collagenous connective tissues, such as perimysium and endomysium (Gajdosik, 2001). Therefore, we hypothesized that genotypes affecting collagen expression can contribute to the individual difference in muscle stiffness. To test this hypothesis, we examined the associations of muscle stiffness with polymorphisms affecting the expression of type I and V collagen.
METHODS: Polymorphisms affecting the expression of type I and V collagen were selected based on the Genotype-Tissue Expression database (GTEx) and previous studies. Seventy-seven healthy young male subjects were genotyped by TaqMan SNP Genotyping Assay, for rs1107946 and rs9893529 polymorphisms associated with expression of collagen type I alpha 1 chain (COL1A1) and rs12722 polymorphism associated with collagen type V alpha 1 chain (COL5A1) mRNA stability. Passive muscle stiffness of each of the hamstring (biceps femoris long head, semitendinosus, and semimembranosus) of the right leg was assessed in a seated position using ultrasound shear wave elastography.
RESULTS: Stiffness of the semimembranosus significantly differs among the COL1A1 rs1107946 genotypes ($P < 0.05$ by ANOVA). CC genotype carriers showed higher passive stiffness of the semimembranosus than AC genotype carriers (CC: 51.6 kPa vs. AC: 39.2 kPa, $P < 0.05$ by Bonferroni post hoc test). There was no association of the other two polymorphisms with passive stiffness of the hamstring muscles.
CONCLUSION: Type I collagen is the major component of perimysium and endomysium (Light et al, 1984). rs1107946 A to C polymorphism is located within the COL1A1 promoter region, and in vitro functional assay showed that the C allele has a higher transcriptional activity than the A allele. Indeed, according to the GTEx, the C allele is associated with higher gene expression of COL1A1 in human tissue. Taken together, our result suggests that the rs1107946 polymorphism contributes to the individual difference in muscle stiffness through altered COL1A1 expressions.

ASSOCIATION ANALYSIS OF ACE I/D AND ACTN3 R577X GENE POLYMORPHISMS IN ELITE INDIAN ATHLETES

GROVER, V.K., KUMAR, A., VERMA, J.P., SHARMA, N., TIWARI, P.K.

LAKSHMIBAI NATIONAL INSTITUTE OF PHYSICAL EDUCATION

INTRODUCTION: Success in sports relies upon the aerobic and anaerobic capacities of an individual depending upon the energy metabolism requirement of a particular sport. The genetics plays an important role in determining these capacities of an individual in sports. ACE I/D gene polymorphism was the first gene variant that was investigated with respect to physical performance (Montgomery et al., 1998). In the Australian rowing team that won most rowing medals in 1996 Olympics, most of the team members had I allele and I/I genotype of ACE I/D gene polymorphism (Gayagay et al., 1998). 155 DNA polymorphisms have been found to be associated with sports performance or related phenotypes (Ahmetov et al., 2016). The ACE I/D and ACTN3 R577X gene polymorphisms are the most studied gene polymorphisms worldwide in different cohorts (Ahmetov et al., 2016). However, none of the studies has been conducted so far to find the association in Indian elite athletic cohort. Here, we investigated the association of ACE I/D and ACTN3 R577X gene polymorphisms with athletic status of Indian elite boxers, endurance athletes, power/speed athletes as compared to nonathletes.
METHODS: In the present study, 51 elite boxers, 40 elite endurance athletes, 40 elite power/speed athletes and 100 nonathletes (healthy individuals who have never competed in sports) participated in the study. Around 2 ml saliva was collected in a vial containing 2 ml STE buffer from the subjects for genetic analysis as per the ethical guidelines of the Institutional Human Research Ethics Committee, Jiwaji University, Gwalior. DNA was isolated by spin column based method. Further, ACE I/D gene polymorphism was determined by simple PCR and ACTN3 R577X gene polymorphism by PCR-RFLP method.
RESULTS: The genotypic and allelic frequencies of selected gene variants were compared among Indian elite boxers, elite endurance athletes, elite power/speed athletes and nonathletes. The I allele and I/I genotype of ACE I/D gene polymorphism was found to be significantly associated ($p<0.05$) with Indian endurance athletes as compared to non athletes. In Indian boxers, we observed higher frequency of I allele as compared to non athletes. In ACTN3 R577X gene polymorphism, significant allelic and genotypic frequencies were observed in Indian athletic cohort as compared to non athletes.
CONCLUSION: Taken together, we showed for the first time the analysis of ACE I/D and ACTN3 R577X gene polymorphisms in Indian elite athletic cohort. Our results support the earlier findings in other population based studies done worldwide.
Ahmetov, I.I., Egorova, E.S., & Gabdrakhmanova, L.J., et al. (2016). Genes and Athletic Performance: An Update. Med Sport Sci, 61:41-54.
Gayagay, G., Yu, B., Hambly, B., Boston, T., & Hahn, A., et al. (1998). Elite endurance athletes and the ACE I allele– the role of genes in athletic performance. Hum Genet, 103:48–50.
Montgomery, H.E., Marshall, R., & Hemingway, H., et al. (1998). Human gene for physical performance. Nature, 393: 221-222.

IS THE PPARGC1A RS8192678 POLYMORPHISM, A GENETIC MARKER OF PHYSICAL PERFORMANCE AND FITNESS, A RISK FACTOR FOR THE COLORECTAL CANCER DEVELOPMENT IN WOMEN?

YVERT, T.1, IANA, C.I.1, RUBIO, M.2, GOMEZ-GALLEGO, F.3, SANTIAGO, C.1

1.DEPARTMENT OF BASIC BIOMEDICAL SCIENCE/UNIVERSIDAD EUROPEA DE MADRID 2.DEPARTMENT OF PHARMACY, BIOTECHNOLOGY, NUTRITION, OPTICS AND OPTOMETRY3.FACULTY OF HEALTH SCIENCES. UNIVERSIDAD INTERNACIONAL D

INTRODUCTION: Exercise is one of the main mitochondrial regulation factors. The number of mitochondria can increase by 50-100% depending on the training program, improving the energy production capacity of the organism, thus, improving global health. Besides, several genetic polymorphisms in the nuclear genes related to the PPARGC1A-NRF-TFAM mitochondrial biogenesis pathway have been found to correlate with the elite athlete status and with other markers of physical performance and fitness. In addition, several authors have shown that alterations in mitochondrial biogenesis of tumor cells could be risk factors for cancer progression. Thus, the aim of this study is to analyze the frequency of the main genetic polymorphisms involved in these mitochondrial biogenesis pathways in samples of healthy women and women with colorectal cancer.
METHODS: We analyzed 84 DNA samples from tumors of women with colorectal cancer (group 1) and 449 DNA samples from peripheral blood of healthy women as control group (group 2) paired by age with group 1. All the samples were ceded by the Spanish National DNA Bank Carlos III (BNADN) and donated voluntarily after informed consent signature. The genetic polymorphisms rs2267668, rs8192678, rs6949152, rs12594956 and rs1937 of the genes PPARD, PPARGC1A, NRF1, NRF2 y TFAM, respectively, were analyzed by Q-PCR with a StepOne equipment (Life Technologies) with Taqman probes pre-designed for Life Technologies.
RESULTS: All the genetic polymorphisms (rs2267668, rs8192678, rs6949152, rs12594956 and rs1937) satisfied the Hardy-Weinberg equilibrium ($p>0,05$), except for the NRF-1 rs6949152 polymorphism in colorectal cancer ($p=0.044$). No significant differences were found between the genotypic frequencies of the control group and the colorectal cancer group, except for PPARGC1A and NRF-1 ($p=0.035$ and $p=0.023$, respectively). Furthermore, comparing the two groups for the TT genotype frequencies vs. CT and CC genotypes frequencies of

the PPARGC1A rs8192678 polymorphism, we found that having the TT genotype increase 1.9 times the probability to develop colorectal cancer (OR 95% CI=1.905; 3.598-1.008).
CONCLUSION: The presence of the T allele in homozygosis of the PPARGC1A rs8192678 polymorphism may represent a risk factor for the colorectal cancer development. Our results highlight the possible important role of the mitochondrial biogenesis in the development of this kind of cancer. Taking into account that mitochondrial biogenesis is strongly increased by physical exercise, we suggest that it is necessary to further study: i) the role of mitochondrial biogenesis in cancer development and ii) the protective role that physical exercise may play against cancer through the stimulation of mitochondrial activity.
ACKNOWLEDGEMENTS:
This work was supported by Universidad Europea (Ref. 2016/UEM12).

APOLIPOPROTEIN E ε4 ALLELE IS NOT ASSOCIATED WITH ELITE RUGBY STATUS BUT IS PRESENT IN 30% OF ATHLETES

HEFFERNAN, S.M.1,2, KILDUFF, L.P.3, ERSKINE, R.M.4, DAY, S.H.1, STEBBINGS, G.K.1, COOK, C.J.5, GRAINGER, A.2, BRAZIER, J.1, ANTROBUS, M.R., WILLIAMS, A.G.1

UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: The APOE ε4 allele is a candidate genetic marker for risk and severity of mild traumatic brain injury (mTBI) including sport-related concussion. ε4 allele carriers experience reduced motor rehabilitation outcomes, poorer neurocognitive outcomes, increased cognitive impairments, amnesia and memory defects following mTBI. Concussion injury (mTBI) rates in elite rugby players are substantial and, consequently, elevated risk and severity of mTBI due to carriage of the ε4 risk allele may be detrimental to both the short-term and long-term health of elite players and reduce their likelihood of career success. Therefore, we investigated APOE ε2/ε3/ε4 of athletes at the elite level of competitive rugby.
METHODS: Genomic DNA was collected from 1006 Caucasian participants, comprising 523 elite rugby athletes and 483 non-athlete controls (RugbyGene study). All samples were genotyped for the APOE ε2/ε3/ε4 variants (rs429358 and rs7412) using real-time PCR. Pearson's Chi-square ($\chi 2$) tests were used to compare genotype frequencies between groups.
RESULTS: No genotype differences ($P > 0.05$) were identified between controls (ε4/ε4 = 2.3%) and either rugby union (ε4/ε4 = 3.7%) or rugby league (ε4/ε4 = 1.3%) athletes. Similarly, when the presence of the ε4 allele (ε4+) was compared to non-carriers, no allelic differences were observed between controls (ε4+ = 28%) and either rugby union (ε4+ = 29%) or rugby league (ε4+ = 33%). Rugby union athletes with international competitive experience showed an underrepresentation of the ε4/ε4 genotype compared to those without international experience (2.6% versus 4.7%, $P = 0.01$), but exhibited a similar frequency to controls (2.3%).
CONCLUSION: These results suggest that APOE ε4 plays little or no role in the likelihood of a rugby athlete achieving elite competitive status. However, our data suggest that ~30% of rugby athletes could be at greater risk of poor recovery from concussion due to carriage of the ε4 APOE allele and this warrants research to establish if previously identified APOE ε4-mTBI associated outcomes exist in elite rugby.

14:00 - 15:30

Invited symposia

IS-BN03 Do prosthetic legs enhance or hinder running performance?

NATURAL VS. ARTIFICIAL RUNNING: FROM BIOLOGICAL AND PROSTHETIC LIMBS TO GAIT MECHANICS AND SPEED

WEYAND, P.

SOUTHERN METHODIST UNIVERSITY

The sprinting performances of runners with artificial limbs have markedly improved as lightweight, carbon-fiber running prostheses have become more widely available. In the last half-decade, amputee performances have approached or met international standards for non-amputees in two Olympic sprint running events. As the performance gap has narrowed, and the specter of amputee athletes outperforming Olympic medalists has ceased being unrealistic, a basic scientific and athletic policy question has emerged: do artificial limbs artificially enhance sprint running performance? This presentation will consider the evidence currently available to answer this question in two steps. Initially, the relationships between stride timing parameters and the ground reaction forces required to attain elite sprint running speeds in non-amputees will be established. Next, the conformation, or lack thereof, of amputee athletes to the established biological relationships will be considered. Conclusions will be provided regarding speed-enhancement via technology for amputee athletes.

EFFECTS OF RUNNING-SPECIFIC LEG PROSTHESES ON RUNNING, SPRINTING, AND JUMPING PERFORMANCE

GRABOWSKI, A.

UNIVERSITY OF COLORADO BOULDER

INTRODUCTION: Running-specific leg prostheses (RSPs) are made of carbon fiber, mimic the spring-like function of tendons, and allow elastic energy storage and return during level, steady-speed running; however, unlike biological legs, passive-elastic RSPs cannot generate mechanical power anew, vary stiffness, or allow ground clearance during leg swing. Athletes with transtibial amputations (TTAs) using RSPs have lower stance-average vertical ground reaction forces (vGRF) in their affected vs. unaffected leg across running speeds (Grabowski et al. 2010). Also, athletes with bilateral TTAs using RSPs have 23% slower starting block acceleration compared to non-amputees (Taboga et al. 2014). Moreover, when athletes with TTAs negotiate curves, their inside leg and affected leg limit speed (Taboga et al. 2016). It is possible that the RSP configurations used by athletes with TTAs do not optimize performance. Thus, we determined how different RSP model, stiffness, and height affect running and sprinting in athletes with TTAs. We also determined the effects of using an RSP for the long jump.

METHODS: I will present a series of studies that assessed biomechanics, metabolic costs, and top speeds of athletes with unilateral and bilateral TTAs who used 15 different RSP model, stiffness, and height configurations for running and sprinting. I will also present a study of the effects of using an RSP for the long jump.
RESULTS: Athletes with TTAs using J-shaped vs. C-shaped RSPs had 3.4–4.7% lower net metabolic cost of transport (CoT) at 2.5-3m/s (Beck et al. 2017a, b). Use of less stiff RSPs lowered net CoT for athletes with bilateral TTAs. Athletes with TTAs using J-shaped vs. C-shaped RSPs had 6.9–9.8% faster top speeds. Further, RSP stiffness and height affect the biomechanics of athletes with TTAs across speeds (3-9m/s) (Beck et al. 2017a, b, c). Athletes with bilateral TTAs using stiffer RSPs had greater peak and stance average vGRF and overall leg stiffness (inversely related to speed), briefer contact time, and faster step frequency; these effects were mitigated at faster speeds. ±0.02m RSP height changes did not affect biomechanics across speeds (Beck et al. 2017c), but increased RSP height resulted in more asymmetric peak vGRF in athletes with unilateral and increased peak braking GRF in athletes with bilateral TTAs at 2.5-3m/s (Beck et al. 2017a, b). Use of an RSP impairs performance during the approach, but may enhance performance during the take-off step of the long jump.
Discussion:
J-shaped and less stiff than recommended RSPs optimize performance for athletes with TTAs.
References:
Beck O, Taboga P, Grabowski A. (2017a) J Appl Phys, 123, 38-48; (2017b) J Appl Phys, 122, 976-984; (2017c) Roy Soc Int, 14, 20170230
Grabowski A, McGowan C, McDermott W, Beale M, Kram R, Herr H. (2010) Biol Lett, 6, 201-204
Taboga P, Grabowski A, diPrampero P, Kram R. (2014) J Appl Biom, 30, 381-389
Taboga P, Kram R, Grabowski A. (2016). J Exp Biol, 219, 851-858

SUPER-HUMANS? ATHLETIC PERFORMANCE OF AMPUTEES USING RUNNING-SPECIFIC PROSTHESES

HOBARA, H.

NATIONAL INSTITUTE OF ADVANCED INDUSTRIAL SCIENCE AND TECHNOLOGY

Introduction: Recent developments in carbon fiber running-specific prostheses with energy-storing capabilities have allowed individuals with lower extremity amputation (ILEAs) to regain the ability to run. This phenomenon exemplifies how ILEA sprinters are highly motivated and work hard as well as how current prostheses have advanced. This raises the following question: How fast would running-specific prostheses allow ILEA sprinters to run? The aim of this study was 1) to assess the progression of the winning times of the men's 100-m sprint in the ILEA sprinters at the past Paralympic games, and 2) to investigate average spatiotemporal parameters during 100-m sprint in the ILEA sprinters.
Methods: The winning times of the men's 100-m sprint in the Olympics and Paralympics were obtained from the official website of each organization. For Paralympics, we included the winning times of the men's 100-m sprint in the C (1976 and 1980), A4 (1984), A4-A9 (1988), TS2 (1992), T43-44 (1996-2016) classifications. We performed regression analyses to predict the winning time for future Olympics and Paralympics for non-amputees and ILEA sprinters, respectively. Further, we calculated average step frequency and step length during 100-m sprint in four groups (bilateral transfemoral, unilateral transfemoral, bilateral transtibial and unilateral transtibial amputees) by using publicly-available Internet broadcasts.
Results: The difference in winning times between non-amputees and ILEAs was over 4.0 s in 1976. The ILEAs shaved approximately 1.5 s off the time difference from 1984 to 1988. As of 2018, the difference between the two groups has gone down to 1.00 s. We totally collected 505 samples of spatiotemporal parameters during sprinting from four amputee groups. In our dataset, bilateral transtibial amputees was characterized by the highest step frequency and relatively longer step length when compared to other three amputee groups.
Discussion: Our regression model predicted that ILEA sprinters would outperform non-amputees in 2068, where the predicted winning times could be 9.039 and 9.046 s, respectively. These results indicate that if current trends continue, the fastest sprinters in the world may be ILEAs from 2068 onward. Further, bilateral transtibial amputees may be the 'nearest positions' to surpass non-amputee's sprinting performance because of its step characteristics in conjunction with mechanical leg properties.

Oral presentations

OP-PM27 Muscle mass regulation

LOW RESPONDERS TO ENDURANCE TRAINING ALSO EXHIBIT IMPAIRED MUSCLE HYPERTROPHY AND EXACERBATED ATROPHY

DOERING, T.1, WEST, D.2, THOMPSON, J.1, BUDIONO, B.1, LESSARD, S.3, KOCH, L.4, BRITTON, S.5, STECK, R.6, PEAKE, J.6, ASHTON, K.1, COFFEY, V.1

1BOND UNIVERSITY, AUSTRALIA; 2UNIVERSITY OF CALIFORNIA DAVIS, USA; 3HARVARD UNIVERSITY, USA; 4UNIVERSITY OF TOLEDO, USA; 5UNIVERSITY OF MICHIGAN, USA; 6QUEENSLAND UNIVERSITY OF TECHNOLOGY, AUSTRALIA

INTRODUCTION: Variation in the adaptation response to exercise has been well documented, with a significant proportion attributed to genetic factors. Whether there is specificity in the magnitude of adaptation in skeletal muscle with divergent contractile activity is not known. We determined the adaptation response in skeletal muscle of rats selectively bred for high and low response to endurance training when subjected to contrasting stimuli of compensatory hypertrophy and short-term atrophy.
METHODS: Sixty-week old (G19) female rats selected from high responders to training (HRT) or low responders to training (LRT) after an eight-week treadmill training protocol (3×/wk) underwent synergist ablation to induce functional overload of plantaris muscle (14 d, n=7/grp) and unilateral hind limb casting (3 d, n=6/grp). Puromycin injections were administered 30 min prior to sample collection to determine muscle protein synthesis (MPS) via SUnSET method and whole muscle mass was quantified. Muscle mass and Western blots were analyzed using two-way ANOVA with Tukey's post-hoc test ($p<0.05$) and Cohen's d effect sizes.
RESULTS: There were divergent responses for running distance from pre-to-post endurance training which increased in HRT (57 ±28%) but not LRT (-3 ±15%, $p<0.05$). Functional overload induced greater plantaris hypertrophy compared to control limb in HRT (109 ±49 g, $p<0.01$) than LRT (61 ±21 g, $p=0.05$; ΔHRT-LRT d=1.5) but MPS was reduced compared to control in HRT (-26%) and LRT (-13%). Plantaris atrophy was greater in LRT immobilized limbs relative to control group (-58 ±25 g, $p<0.05$) compared with HRT (-23 ±15 g; ΔHRT-LRT d=1.7) which

was associated with lower rates of MPS in LRT (-65%) versus HRT (-48%; ΔHRT-LRT d=1.2). LRT also had more soleus atrophy (-15 ±16 g) than HRT (5 ±13 g; ΔHRT-LRT d=1.8) and rates of MPS were lower in LRT (-75%, p<0.05) than in HRT (-37%; ΔHRT-LRT d=1.0).
CONCLUSION: Selectively bred low-responders to endurance training have impaired muscle plasticity regardless of the mode of contractile overload. Our findings indicate the ability to adapt to diverse training stimuli may share common heritable, genetic underpinnings with profound effects on the specificity and magnitude of adaptation. HRT also appear 'protected' from short-term muscle atrophy and the exacerbated atrophy in LRT was associated with lower rates of translation for muscle protein synthesis. Our novel approach using a unique rat model system shows low responders to endurance training have compromised responses to muscle loading/unloading attributable to a maladaptive genotype.

COUNTERMEASURES TO ALLEVIABLE THE HYPOXIA-INDUCED ATROPHY OF SKELETAL MUSCLE CELLS.

BENSAID, S.
UNIVERSITY OF LILLE

INTRODUCTION: Chronic exposure to severe hypoxia has deleterious effects on the muscular system, in particular on skeletal muscle mass. Hypoxia leads to imbalance of protein homeostasis, decreasing protein synthesis (mainly regulated through PI3K-Akt-mTOR pathway) while increasing protein degradation (mainly through autophagy and proteasomal degradation). In contrast, mechanical stimuli and nutrients, particularly the branched-chain amino acids (BCAA), induce activation of the mTOR pathway in human and rat skeletal muscle as well as and in cultured muscle cells, and decrease protein catabolism. In a model of skeletal muscle cell culture, we attempt to determine whether the combination of mechanical stimulation, nutritional supplementation and reoxygenation could reverse the deleterious effects of hypoxia on protein homeostasis.
METHODS: We induced a hypoxic stress on skeletal muscle murine cells differentiated into myotubes C2C12: four days after differentiation, the C2C12 myotubes were placed into a hypoxic chamber at 4% O2 for 24h. Electrical stimulation (ES) was applied to the cells using a pulse generator to provide electric pulses (30 V at 1 Hz for 3 ms at 997 ms intervals) during 1 hour. Following the ES treatment, myotubes were firstly supplemented with branched-chain amino acids (BCAA: mixture of leucine, isoleucine and valine added to culture media, at concentration of 5 mM) while placed to normoxia during 2 hours (corresponding so to a reoxygenation protocol).
RESULTS: After 24 hours of hypoxia, the morphological analysis of myotubes shows a significant decrease in their diameter, translating the activation of protein degradation pathways at the expense of protein synthesis pathways. When applied separately, each treatment has little effect on the mTOR pathway and morphology of myotubes. However, the combination of EM, supplementation BCAA and reoxygenation lead to an increase of the phosphorylation of key proteins involved in protein synthesis pathway (Akt and p70S6 kinase), thus reflecting their activation state. In addition, morphological analysis shows a significant increase in myotube diameter and fusion index (reflecting the state of differentiation), a sign of the presence of muscle hypertrophy.
CONCLUSION: Our preliminary results suggested that mTOR pathway responds to a combination of electrostimulation, nutrient supplementation and reoxygenation by phosphorylation of key regulators of protein synthesis, and could reverse the protein loss induced by hypoxia.

SUBCUTANEOUS HORMONE INJECTIONS AS MUSCLE FILLERS: CASE OF NECROSIS IN A BODYBUILDER.

SANTOS, A.
SÃO PAULO UNIVERSITY

INTRODUCTION: Use of oil injections in bodybuilding and for body sculpting is highly controversial. Nevertheless, intramuscular oil injections and hormones are being used to enlarge and shape muscle mass among some athletes (Friedman et al., 2016, Ghandourah et al., 2012, Banke et al. 2012). The aim of of this study is to present the case of a 27-year-old, male, Brazilian bodybuilder and personal trainer, with a long history of competitive bodybuilding and anabolic-androgenic steroid use.
METHODS: Employing a qualitative methodology with in-depth interviews, we qualitatively investigated the "discourse analysis" according to Gill (2006), where the interest is the material (interview), in order to tabulate and organize the data about the related case. We describe how hazardous this practice is in order to document the increasing number of victims of this practise.
RESULTS: He injected testosterone enanthate, an oil-based anabolic-androgenic steroid, into his biceps, in a series of subcutaneous injections, with the purpose of "muscle sculpting" his arms. While the right biceps absorbed the substance, the left biceps did not. Following several days with pain, swelling, high fever, and no physical training, our subject was admitted to the emergency room of a local hospital. Magnetic Resonance Imaging revealed multiple, inflamed oil-filled cysts, fibrosis, and necrosis in his left arm, requiring immediate surgical intervention to remove the necrotic tissue, including muscle mass, through a 4-inch incision. Treatment with various antibiotics and anti-inflammatories and several days of hospitalization followed. Treatment continues to the present, including regular monitoring via MRI, and our subject has returned to an exercise regime as part of the recovery program.
CONCLUSION: We call attention to this controversial and clandestine practice (also known as "aesthetic" doping, Santos & Bahrke., 2017), as it is not an isolated phenomenon, but an ever-increasing popular means to build and sculpt the body. Unfortunately, this practice is often associated with dire, unintended adverse effects, including death (Rollins, 1997).
Banke, IJ et al. (2012). Int J Sports Med, 33: 829–834.
Friedman, et al. (2016). PRS Global Open, 1-3.
Ghandourah, et al. (2012). Journal of Medical Case Reports, 6:248.
Gill, R. (2006). 3ª. Ed. Petrópolis: Vozes Editora.
Rollins, CE. (1997). Am J Forensic Med Pathol,18(1):100-3.
Santos AM, Bahrke, M. (2017). Book of Abstracts for the 22nd Annual Congress of the European College of Sport Science, 355.
azepersonal@gmail.com

SHORT-TERM DHEA INTAKE AND SUPRAMAXIMAL EXERCISE IN YOUNG RECREATIONALLY TRAINED WOMEN

GRAVISSE, N., VIBAREL-REBOT, N., LABSY, Z., DO, M.C., GAGEY, O., DUBOURG, C., AUDRAN, M., COLLOMP, K.
UNIVERSITY OF ORLEANS

INTRODUCTION: DHEA, as anabolic agent, is banned by WADA because it may improve performance. However, previous studies in young or middle aged men shown no effect on performance and only one study suggested an anabolic effect . The ergogenic and anabolic effect of DHEA in female athletes has never been investigated while DHEA induced a large increase of anabolic hormones in

blood in this population . The aim of this study was to determine whether short-term DHEA intake would improve performance during a supramaximal field exercise in healthy young recreationally trained women. The impact on body composition, salivary steroid hormones, metabolic responses and mood state was also evaluated.
METHODS: Eleven young female volunteers <20.6 ± 0.6 years> under estroprogestative contraception completed four running-based anaerobic sprint tests: just before and after treatment with either oral placebo or DHEA <100 mg/day for 4 weeks>, following a double-blind and randomized protocol. Bioelectrical impedance assessed body composition and subjects responded to a Profile of Mood States questionnaire. At rest and after 5 min of passive recovery, blood samples were collected for lactate measurement and saliva samples for DHEA, testosterone and cortisol analysis.
RESULTS: There was no significant difference in body composition or performance parameters after DHEA administration, despite a tendency toward increased peak power and decreased fat mass. However, DHEA treatment induced a very marked increase in saliva DHEA <3-fold> and testosterone <20-fold> concentrations, with no change in cortisol or lactate levels. No effect on mood state was noted.
CONCLUSION: Short-term DHEA intake did not improve performance or have an anabolic effect in young female recreationally trained athletes like previously noted in men , despite the striking increase in androgenic hormones also observed in blood with this population . Further studies are needed to determine whether a higher dosage would generate an ergogenic and/or anabolic effect in young female athletes.
REFERENCES: Brown GA, Vukovich MD, Sharp RL, Reifenrath TA, Parsons KA, King DS. <1999>. J. Appl. Physiol. Bethesda Md 1985 87, 2274–2283.
Collomp K, Buisson C, Gravisse N, Belgherbi S, Labsy Z, Do MC, Gagey O, Dufay S, Vibarel-Rebot N, Audran M. <2018>. Endocrine.
Nestler JE, Barlascini CO, Clore JN, Blackard WG. <1988>. J. Clin. Endocrinol. Metab. 66, 57–61.
Wallace MB, Lim J, Cutler A, Bucci L. <1999>. Med. Sci. Sports Exerc. 31, 1788–1792.

NANDROLONE DECANOATE ADMINISTRATION DOES NOT ATTENUATE MUSCLE ATROPHY DURING A SHORT PERIOD OF DISUSE

HORSTMAN, A., BACKX, E., SMEETS, J., VAN KRANENBURG, J., DE BOER, D., DOLMANS, J., SNIJDERS, T., DE GROOT, C., VAN LOON, L.

MAASTRICHT UNIVERSITY

INTRODUCTION: A few days of bed rest or immobilization following injury, disease, or surgery can lead to considerable loss of skeletal muscle mass and strength. Such short, successive periods of muscle disuse may be largely responsible for the age-related loss of muscle mass throughout the lifespan. Protein supplementation beyond habitual protein intake levels does not prevent muscle loss during limb immobilization. Therefore, adjuvant pharmaceutical interventions may be required to preserve muscle mass and/or strength during short periods of bed rest or limb immobilization. Prolonged nandrolone decanoate (NAD) administration has been shown to increase fat free mass or muscle performance in several pathological conditions in vivo in humans. Based on these findings it could be speculated that NAD administration may represent an effective adjuvant pharmaceutical strategy to prevent or attenuate disuse atrophy. Therefore, our aim was to assess whether intramuscular injection of NAD prior to leg immobilization can attenuate the loss of muscle mass and strength in vivo in humans.
METHODS: Twenty-eight healthy males (22±1 y) were subjected to 7 d one-legged knee immobilization by means of a full leg cast with (NAD, n=15) or without (CON, n=13) prior intramuscular NAD injection (200 mg). Before and immediately after immobilization, quadriceps muscle cross-sectional area (CT) and leg strength (1-RM) were assessed and muscle biopsies were taken to assess type I and II muscle fiber cross-sectional area. Pre- versus post-immobilization data were analyzed using repeated-measures ANOVA with Group (CON-NAD) as between-subjects factor and Time (pre-post immobilization) as within-subjects factor.
RESULTS: Quadriceps muscle size decreased during immobilization from 7,712±324 to 7,287±305 mm2 and from 7,805±221 to 7,352±202 mm2 in the CON and NAD group, respectively (P<0.01). No differences were observed in muscle loss between CON (6±1%) and NAD (6±1%; P=0.59). Leg strength declined from 56±4 to 53±4 kg (-6±2%) and from 64±3 to 60±3 kg (-7±3%), respectively (P=0.001), with no differences between groups (P=0.55). No changes in type I or II muscle fiber size, number of myonuclei, or satellite cell content were observed in both groups (P>0.05).
CONCLUSION: Intramuscular nandrolone decanoate administration does not preserve skeletal muscle mass and strength during a short period of leg immobilization in vivo in humans.

IGF-I IS NOT SUPPRESSED IN ADOLESCENTS SUBMITTED TO RESISTANCE TRAINING AND CAN BE A MARKER OF TRAINING STATUS.

CORREA-JUNIOR, M., TOURINHO-FILHO, H., MARTINELLI-JUNIOR, C.

SCHOOL OF MEDICINE OF RIBEIRAO PRETO - USP

INTRODUCTION: Regular physical exercise during childhood and adolescence can promote growth and development of muscle and bone mass. Although physical exercise is closely linked to the anabolic function of the GH /IGF-I axis the real impact of resistance training on GH/IGF axis is still unclear. The kinetics of IGF-I and IGFBP-3 during chronic training is not fully understood yet and an initial catabolic phase followed by an later anabolic phase has been reported in swimmers. The aim of the present study was to analyse the kinetics of IGF-I and IGFBP-3 in adolescents undergoing ten weeks of hypertrophy training.
METHODS: Twenty-two male volunteers aged 18 to 25 years with at least 6 month experience in resistance training were enrolled and submitted to a standard hypertrophy training program during 10 weeks. Serum IGF-I and IGFBP-3 concentrations were determined before, 30 min-after and 24h-after the training session at the 1st, 5th and 10th week of resistance training. Body composition, lean mass, muscle mass, fat percentage and body mass index were also evaluated at the 1st, 5th and 10th week and compared to the changes in serum IGF-I and IGFBP-3. Data were paired compared.
RESULTS: IGF-I levels increased during the training session at the 1st evaluation (P=0.03) and also increased during the 10 weeks of training (P<0.003). No changes in IGFBP-3 levels were observed during a training session or during the 10 weeks of training. Body mass, lean mass, fat percentage and body mass index of the volunteers remained unchanged throughout the 10 weeks of training. A negative correlation was observed between the changes in serum IGF-I concentrations and the variation in muscle mass or lean mass when data from the 1st and the 10th weeks were compared (r=-0.62; P=0,002).

CONCLUSION: In summary, no catabolic phase was detected in adolescents during hypertrophy training; IGF-I was sensitive to the acute and chronic effects of resistance training and can be considered as a biomarker of training status in non-athlete volunteers. The negative correlation between the variations in lean mass and IGF-I could suggest a training induced increase in IGF-I sensitivity.

Oral presentations

OP-PM28 Molecular metabolism

SCLEROSTIN RESPONSE TO HIGH INTENSITY WEIGH BEARING VS NON-WEIGHT BEARING INTERVAL EXERCISE IN MALES AND FEMALES

KLENTROU, P., KOUVELIOTI, R., KURGAN, N., BROWN, D.

BROCK UNIVERSITY

INTRODUCTION: Canonical Wnt/B-catenin signaling pathway is critical for osteoblastogenesis. Sclerostin is an osteocyte-derived osteokine that inhibits bone formation by inhibiting Wnt signaling . Mechanical loading has shown to decrease sclerostin expression, and subsequently enhance bone formation, in cell and animal studies . However, there are only few studies examining the effects of exercise on sclerostin in humans. The aim of this study was to compare the response of sclerostin to two modes of high intensity interval exercise in young men and women.
METHODS: Forty young men and women <22.3 ± 2.5 years old; BMI: 23.5 ± 3.1 kg/m2> performed two high intensity interval trials on the treadmill and cycle ergometer, respectively. Trials consisted of eight 1-minute high intensity cycling or running intervals , separated by 1-min passive recovery. Blood samples were collected pre-exercise, and 5 minutes, 1 hour, 24 hours and 48 hours post-exercise. Serum sclerostin levels were measured by ELISA.
RESULTS: A 3-way repeated measures ANOVA showed significant time and sex effects, as well sex-by-time interaction , while the exercise mode effect was not significant. Sclerostin levels significantly increased at 5 min post HIIE , and returned to near baseline values by 1 hour following the exercise without significant differences between the two modes of HIIE.
CONCLUSION: In young men and women, one session of weight bearing and non-weight bearing HIIE leads to an increase in sclerostin 5 min post-exercise. Such an increase in sclerostin was previously found 5 min post plyometric exercise in men . This finding suggests that regardless of impact, high intensity exercise stimulates a similar osteocyte response in both sexes. Further research is required to explore how mechanical loading and/or other systemic factors, such as post-exercise induced inflammation, contribute to the effects of exercise on sclerostin and bone metabolism in general.
REFERENCES: Dekker J, Nelson K, Kurgan N, Falk F, Josse A, Klentrou P <2017>. Ped Exerc Sci.29:504-12.
Falk B, Haddad F, Klentrou P, Ward W, Kish K, Mezil Y, et al. <2016>. Osteoporos Int. 27:1245-49.
Robling AG, Niziolek PJ, Baldridge LA, Condon KW, Allen MR, Alam I, et al. <2008>. J Biol Chem. 283:5866-75.
Sapir-Koren R, Livshits G. <2014>. Osteoporosis Int. 25:2685-00.

LEUCINE INDUCES EXPRESSION OF IGF1 AND IGF1-DEPENDENT GENES IN HUMAN MYOBLASTS

LEDNEV, E.M.1,2, FURALYOV, V.A.3, KRAVCHENKO, I.V.3, LYSENKO, E.A.1,2, POPOV, D.V.1,2

1:INSTITUTE OF BIOMEDICAL PROBLEMS OF THE RAS,2:FACULTY OF FUNDAMENTAL MEDICINE,LOMONOSOV MOSCOW STATE UNIVERSITY,3:RESEARCH CENTER OF BIOTECHNOLOGY RAS

INTRODUCTION: IGF1 plays an important role in the regulation of connective tissue, bone and muscle homeostasis in adults. Experiments in rodents demonstrated that leucine (Leu) intake increases the systemic IGF1 level (Teodoro et al., 2012; Pedrosa et al., 2013; Pedroso et al., 2014). Studies in HeLa, HEK293T and COS7 cells revealed an obligate two-step mechanism of mTORC1 regulation: pre-activation (priming) by arginine (Arg) and then activation by Leu (Dyachok et al., 2016). The aim of our research was to investigate effect of Leu on expression of IGF1 and IGF-1-dependent genes in human myoblasts. We have assumed that Leu may regulate the gene expression in human myotubes, and this effect may be improved by pre-activation with Arg.
METHODS: After starvation (1 h), myotubes were incubated with Arg (0,4 mM, 30 min), or Leu (0,8 mM, 30 min), or Arg and then Leu. The 4E-BP1Thr37/46 and S6K1Thr389 phosphorylation (targets of mTORC1) was evaluated by Western blot. In the second experiment, after starvation (1 h) myotubes were incubated with Leu (0,8 mM, 24 h), or Arg (0,4 mM, 24 h) and then Leu (24 h). Expression of IGF1, COL1A1, COL3A1, COL5A1, SREBF1, HMGCR, LOX genes was measured by qPCR.
RESULTS: Arg did not affect the S6K1Thr389 or 4E-BP1Thr37/46 phosphorylation, whereas Leu increased proteins phosphorylation (10-fold and 3,5-fold, respectively), but the most significant effect was related with consecutive Arg-Leu stimulation. Leu had little effect on the IGF1 and IGF1-dependent genes expression. The consecutive Arg-Leu stimulation increased expression of IGF-1Ea, MGF, COL1A1, COL5A1 and SREBF1 (3-fold, 5,8-fold, 3,6-fold, 1,4-fold, and 1,4-fold, respectively).
CONCLUSION: Two-step mTORC1 activation by Arg and Leu in human myoblasts was shown. The same effect for leucine-stimulated gene expression was found: the consecutive Arg-Leu stimulation leads to the most significant activation of genes expression. It means that expression of IGF1 and IGF1-dependent genes is regulated by amino acids via a two-step mechanism.
The study was supported by the Science research program of RAS presidium «Fundamental research for biomedical technologies» for 2018-2020 yy.
References: Teodoro GF, Vianna D, Torres-leal FL, Pantaleao LC, Matos-Neto EM, Donato J Jr, Tirapegui J. (2012). J Nutr, 142(5), 924-930.
Pedrosa RG, Donato J Jr, Pires IS, Tirapegui J. (2013). Appl Physiol Nutr Metab, 38(6), 694-697.
Pedroso JA, Nishimura LS, de Matos-Neto EM, Donato J Jr, Tirapegui J. (2014). Cell Biochem Funct, 32(4), 326-332.
Dyachok J, Earnest S, Iturraran EN, Cobb MH, Ross EM. (2016). J Bil Chem, 291(43), 22414-22426.
[ledhauz@gmail.com]

MUSCLE FIBRE TYPE SPECIFIC EXPRESSION OF LIPOLYTIC PROTEINS IN SKELETAL MUSCLE OF ENDURANCE TRAINED INDIVIDUALS

SHAW, C.S., SWINTON, C., MORALES-SCHOLZ, G.M., ALDOUS, A., MURPHY, R.M., HOWLETT, K.F.

DEAKIN UNIVERSITY

INTRODUCTION: A high capacity for fat oxidation during exercise in endurance trained athletes is attributed to a greater utilisation of intramuscular lipid (IMCL) in type I muscle fibres. IMCL breakdown is regulated by lipolytic enzymes and proteins contained on the lipid droplet surface but little is known about the muscle fibre type specific abundance of these key lipolytic components in endurance athletes. Recent findings suggest that autophagic degradation of lipid droplets and chaperone-mediated autophagy may also regulate lipolysis, however their role in IMCL breakdown has not been explored. This study investigated the muscle fibre type specific abundance of LD proteins, lipolytic enzymes and components of the autophagy/lysosome system in endurance trained individuals.
METHODS: Endurance trained (n=7, 28±3 years, BMI 24.0±0.8, VO2max 62.6±1.6 ml·min-1·kg-1) and untrained (n=8, 25±1 years, BMI 25.1±0.6, VO2max 44.9±1.9 ml·min-1·kg-1) males were recruited. An incremental exercise test was performed to determine maximal fat oxidation rates and maximal oxygen uptake. Muscle biopsies were collected and muscle fibre type composition and fibre type-specific IMCL content was assessed with immunofluorescence microscopy. Muscle fibre type specific analysis of lipolytic and autophagy-related proteins was performed with immunoblotting of pooled single muscle fibres.
RESULTS: Endurance trained individuals displayed a higher peak fat oxidation rate (0.49±0.05 vs. 0.20±0.03 g·min-1, $P<0.05$), a greater proportion of type I muscle fibres and higher IMCL content compared to untrained individuals ($P<0.05$). Type I muscle fibres from endurance trained individuals had a greater abundance of ATGL. In whole muscle, the endurance trained group also had greater abundance of PLIN2, PLIN5 and ATGL compared to the untrained group ($P<0.05$) but there were no differences in HSL. Furthermore, the trained group had greater abundance of markers of autophagy flux (LC3-II/I, GABARAP), lysosome content (LAMP2) and chaperone-mediated autophagy (LAMP2A, all $P<0.05$).
CONCLUSION: These results demonstrate that the higher rates of IMCL utilisation during exercise in endurance trained athletes are related to fibre type specific upregulation of IMCL storage and expression of lipolytic regulatory proteins, alongside a greater proportion of type I muscle fibres. These results also demonstrate that muscle from endurance trained athletes has a greater abundance of the autophagic machinery which may have relevance for the regulation of IMCL breakdown.

COMPARATIVE ANALYSIS OF INFLAMMATORY, METABOLIC AND IGF-1 GENE EXPRESSION AFTER AEROBIC, RESISTANCE AND COMBINED EXERCISE IN MUSCLE OF TYPE 1 DIABETIC PATIENTS

ANNIBALINI, G.2, MINNOCK, D.1, CONTARELLI, S.2, SALTARELLI, R.2, GUESCINI, M.2, LEROUX, C.1, STOCCHI, V.2, BARBIERI, E.2, DE VITO, G.1

UNIVERSITY OF URBINO CARLO BO

INTRODUCTION: The identification of the optimal exercise modality, in Type 1 diabetes (T1DM) patients [1], is essential to maximize the beneficial effects of exercise. In this study, muscle biopsies from T1D patients were obtained before and after an acute bout of either aerobic, or resistance or combined exercise to quantify the mRNA expression level response of genes involved in inflammation, metabolism and muscle growth.
METHODS: Six sedentary T1DM patients (3M/3F) performed on separate days, 40 min of either aerobic (AER; 80% of HRR), resistance (RES; 30%-80% of 1RM) or combined resistance and aerobic, exercise (COMB; 20 min each). Muscle biopsies were taken from vastus lateralis muscle before and immediately after each session. A 4th no-exercise session was used as control. Gene-specific primers were used to amplify TNF-α, IL-6, MCP-1, IGF-1 isoforms, PGC-1alpha, PPAR-alpha, PPAR-delta and GLUT4 mRNAs by real-time PCR. Significant effects were assessed by analysis of variance with repeated measures.
RESULTS: Post-exercise TNF-α, IL-6, MCP-1 mRNA levels significantly increased compared to no-exercise. Metabolism-related gene expression (PGC-1alpha, PPAR-alpha, PPAR-delta and GLUT4) did not change. Both AER and RES sessions promoted the splicing of IGF-1Ea variant while the mRNA expression of IGF-1Eb and IGF-1Ec did not change.
CONCLUSION: In this study, we showed an increased expression of muscle cytokine mRNAs after an AER, RES and COMB exercise in T1DM patients. This inflammatory response is probably implicated in the activation of anabolic processes, underlying muscular repair and regeneration [2]. We also demonstrated that the AER and RES exercise both increased IGF-1Ea/IGF-1Eb ratio in the muscle of T1DM patients. The observed increase in muscle IGF-1Ea mRNA is particularly important since local (paracrine/autocrine) IGF-1Ea expression plays a central role in skeletal muscle hypertrophy [3]. A deeper understanding of the adaptive response in molecular signalling to acute exercise may facilitate efforts to improve skeletal muscle health in T1D adopting a more informed and effective exercise prescription in these patients.
References: [1] Riddel MC et al. The Lancet 2017; 5: 377–390.
[2] Peake JM et al. J Appl Physiol 2017; 122:559-570.
[3] Tonkin J et al. Mol Ther 2015; 23:1189-1200.
Contact: giosue.annibalini@uniurb.it

THE ACUTE EXERCISE METABOLISM OF THE SO-CALLED MYOKINE BAIBA

STAUTEMAS, J.1, VAN KUILENBURG, A.2, STROOMER, L.2, VAZ, F.2, LEFEVERE, F.1, BLANCQUAERT, L.1, EVERAERT, I.1, DERAVE, W.1

1.GHENT UNIVERSITY 2. UNIVERSITY OF AMSTERDAM

INTRODUCTION: Beta-aminoisobutyric acid (BAIBA), also known as 3-amino-2-methylpropanoic acid, is a non-proteinogenic amino acid. Recently, Roberts et al. (1) suggested that BAIBA is a myokine involved in browning of fat. However, the authors did not provide evidence for an acute effect of exercise supporting their statement and did not take into account the metabolic distinct R- and S-enantiomer of BAIBA. R-BAIBA is an intermediate of the thymine degradation pathway, whereas S-BAIBA is derived from valine degradation. Thymine degradation primarily occurs in liver, whereas valine degradation also takes place in muscle. Concerning these enantiomers, there is at this point no consensus about the concentration of R- and S-BAIBA in plasma.
METHODS: In order to elucidate plasma ratios of R- and S-BAIBA and to investigate the acute effect of exercise on these enantiomers, 15 healthy recreationally active subjects were recruited. They participated in a randomized crossover control trial where they exercised for 1h at 40% of Wmax or remained at rest. R- and S-BAIBA were determined in plasma samples (2). Results were analysed using 2 x 4 Repeat-

ed Measures ANOVA with condition (exercise vs rest) and time (4 time points) as within factors. Paired sample t-tests were performed following significant interaction effects.
RESULTS: The mean plasma concentration of baseline R-BAIBA was 67 times higher (1.734±0.821 vs 0.029±0.008 μM) compared to S-BAIBA. The amount of baseline R-BAIBA was not correlated to the amount of baseline S-BAIBA in plasma ($r = -0.263$; $p = 0.344$). Exercise was able to induce a 13% ($p < 0.001$) and 20% ($p < 0.001$) increase in R-BAIBA and S-BAIBA, respectively (condition*time: $p < 0.001$). The increase in S-BAIBA is only 6 ± 4 nM. During a 30 minutes recovery, R-BAIBA concentrations returned to lower levels whereas the S-BAIBA increased even further up to 35±12 nM.
CONCLUSION: We report that S-BAIBA is only 2.03±0.99% of the total amount of BAIBA in plasma. A low intensity exercise was able to induce an acute increase in both R- and S-BAIBA. Our data suggest that although both enantiomers acutely increase during exercise, only S-BAIBA is likely muscle derived and therefore a true myokine.
1. Roberts, Lee D. et al. Beta-Aminoisobutyric Acid Induces Browning of White Fat and Hepatic β-Oxidation and Is Inversely Correlated with Cardiometabolic Risk Factors. Cell Metabolism, 2014, 19 (1): 96 – 108
2. Van Kuilenburg, André B.P. et al. New insights in dihydropyrimidine dehydrogenase deficiency: a pivotal role for B-aminoisobutyric acid? Biochemical Journal, 2004, 379: 119-124

ASSOCIATIONS BETWEEN SUBJECTIVE MUSCLE SORENESS AND REDOX BIOMARKERS IN AMERICAN COLLEGE FOOTBALL

MCKAY, B.A.1, DELANEY, J.A.2, MURRAY, A.2, PEDLAR, C.3,4,5, SIMPKIN, A.J.4,6, LARKIN, T.A.1, LEWIS, N.A.3,4, SAMPSON, J.A.1

1UNIVERSITY OF WOLLONGONG, AUSTRALIA 2UNIVERSITY OF OREGON, EUGENE, USA 3ST MARY'S UNIVERSITY, TWICKENHAM, UK 4 ORRECO LTD, NATIONAL UNIVERSITY OF IRELAND BUSINESS INNOVATION CENTRE, GALWAY, IRELAND 5

INTRODUCTION: American College Football (ACF) is a high-impact, collision-based sport, that frequently requires repeated maximal efforts, that results in high levels of fatigue and muscle damage [1]. Subjective questionnaires are commonly used to monitor player wellbeing, offering basic but informative athlete wellness data. Objective biological measures are an attractive tool for athlete monitoring for example, endogenous measures of oxidative stress (OS) are associated with excessive fatigue and underperformance [2]. However, limited data exist describing the relationship between subjective and objective measures. This investigation will therefore assess whole blood measures of OS to determine associations between OS and subjective measures of soreness in ACF players.
METHODS: 23 male ACF players (21.1±1.2 years; 108.0±20.0 kg) participated in this longitudinal study; Three samples/player were taken in week one (prior to pre-season training) to determine baseline and then once per week over a 9-week data collection period during the college football season. Redox was assessed using FORT (free oxygen radicals test) and FORD (free oxygen radical defense) assays from a fingertip blood sample. The FORT:FORD ratio provided an index of oxidative stress (OSi). Perceived muscle soreness was recorded each morning using a 5 point scale (1 = high soreness and 5 = low soreness). Linear mixed models were used to analyse the effect of a two within-subject standard deviation (SD) change in OS on subjective muscle soreness. The effects were interpreted using a magnitude-based inference network, and are presented as standardised effect size ± 90% confidence intervals (ES; 90% CI).
RESULTS: At baseline, FORT and FORD averaged 1.95±0.3 mmol·L-1 and 1.47±0.2 mmol·L-1 respectively. Similar mean values were observed during the college football season (FORT=1.94±0.4 mmol·L-1 and FORD=1.43±0.2 mmol·L-1). However, variations in FORT (1.02±0.26 mmol·L-1) and FORD (0.43±0.10 mmol·L-1) were evident across the 9-week data collection period. A two SD change in FORT and FORD were associated with likely small increase and decrease in perceived muscle soreness (4.9%±3.1%, ES = 0.44±0.3 and -3.4%±2.8%, ES = 0.39±0.3) respectively. Collectively, a two SD change the in OSi was responsible for a very likely small increase in perceived muscle soreness (9%±5.5%, ES = 0.56±0.3).
CONCLUSION: In this investigation, perceptions of muscle soreness were likely associated with changes in OS. Further investigations to determine the cause of the fluctuations in OS observed in team sport are warranted. This information may be useful for sports scientists to help select appropriate athlete monitoring variables.
1. Fullagar et al., (2017) Int J Sp Phys. 12(10): p. 1396-1403.
2. Lewis et al., (2015) Sports Med. 45(3): p. 379-409.

Oral presentations

OP-PM29 Epidemiology

THE EFFECT OF MATCH FREQUENCY ON THE PERCEPTUAL RECOVERY AND WELLBEING RESPONSES OF ADOLESCENT RUGBY UNION PLAYERS.

PHIBBS, P.J., JONES, B., TILL, K.

LEEDS BECKETT UNIVERSITY

INTRODUCTION: Adolescent rugby union players can play multiple matches per week, but the subsequent effect on recovery and wellbeing is unknown. The aim of this study was to determine the perceptual recovery and wellbeing responses of under-18 rugby union players during weeks with different match frequencies.
METHODS: Match and training load data , perceptual recovery <0-10 perceived recovery scale: PRS>, and wellbeing <1-5 Likert scales for fatigue, sleep quality, upper and lower-body soreness, stress, and mood> were collected daily from 20 academy players across a 14-week school rugby union season. Differences in weekly summated training and match loads, PRS, and wellbeing between 0, 1, and 2-match weeks were assessed using Cohens d effect sizes <±90% confidence intervals> and magnitude-based inferences.
RESULTS: Total weekly match and training sRPE loads increased substantially with match frequency <1210 ± 571, 1511 ± 489, and 1692 ± 517 AU for 0, 1, and 2-matches/week, respectively>. Perceived recovery was reduced with increases in match frequency <45.4 ± 7.8, 44.0 ± 8.3, and 41.9 ± 8.8 AU for 0, 1, and 2-matches/week, respectively>. PRS was possibly lower with 1 match/week, and likely lower with 2 matches/week compared to weeks with no matches, respectively. PRS was also possibly lower in weeks with 2 matches compared to 1 match. Wellbeing was also reduced during weeks with matches <145.2 ± 15.1, 141.6 ± 15.7, and 141.0 ± 15.5 AU for 0, 1, and 2-matches/week, respectively>. Wellbeing was possibly lower with 1 match/week, and possibly lower with 2 matches/week compared to weeks with 0 matches, respectively. Differences in wellbeing between 1 and 2-matches/week were unclear. There were likely increases

in perceptual fatigue and lower-body soreness during weeks with matches, but differences in sleep quality, stress, and mood were either trivial or unclear between all match frequencies.
CONCLUSION: This is the first study to examine the effects of playing multiple games per week on perceptual recovery and wellbeing in adolescent rugby union players. There were small reductions in perceived recovery and wellbeing during weeks with either 1 or 2 matches compared to weeks with 0 matches, associated with an increase in total match and training loads. However, there were no substantial differences between perceptual recovery and wellbeing between weeks with 1 or 2 matches. Strength and conditioning training, and other activity loads were reduced to compensate for additional match loads during weeks with multiple matches, which may not be optimal for developing important physical qualities for rugby union . Rugby match-play also carries a significantly higher risk of injury compared to training. Therefore, decisions regarding appropriate match exposures for adolescent rugby union players should also take these factors into consideration.

INCIDENCE OF SPORTS INJURY-RELATED HOSPITALISATIONS IN AUSTRALIAN CHILDREN OVER A TEN-YEAR PERIOD: A NATIONWIDE POPULATION-BASED COHORT STUDY

LYSTAD, R.P., CURTIS, K., BROWNE, G., MITCHELL, R.

MACQUARIE UNIVERSITY

INTRODUCTION: Injury is a leading cause of death and disability among children worldwide, and participation in sport and active recreation is a common contributor to this burden. To date there have been no nationwide population-based study examining trends in sports-related injury among Australian children. This study aims to (1) quantify and describe the incidence and cost of sports injury-related hospitalisations in Australian children, and (2) examine the temporal trend over a 10-year period.
METHODS: This population-based cohort study used linked hospitalisation and mortality data of children aged ≤16 years who were hospitalised for sports-related injury in Australia during 1 July 2002 to 30 June 2012. Age-standardised incidence rates were calculated with 95% confidence intervals (CI). Negative binomial regression was used to examine change in temporal trends in incidence rates.
RESULTS: There were 130,167 sports injury-related hospitalisations of Australian children aged ≤16 years during the 10-year study period. The overall incidence rate was 281.0 (95%CI: 279.5–282.6) per 100,000 population. The incidence rate in male children (419.7 [95%CI: 417.1–422.4] per 100,00 population) was more than three times that of female children (134.8 [95%CI: 133.2 to 136.3] per 100,000 population). There was no significant decline in the annual incidence rate during the 10-year study period (-1.05% [95%CI: -3.01% to –0.95%]; P=0.302). The most common sports activities resulting in injury-related hospitalisation were team ball sports (43.1%) and wheeled non-motor sport (22.3%). The total direct hospital costs of sports injury among Australian children was AUD$39.6 million per year over the 10-year study period.
CONCLUSION: There has been no significant decline in sports injury-related hospitalisation rates among children in Australia during 2002–03 to 2011–12. This suggests that sports injury prevention initiatives in Australia to date have either been inadequate or ineffective. There is a clear need to develop and implement a national injury prevention strategy to reduce the burden of sports injuries among Australian children.

SELF-REPORTED COGNITIVE DIFFICULTIES ARE NOT SUPPORTED BY OBJECTIVE MEASURES IN RETIRED CONTACT SPORT ATHLETES; A SYSTEMATIC REVIEW

CUNNINGHAM, J., BROGLIO, S., OGRADY, M., WILSON, F.

TRINITY COLLEGE DUBLIN

INTRODUCTION: In the last decade, a dramatic shift in both public and scientific perception around the long-term consequences of sports-related concussion (SRC) is evident. An injury which was once viewed as a short-lived impairment of neurological function, is now being implicated in a number of long-term neurocognitive sequelae. While the short-term effects of concussion on cognitive processes are known, the long-term consequences are less understood. The purpose of this paper aimed to synthesize and present the available evidence examining cognitive health status in retired athletes.
METHODS: Six databases were systematically searched from inception to October 2017 using medical subject headings and keywords. Cross-sectional studies of living retired male or female athletes in which at least one cognitive test was used as an outcome measure were included. Two reviewers independently screened studies for inclusion. Data extraction was performed using STROBE guidelines. Methodological quality was assessed independently by two reviewers using the Downs and Black methodological quality tool.
RESULTS: The search yielded 18 cross-sectional observational studies that were included in a qualitative synthesis. Overall methodological quality of the included studies was moderate. Ten of 18 studies found significantly increased subjective reports of cognitive difficulties experienced by former athletes in comparison to non-athlete control groups/normative data. There is mixed evidence of measurable cognitive deficits in neuropsychological testing in retired athletes. Six studies reported a frequency-response relationship, with greater cognitive impairments (subjective/objective) in those with greater levels of exposure to head impacts or concussions. Eight other studies did not find such a relationship. Thus, evidence for long-term cognitive dysfunction in retired athletes with a history of head impact exposure is mixed.
CONCLUSION: Findings are inconsistent and investigations are commonly influenced by methodological biases and flaws, reducing the overall quality of the studies. Retired players have increased self-reported cognitive issues in retirement. However, these subjective complaints are not detected in the majority of standard neuropsychological tests being used. Significant associations between head impact exposure and performance on neuropsychological tests are not present. Studies which have explored the rate of mild cognitive impairment (MCI) in retired players to date have been based on self-reported cognitive difficulties and findings have been mixed. Current evidence suggests that large gaps remain in understanding the potential cause-and-effect relationships between SRC and long-term brain health in athletes. Further research is required to unravel the complex interaction between previous head impact exposure and the many other factors which may influence cognitive health in the aging retired athlete.

REQUIREMENTS FOR HEALTH RELATED EXERCISES IN PRIMARY PREVENTION FOR EMPLOYEES OF STATIONARY NURSING HOMES

OTTO, A.K., STAACK, S., WIGGERING, C., WOLLESEN, B.

UNIVERSITY OF HAMBURG

INTRODUCTION: The percentages of older people receiving care are increasing and characterized by multimorbidities. This results in work intensification and high stress levels for employees in nursing homes. Frequent stressors are confrontation with death and dealing with elderly people suffering from behavioral disorders (Pélissier et al., 2015). In addition, physical loads in combination with psychosocial work factors affect the risk of musculoskeletal disorders (Jansen et al., 2004). Prevention programs should target the specific problems and requirements of the different professions in nursing homes. The aim of this study is to analyze the specific health related problems of the professions (geriatric nurses [1], professional housekeepers [2], psycho-social carers [3]) to develop individualized health promotion programs.
METHODS: N= 194 (N[1]= 139, age: 40.5±12.2 years; N[2]= 28, age: 44,5±11,5 years; N[3]= 27, age: 49.8±8.2 years) employees of six stationary nursing homes were included in a quantitative survey (Nordic Questionnaire, Questionnaire of Slesina, SF-12, TICS, preferred physical activities). The evaluation was conducted considering the three professions. The analysis incorporated Chi²-Tests and Analysis of variance (SPSS 23).
RESULTS: The comparison of the professions revealed a significant (p= 0.033) lower mental score of the SF-12 for geriatric nurses in comparison to professional housekeepers (5.94, 95% -CI [0.35, 11.53]). There were no significant differences between groups regarding stress values. All professions were burdened by time pressure and pressure to perform. In addition, the geriatric caregivers and professional housekeepers were adversely affected by high physical demands and poor postures. Musculoskeletal disorders like low back, shoulder and neck pain were identified in all types of professions. Results indicate that geriatric nurses and professional housekeepers preferred strength training whereas psycho-social carers preferred relaxation training.
CONCLUSION: Specific health promotion programs according to the profession are desirable to reduce work related stress as well as musculoskeletal disorders. Especially geriatric nurses and professional housekeepers require programs to reduce mental stress in combination with ergonomic movement programs. Surprisingly, psycho-social carers reported musculoskeletal disorders in spite of low physical demands. Furthermore, future research should assess whether these effects are caused by age or high stress levels.
REFERENCES:
Jansen, J.P., Morgenstern, H., Burdorf, A. (2004). Occup Environ Med, 61, 972-979.
Pélissier, C., Vohito, M., Fort, E., Sellier, B., Agard, J.P., Fontana, L., Charbotel, B. (2015). J Occup Health, 57, 285-296.
CONTACT: ann-kathrin.otto@uni-hamburg.de

THE PREVALENCE OF BAREFOOT ACTIVITY IN NEW ZEALAND SECONDARY SCHOOL BOYS

FRANCIS, P., SCHOFIELD, G., MACKAY, L.

LEEDS BECKETT UNIVERSITY, AUCKLAND UNIVERSITY OF TECHNOLOGY

INTRODUCTION: Humans were barefoot for millions of years during evolutionary history. During the past few centuries, particularly in industrialised countries, walking and running have generally been carried out in shoes. It is often assumed that economic resource is the major reason that non-industrialised countries such as Africa have a higher prevalence of barefoot activity. New Zealand is an industrialised country with comparable resources to that of many European countries, however, it seems to remain socially acceptable to carry out barefoot activities. A chance observation of students competing barefoot on a tartan track, prompted us to determine the prevalence of barefoot activity in an all-boys secondary school in Auckland New Zealand.
METHODS: Following ethical approval from Auckland University of Technology research ethics committee, an 11 question survey was administered at an Auckland boys secondary school to determine the footwear habits of students during: a) daily life (at home, in the supermarket and on the bus) b) school life (c) physical education class and (d) sport in general. Participants were asked to select whether they were barefoot: 1) most of the time, 2) around half of the time or 3) none of the time. Participants were also asked to specify, when running at their most recent athletics event (100m – 3,000m) on a track, whether they ran barefoot, in shoes, in spikes or another type of footwear. Descriptive statistics were computed using SPSS.
RESULTS: A total of 714 students (Year 9 – Year 13; 12 – 19 years) responded to the survey. The school was located in an area of high socioeconomic status (Decile 9 out of 10). More than half of the sample reported being barefoot most of the time at home (n=404, 56.6%) and during PE class (n=420, 58.8%). More than half of the sample reported being barefoot around half of the time or more during sport (n=380, 53.2%). A smaller amount went to the supermarket (n=140, 19.6%) or took the bus (n=59, 8.3%) whilst barefoot around half of the time or more. Over 50% of students competing in the 100m (n=200/397) and 200m (n=118/231) competed barefoot. The percentage of barefoot competitors decreased with increasing distance from the 400m (n=68/147; 46%) to the 3,000m (n=21/67; 31%).
CONCLUSION: The results of this survey demonstrate that over 80% of students at an all-boys secondary school, of high socioeconomic status, take part in physical education classes around half of the time or more in bare feet. These results point towards a cultural difference between New Zealand and other modern industrialised countries, rather than the absence of resources to purchase shoes. Given that differences in foot morphology occur between those who grow up barefoot and shod, we need to consider what the evidence is for shoe prescription in otherwise healthy adolescents.

Oral presentations

OP-BN16 Motor Imagery

MOTOR CONTAGION IN SINGLE-LIMB STANCE BY MEANS OF BIOLOGICAL AND NON-BIOLOGICAL POINT LIGHT DISPLAYS DOES NOT INDUCE POSTURAL REACTIONS BUT ENHANCES MUSCLE ACTIVITY

EILS, E., BROCKMANN, T., DE LUSSANET, M.H.E., ZENTGRAF, K.

INSTITUTE OF SPORT AND EXERCISE SCIENCES

INTRODUCTION: Copying the actions of others is relevant in sports-related settings, e.g. when motor learn-ing of new motor skills. Although there seems to be evidence that humans are prone to copying the action of others (Heyes, 2011), it might not be as generalizable

as previously suggested (Tia et al., 2011) and the mechanisms why and when subjects are influenced to copy others' movements are still unclear. A motor contagion effect (MCE) resulting in increased body sway when observing a point-light display (PLD) of a model in postural imbalance in comparison to a non-biological stimulus might not only result in increased movement, but also in an adjustment of muscle activity. Therefore, the aim of the present study was to investigate the influence of biological and non-biological stimuli on muscle activity when observing a PLD of postural imbalance.
METHODS: 29 subjects participated in the study. Subjects stood in single limb-stance (SLS) and observed different PLD conditions: a person in single-limb-stance (biomotion-BM), moving dots without biological information (non-BM), and a static control stimulus (CON). Center of Pressure (COP) excursions were captured by means of a force plate, muscle activity of tibialis anterior (TA), peroneus longus (PL) and medial gastrocnemius (GM) by bipolar EMG-electrodes, and body sway by using reflective markers (Qualisys, Sweden). Sway excursions of the COP and the markers as well as RMS muscle activity were used for analyses. A one-way repeated measures ANOVA was used for statistical analysis (Bonferroni-Holm method for post-hoc testing).
RESULTS: The results showed no significant differences between the three conditions for COP and body-part movements. Significant differences were found in muscle activity of PL between conditions ($F(2,56) = 4.2$, $p = .02$, $eta^2 = .13$). Post-hoc tests revealed differences between CON and BM but not between BM and non-BM.
CONCLUSION: Muscle activity of PL is of importance when regulating postural sway in SLS (Louwerens et al. 1995). Although results indicate an increased muscle activity for BM compared to CON, the expected MCE could not be identified. Complementary inhibition processes preventing loss of balance especially in SLS might play a crucial role, masking MCE. Results indicate again that the observed MCE postulated from Tia et al. (2011) could not be verified.
References: Heyes, C., (2011), Psychological Bulletin, 137(3), 463-483.
Tia, B. et al. (2011), PlosOne 6(3):e17799.
Louwerens , JW. et al. (1995) Acta Orthop Scand, 66(6), 517-523.

MIRROR OBSERVATION IN COMBINATION WITH MOTOR IMAGERY REDUCES INTRACORTICAL INHIBITION IN THE IPSILATERAL PRIMARY MOTOR CORTEX DURING UNILATERAL PLANTARFLEXIONS.

MARQUEZ, G.1, TAUBE, W.2, SCHMID, N.2, KELLER, M.2,3

1. CATHOLIC UNIVERSITY OF MURCIA; 2. UNIVERSITY OF FRIBOURG; 3. UNIVERSITY OF BASEL

INTRODUCTION: Literature suggests that both motor imagery (MI) and mirror observation (MO) promote skill learning (1). These behavioural adaptations are explained by neural activation in motor centers of the brain while imagining and/or observing a specific motor task. In order to provide recommendations for the conception of interventions using non-physical training, the current study elaborated how the brain is activated during MI and MO but also during a combination of MO with MI (MO+MI). It was hypothesized that MO+MI results in enhanced brain activations compared to using solely MO or MI.
METHODS: Sixteen healthy participants (26.9 ± 4.6 years, 6 female) were recruited for the study. Participants were instructed to perform unilateral plantarflexions with the right leg while the left leg (from which was measured) was always at rest. Contractions of the right leg triggered the stimulator. Transcranial magnetic stimulation was used to assess corticospinal excitability (CSE) and short-interval intracortical inhibition (SICI) in the left hemisphere. To test for modulations in spinal excitability, peripheral nerve stimulation was applied to the left posterior tibial nerve. Neural activation in the right (ipsilateral) hemisphere to the contracting leg was recorded in four experimental conditions: control (neither MO nor MI), MO, MI and MO+MI. To test for a muscle-specific activation, the left soleus (SOL) and left tibialis anterior (TA) muscles were recorded.
RESULTS: Plantarflexor contractions of the right foot were performed identical in the four conditions indicating that stimulations occurred at the same phase of the movement. The size of the motor evoked potentials of left SOL and TA did not differ between conditions ($p>0.08$). However, our results revealed significantly ($p<0.01$) reduced SICI of the resting left SOL during MO+MI (25.5%) compared to the control condition (36.8%). In addition, this modulation of SICI was not evident in left TA. Regarding the SOL H-reflex of the left leg, no differences were found between conditions.
CONCLUSION: The present study demonstrated that the MO+MI-condition was most effective to influence motor cortical inhibitory networks within M1 of the resting (right) hemisphere. Furthermore, it seems that this modulation is direction- and/or muscle-specific because it was not evident for the left TA. Future studies should determine whether the use of MO+MI could enhance interlimb transfer effects. Thus, the data of the present study could help to improve the rehabilitation of patient groups with unilateral orthopaedic and neurological conditions.
(1) Vogt et al. (2013) Multiple roles of motor imagery during action observation. Front. Hum. Neurosci. 7:807.
Contact: gmarquez@ucam.edu

THE CORTICOSPINAL EXCITABILITY INCREASE AFTER SOMATOSENSORY STIMULATION AT REST AND DURING MOTOR IMAGERY IS TIME INTERVAL-DEPENDENT

TRAVERSE, E., LEBON, F., MARTIN, A.

INSERM UNIVERSITÉ BOURGOGNE FRANCHE-COMTÉ

INTRODUCTION: Saito et al., 2013 demonstrated that corticospinal excitability increased during motor imagery (MI) combined with somatosensory stimulation (SS) induced by electrical stimulation of the peripheral nerve. These modulations may involve peripheral and/or cortical processes, especially the primary motor cortex and primary somatosensory cortex, known to be activated during kinesthetic MI modality. The aim of the current study was to assess the interaction between SS and MI on CSE using different time-interval.
METHODS: Six subjects performed the experiment. Transcranial magnetic stimulation (TMS) of the primary motor cortex was applied at an intensity of 120% of rest motor threshold to evoke an unconditioned motor evoked potential (MEP) at rest or during an imagined maximal plantar flexion of the right foot. SS was induced using a triplet electrical stimulation applied on the posterior tibial nerve at 80% of motor threshold at rest or during MI. To test the effect of afferences on CSE, TMS was applied 1 to 150ms after SS to evoke a conditioned MEP (MEPc) at rest and during MI. Peak-to-peak MEP and MEPc amplitudes were analyzed for the soleus muscle and expressed as function of the unconditioned MEP.
RESULTS: At rest, MEPc amplitude increased for the time intervals of 20 to 50ms (mean : +38 ± 24%) and from 100ms (+37.4 ± 29%). During MI, unconditioned MEP increased by +61.1 ± 13% in comparison to rest. MEPc amplitude was not modulated up to 100ms and increased at 150ms (+46.4 ± 22%). At 150 ms, MEPc increased during MI and rest was similar.

CONCLUSION: At rest, CSE increased when the stimulation was induced at least 20ms after the SS. This latency allows the somatosensory volley to reach the cortical level (Carson & Kennedy, 2013), specifically the primary somatosensory cortex that modulates the primary motor cortex activity (Veldman et al., 2015). During MI, SS did not further increase CSE. This lack of modulation could be possibly due to a conflict that arises at the primary motor cortex level between neural activities induced by MI and those induced by SS. Beyond 100ms, the cortical network possibly returns to its basic state and so the CSE similarly increased at rest and during MI combined with SS.

CHANGES IN BRAIN OSCILLATIONS AND EVOKED-RELATED POTENTIALS DURING PROLONGED MOTOR IMAGERY AND SUBSEQUENT ACTUAL ISOMETRIC KNEE EXTENSIONS

JACQUET, T., PAGEAUX, B., BARD, P., PFISTER, P., LEPERS, R., POULIN-CHARRONNAT, B.

UNIVERSITÉ BOURGOGNE FRANCHE-COMTÉ

INTRODUCTION: Motor Imagery (MI) is the mental simulation of action without concomitant movements. Recently, it has been shown that prolonged MI increases feeling of fatigue and impairs motor control, suggesting that MI may induce mental fatigue. The present study, which used electroencephalography (EEG), aims first at analyzing the changes in EEG-spectral parameters during prolonged MI, and second at examining Movement-Related Cortical Potentials (MRCPs) and Event-Related Spectrum Power (ERSP) during both imagined and actual isometric knee extensions.
METHODS: Twelve participants completed a prolonged MI session and a control session. The prolonged MI session, consisted of imagining 200 maximal isometric knee extensions (5 s ON – 10 s OFF, duration 50 min). The control session consisted of watching a documentary for the same duration. Each session was followed by 150 voluntary isometric knee extensions (2.5 s ON – 5.5 s OFF) at 50% maximal force. MRCPs and ERSP analyses were computed for both imagined and actual isometric contractions. During both prolonged MI and documentary viewing, Power Spectral Density (PSD) was analyzed for the first and last 5 minutes.
RESULTS: MRCP amplitude increased over time during imagined and actual contractions, and this increase was greater after prolonged MI. For actual contractions, ERSPs conducted on MRCP time-window showed over time lower desynchronization in delta power during muscular contraction. In addition, greater synchronization was observed in both delta and gamma power during relaxation phase. These changes were more pronounced following prolonged MI. Similar results were observed during imagined MRCPs, but to a lesser extent. Finally, PSD analyses showed a decrease in alpha and beta power over time during prolonged MI, but not during the documentary viewing.
CONCLUSION: Changes observed in both MRCP amplitude and associated ERSP analyses suggest an increased difficulty to perform contractions during and after prolonged MI. As observed in previous studies dealing with mental fatigue, PSD analyses showed a decrease in beta power. However, and contrary to what has been previously observed, the alpha power decreased over time. This decrease could be due to an increase of vigilance during prolonged MI in order to compensate for mental fatigue effects. Taken all together, these results confirm that when prolonged, MI induces a state of mental fatigue. Future studies should take into account the duration of MI to limit the extent of MI-induced mental fatigue.

COMPENSATION OF MOTOR MEMORY DEFICIT BY MOTOR IMAGERY TRAINING IN THE ELDERLY

RUFFINO, C., BOURRELIER, J., PAPAXANTHIS, C., MOUREY, F., LEBON, F.

INSERM UNIVERSITÉ BOURGOGNE FRANCHE COMPTÉ

INTRODUCTION: Motor learning plays a crucial role on the everyday life. However, the literature presents contradictory results concerning the capacity of the elderly to acquire new motor skills, compared to the young adults (Anguera et al., 2011). For example, Malone and Bastian (2016) presented similar locomotor adaption between young and elderly adults. Nevertheless, the results showed that elderly still forgot much of the new pattern after a short break; the motor memory was impaired in this population. Previous studies demonstrated that motor imagery capacities should be preserved correctly with aging (Saimpont et al., 2013). In the current study, we tested the putative role of motor imagery training (MIT) to compensate the motor memory deficit observed in the elderly.
METHODS: We recruited 20 young (27±5years) and 23 elderly (73±5years) adults, divided in four groups: 1) young control group, 2) elderly control group, 3) Young MIT and, 4) Elderly MIT. In pre- and post-tests, the subjects performed three actual trials on a dexterity manual task, commonly used in clinic (the Nine Hole Peg Test), consisting in moving sticks, as fast as possible. The two control groups viewed a non-emotional documentary movie during 30 minutes and the MIT groups mentally repeated the task (50 imagined trials). We used the movement duration as a performance factor.
RESULTS: First, we observed a performance improvement throughout the three pre-test trials for all groups. Immediately after the break (post-test1), the young control group showed a preservation of motor performance compared to the one realized before the break (pret-test3). As expected the young adults increased their performance after MIT. For the elderly, the control group showed a deterioration of motor performance at post-test1, attesting the motor memory deficit observed with aging. Interestingly, the elderly MIP group showed a preservation of motor performance between the pre-test3 and the post-test1.
CONCLUSION: In this study, we demonstrated the beneficial effects of MIT, used alone, in the elderly population. Indeed, our results showed that mental training could compensate motor memory deficit observed with aging. This method would be an alternative, non-drug, to prevent the deterioration of motor skills.

Oral presentations

OP-PM38 Heart rate monitoring

NON-ATHLETES REACH CLOSE TO HEART RATE MAXIMUM IN STANDARD CARDIORESPIRATORY FITNESS TESTING

MOHOLDT, T., SØRÅS, S.E., RELLING, B.E., LUNDGREN, K.M., KIEL, I.A., BERGLUND, I.J.

NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

INTRODUCTION: It is suggested that individuals will not reach their heart rate maximum (HRmax) at an incremental cardiorespiratory fitness (CRF) test, and commonly five beats per minute (bpm) are added to the highest heart rate (HR) reached. To our knowledge, there is not sufficient data justifying such estimation. Although established that HRmax decreases with age, the effect of sex and CRF on HRmax is still controversial (1,2). Our aim was to assess the relationship between the highest HR reached during an incremental CRF test compared

to the same values obtained during an exercise test designed to reach HRmax in non-athletes. We also investigated whether age, sex or CRF would affect the relationship between the highest HRs in these two tests, as well as whether HRmax differed between males and females and between those with high versus low CRF.
METHODS: Fifty-one males and 57 females (aged 22-70 years) completed both an incremental CRF test and a test designed to reach HRmax (with repeated work bouts at high intensity before maximal exertion, ≥ 48 hours apart). To compare the difference between HRmax and HRcrf we used a two-sided, paired sampled t-test. We assessed the relationship between the highest HR in the two tests using linear regression analysis, with HRmax from the HRmax test as a dependent variable, and the highest HR reached at the CRF test (HRcrf), whether maximum oxygen uptake was reached on the CRF test, CRF, sex and age and as independent variables. CRF was categorized as low or high for age and sex, according to a reference material of 4631 healthy Norwegian men and women (3). Additionally, to assess whether HRmax differed between males and females or between those with high versus low CRF, and to assess if there was an interaction between sex and CRF, we performed an age-adjusted two-way ANOVA (sex x CRF).
RESULTS: HRmax was 2.2 (95% confidence interval, 1.5 ,2.9) bpm higher in the test designed to reach HRmax than in the CRF test ($p<0.001$). Only HRcrf significantly predicted HRmax, with no contribution of the other variables in the model. HRmax was predicted from the highest HR reached in an incremental CRF test by: 8.197 + (0.967×HRcrf]) bpm. Individuals with low CRF had on average 5.8 (95% CI, 1.8-9.9) bpm higher HRmax than individuals with high CRF (adjusted for age). There was no effect of sex ($p = 0.38$) and no interaction between CRF and sex ($p = 0.13$) on HRmax.
CONCLUSION: We observed a small (about two bpm), but significant, difference between the maximum HR reached during an incremental CRF test and a test designed to reach HRmax in male and female non-athletes aged 20-70 years. Such a difference is not relevant for exercise prescription in most settings. Based on our findings, the common practice of adding five bpm to the highest HR achieved during a CRF test may be excessive in non-athletes.
References:
1. Tanka H et al. J Am Coll Cardiol 2001; 37(1)
2. Roy S et al. Int J Exerc Sci 2015; 8(4)
3. Aspenes S et al. Med Sci Sports Exerc 2011; 43(8)

HEART RATE MONITORING IN ELITE BADMINTON PLAYERS – USEFULNESS OF A SUBMAXIMAL SHUTTLE-RUN TEST TO ASSESS STRAIN AND RECOVERY

SCHNEIDER, C., RÖLEKE, L., WIEWELHOVE, T., DÖWELING, A., FERRAUTI, A.

RUHR-UNIVERSITY BOCHUM

INTRODUCTION: Assessing changes in fatigue, fitness and (aerobic) performance with exercise heart rate (HRex) during submaximal, non-exhaustive tests became very popular in training research and practice. As HRex may decrease due to (acute) fatigue and/or (long-term) adaptation [1], contextualization and multivariate approaches are required for a valid evaluation of athletes' individual training responses [2]. Therefore, the aim of this observational study was to investigate strain and recovery-related short-term changes in HRex in elite badminton players.
METHODS: 10 elite German badminton players (3 male, 7 female; mean±SD, age 23±4 yrs) were monitored during a 3-month preparatory period in the lead up to the World Championships. HRex and rating of perceived exertion (RPE, 6-20 scale) were repeatedly measured on Mondays (MON) after 1-2 days of pronounced recovery and on Fridays (FRI) following 4 consecutive days of training with up to 2 sessions per day using a submaximal shuttle-run test (approx. 1, 1 and 3 min at 8.2, 9.6 and 11.0 km/h, respectively; 12.8 m shuttle length) during the warm-up of the morning sessions. For HRex and RPE, we examined long-term responses (i.e., intraindividual linear regression [3]), 'overall' differences between MON and FRI (i.e., intraindividual difference between mean values on MON and FRI) and, if possible, individual short-term response patterns (i.e., repetitive intraindividual changes from MON to FRI (strain) or vice versa (recovery), if ≥3 changes were present).
RESULTS: Long-term responses ranged between -0.7 to 0.5 bpm/week for HRex and between -0.1 to 0.2 units/week for RPE. On FRI mean HRex was 2.9±1.7 bpm lower than on MON (-5.5 to 0.1 bpm). Mean RPE was 0.4±0.8 units higher on FRI than on MON (-0.7 to 2.3 units). Repetitive short-term strain and recovery responses were observed in 9 and 6 players, respectively. On average HRex decreased (-3.2±2.7, -7.2 to 1.0 bpm) from MON to FRI and RPE increased (0.5±0.8, -0.5 to 1.3 units). Conversely, HRex increased (2.0±2.0, -1.0 to 4.2 bpm) on average from FRI to MON and RPE remained unchanged (0.0±0.7, -1.2 to 1.0 units).
CONCLUSION: Overall, our preliminary results indicate that HRex during a submaximal shuttle-run test may decline after short-term strain and may increase again after days of pronounced recovery. Mean HRex changes were larger than a previously proposed smallest worthwhile change of 1% but smaller than a suggested typical error of 3% [2]. These findings are limited by the small sample size, non-available training logs and the purely observational character of the study. Nonetheless, the changes in HRex as a response to the training load changes within the usual weekly schedule were surprisingly high compared to similar observations after an ultramarathon [4].
REFERENCES:
1. Akenhead R, Nassis GP (2016) IJSPP, 11:587-93.
2. Buchheit M (2014) Front Physiol, 5:73.
3. Plews DJ, et al (2012) EJAP, 112:3729-41.
4. Siegl A, et al (2017) IJSM, 38:675-82.
CONTACT:
christoph.schneider-a5c@rub.de

HEART RATE IS INADEQUATE TO PRESCRIBE AND MONITOR INTENSIFIED TRAINING

TEN HAAF, T.1, FOSTER, C.1,2, MEEUSEN, R.3,4, ROELANDS, B.3,5, PIACENTINI, M.F.3,6, VAN STAVEREN, S.7, KOENDERMAN, L.7, DAANEN, H.A.M.1, DE KONING, J.J.1,3

1: VU , 2: UWLAX , 3: VUB , 4: JCU , 5: FWO , 6: UNIROMA4 , 7: UMCU

INTRODUCTION: Heart rate can easily be measured and is often used to prescribe and monitor training. Yet, the effect of intensified training on submaximal heart rate is not completely clear. Therefore, the aim of this study was to investigate whether (sub)maximal heart rate is affected by intensified training, and whether this potential change is associated with the change in performance.
METHODS: The study included 30 participants who performed cardiopulmonary exercise tests to exhaustion 2 weeks before (pre), 1 week after (post) and 5 weeks after (follow-up) an 8-day non-competitive cycling tour (TFL). The exercise volume during this tour was 9 fold the

volume during the preparation period. Heart rate, O2pulse, VO2, VCO2, respiratory exchange ratio (RER) and pulmonary ventilation (VE) were obtained at standardized absolute submaximal workload (low, medium and high intensity) and at peak levels. Performance, defined as the peak power output (PPO), and the ventilatory threshold were obtained each test.
RESULTS: The peak power output post TFL was 8.8 W (95% CI [2.5, 15.1]) lower than pre TFL. Heart rate decreased significantly at low (-4.4 beats/min, [-8.6, -0.2]) and medium (-5.5 beats/min [-8.5, -2.4]), but not at high intensity (-2.3 beats/min [-4.9, 0.2] after the 8 day non-competitive tour. Peak heart rate decreased -3.4 beats/min [-6.3, -0.6]. In contrast, O2pulse was on average 0.49 ml O2/beat [0.09, 0.89] higher at all intensities after intensified training. No changes in VO2 (P=.44) or the ventilatory threshold (P=.21) were observed. The change in heart rate was negatively associated with O2pulse at low (r=-.56, P<.01) and medium intensity (r=-.54, P<.01), but not with PPO or any other cardiopulmonary parameter. Changes in O2pulse and VO2 were associated at all exercise intensities. The change in RER (r=-.54, P<.01) and VE (r=-47, P=.02) at high intensity were negatively associated with the change in PPO.
CONCLUSION: This study showed that heart rate at submaximal and maximal exercise intensity is lower after an 8-day non-competitive cycling tour. However, this decrease does not result in lower VO2 and is unrelated to the change in our measure of performance (PPO). Coaches and athletes should, therefore, be aware of the limited practical value of heart rate for prescription and monitoring of intensified training.
CONTACT: tpg.ten.haaf@vu.nl

INDIVIDUAL ASSESSMENT OF STRESS AND RECOVERY IN ADOLESCENT ELITE ROWERS USING THE HEARTRATE RECOVERY (HRR) DURING SUBMAXIMAL ERGOMETER TESTING

PELZER, T., GÖTZ, A., ULLRICH, B., COLLETTE, R., PFEIFFER, M.
JOHANNES GUTENBERG UNIVERSITY, MAINZ

INTRODUCTION: Accompanied monitoring of athletes recovery status is helpful to counteract overreaching and overtraining symptoms in athletes and has recently been highlighted in many works (Le Meur et al., 2016). The heartrate recovery (HRR) assessment dur submaximal training intensities hereby provides a promising approach to optimize training output (Le Meur et al., 2013). In this study, HRR was used to assess stress and recovery in adolescent elite-rowers.
METHODS: Five adolescent elite-rowers (R1-R5; Age: 17.6 ± 1.9 years; Size: 178.1 ± 9.3cm, Mass: 67.1 ± 2.5 Kg) completed four weeks of rowing training, using different intensites (Le Meur et al., 2013). Hereby, the individual given workload of the first training week (TW1=Baseline=100%) was calculated as sRPE (Foster et al. 2001) and used for further workload calculations (TW2-TW4). TW2 and TW3 represented the overload-period (OL) with 140% workload and TW4 served as taper period (TP) with 60%. A submaximal ergometer test (Le Meur et al. 2013) was applied for HRR-measurement and maximal rowing performance was determined with a 1.000m All-Out test. Additionally, acute recovery and stress scale data were daily documented with questionnaires.
RESULTS: Maximal rowing power (1.000m All-out) of all participants increased from 369.2 ± 61.2W (TW1) to 372.8 ± 70.4W after OL and 380.6 ± 62.8W after TP. Mean HRR increased for R1 and R3 (+13.6%) and decreased for R2, R4 and R5 (-12.8%) following OL. After TP, HRR values nearly returned to basic level for R1-R4 and remained increased for R5.
CONCLUSION: In this study, a submaximal ergometer test (LeMeur et al. 2013) was adopted to rowing to assess stress and recovery. HRR showed interindividual differences inbetween the applied training intensites (Baseline-Overload-Taper) what might indicate different levels of adaptation and maladaptation in response to overload training. For individual interpretation of HRR in athletes, results necessarily should be linked to training history, performance output as well as psychometric data. Although only 5 athletes participated for this work, our results provide practical benefits for coaches using the heartrate recovery for training monitoring.
Foster, C., Florhaug, J.A., Franklin, J., Gotschall, L., Hrovatin, L.A., Parker, S., Doleshal, P. and Dodge, C. (2001). A new approach to monitoring exercise training. Journal of Strength and Conditioning Research, 15(1), 109-115.
Le Meur, Y., Pichon, A., Schaal, K., Schmitt, L., Louis, J., Gueneron, J. et al. (2013). Evidence of parasympathetic hyperactivity in functionally overreached athletes. Medicine and Science in Sports and Exercise, 45 (11), 2061-2071.
Le Meur, Y., Buchheit, M., Aubry, A., Coutts, A.J. and Hausswirth, C. (2017). Assessing overreaching with HRR: what is the minimal exercise intensity required? International Journal of Sports Physiology and Performance, 12(4), 569-573.

CAN RESTING HEART RATE INFLUENCE VAGAL REACTIVATION AFTER SUBMAXIMAL EXERCISE TEST?

GARCIA, G.L., FONTANA, K.E., CRUZ, C.J.G., SOARES, E.M.K.V.K., PORTO, L.G.G., JUNQUEIRA JR., L.F., MOLINA, G.E.
UNIVERSITY OF BRASÍLIA – UNB

INTRODUCTION: The resting heart rate (RHR) and vagal reactivation (VR) during the short recovery period after exercise testing (5min) have been commonly used as noninvasive assessment tools of the cardiovagal activity. Therefore, it is reasonable to expect that RHR can influence the VR immediately after submaximal exercise test (SET). The aim was compare VR after SET in active young men with different RHR patterns.
METHODS: We evaluated 42 active men (IPAQ-questionnaire). Volunteers were divided into the Bradycardia Group – RHR < 60 bpm (BG n = 21), aged 24.5 (20-38) years and body mass index (BMI) of 23.8 (20.1-27.4) kg/m2 and the Normocardia Group - RHR = 60 = 100 bpm (NG: n = 21), aged 25.5 (20-40) years and BMI of 25.3 (21.6-28.2) kg/m2. A Polar RS800® was used to record RHR and the RR-interval series during the 5 minutes recovery period after SET. RHR was defined as the mean heart rate recorded for 5 minutes at rest in supine position after 10 minutes of resting. The heart rate variability was analyzed by Kubios software and VR was assessed by the rMSSD index, a vagal marker, from 1st to 5th minute of active recovery at 2.4 km/h and 2.5% grade after SET. Due to non-normal distribution of variables (Shapiro-Wilk test) the Mann Whitney test was used to compare groups and the Spearman correlation test was used to correlate RHR with rMSSD after SET, at the 5% level of significance. Data are shown as medians and extreme values (min-max).
RESULTS: The RHR was BG: 57 (46-59) bpm and NG: 67 (60-76) bpm (p < 0.001). We observed a negative correlation (n=42) between RHR with rMSSD in the 3th (rs = -0.30, p = 0.02), 4th (rs = -0.35, p = 0.01) and 5th (rs = -0.45, p = 0.001) minutes of recovery after SET. A trend of higher values of VR were observed in the 2nd minute on the BG [rMSSD2: 8.3 (4.5-16.4) ms;] as compared to the NG [rMSSD2: 6.5 <3.0-17.10) ms (p = 0.06) and higher values of VR from 3th to 5th minute of recovery on the BG [rMSSD3: 9.5 (5.2-17.2) ms; rMSSD4: 10.3 (4.7-18.7) ms; rMSSD5: 8.7 (5.3-18.5) ms] as compared to the NG [rMSSD3: 6.8 (3.0-11.6) ms; rMSSD4: 5.9 (2.6-17.4) ms; rMSSD5: 6.1 (3.1-16.2) ms](p = 0.001).
CONCLUSION: We observed higher vagal reactivation from 2sd to 5th minute of recovery after SET on group BG comparatively with NG. The significant negative correlation between the RHR and VR from 3th to 5th minute of recovery after SET reinforces the association between RHR and VR. These results support the hypothesis that pre-exercise RHR in supine position could influence the degree of cardiovagal reactivation, and consequently, the speed of cardiovagal activity return to baseline levels after SET.

Oral presentations

OP-BN17 Neuromuscular fatigue

NEUROMUSCULAR FATIGUE IN HYPOXIA REVISITED

RUPP, T.1, MIRA, J.1,2, FLOREANI, M.2, SAVOLDELLI, A.2, AMERY, K.2, KORAL, J.2, ORANCHUK, D.2, MILLET, G.Y.1

*1: LIBM , 2: HPL . * BOTH AUTHORS CONTRIBUTED EQUALLY TO THE WORK*

INTRODUCTION: The magnitude and etiology of fatigue following whole-body exercises at different altitudes remain equivocal owing to i) the actual degree of hypoxemia (arterial saturation, SpO2) achieved by the subjects, ii) the consideration of relative vs absolute workloads and iii) the lag time between exercise cessation and fatigue evaluation, which permits some recovery of neuromuscular function (NMF) and leads to possible fatigue misinterpretation. The aims of this study were to evaluate the rate of fatigue development and its etiology during cycling and right at exhaustion (EXH) in normoxia, moderate and severe hypoxia at relative and absolute workload intensities.
METHODS: Thirteen active subjects first completed three incremental tests to determine maximal aerobic power output (Wmax) in normoxia, moderate hypoxia (MOD, SpO2 clamped at 85%) and severe hypoxia (SEV, SpO2 clamped at 70%). Five fatigue cycling tests were then randomly performed up to EXH on a new cycle-ergometer with instrumented pedals, which allows NMF evaluation in isometric mode within 1-s. In three tests (N, MODabs, SEVabs) initial power output was set at 55% Wmax determined in normoxia (ie. absolute intensity). Two other tests (MODrel, SEVrel) started at 55% Wmax determined in the same environmental condition (ie. relative intensity).
NMF evaluations assessed before, during and immediately at EXH comprised force recordings and electrical stimulation to assess maximum voluntary contraction (MVC) and peripheral fatigue (high-frequency doublet, Db100; Twitch, Pt).
RESULTS: Time to EXH of NORM (84±15 min) was significantly longer than MODabs (50±23 min), SEVabs (25±17 min) and SEVrel (58±19 min, all P<0.001). Times in MODrel (73±20 min) and SEVrel were longer than MODabs and SEVabs, respectively (P < 0.001).
The MVC, Pt and Db100 decreases throughout exercise were similar, at isotime, in NORM, MODrel and SEVrel. While NORM and MODabs also showed similar MVC and Db100 patterns, Pt was more depressed in MODabs than NORM and MVC, Pt and Db100 impairments were exacerbated in SEVabs. Besides, MVC depression was greater in MODabs vs MODrel and MVC, Pt and Db100 impairments were greater in SEVabs vs SEVrel.
However, at EXH, MVC and Db100 decreases were not different among tests (–26 to –31% and –25 to –35%, respectively) even if Pt was less decreased in relative sessions (MODrel, SEVrel).
CONCLUSION: Time to EXH of absolute (as expected) but also relative sessions was increasingly reduced with altitude level. Fatigue magnitude (MVC decrease) and its peripheral component was not altered when exercising at moderate and severe altitude at relative workloads compared to normoxia, whereas the rate of fatigue development was enhanced for higher (absolute) workloads, particularly for low SpO2. Finally, force loss at EXH was similar among sessions, but the amount of peripheral fatigue (e.g. Pt) was likely triggered by exercise intensity per se rather than by the degree of hypoxemia.

H-REFLEX CHANGES ARE NOT DIFFERENT BETWEEN GIRLS AND WOMEN AFTER A SUBMAXIMAL FATIGUE PROTOCOL.

PAPAVASILIOU, A.1, BASSA, E.1, XENOFONDOS, A.1, SFYRIOU, E.1, TSATALAS, T.2, KOTZAMANIDIS, C.1, PATIKAS, D.1

ARISTOTLE UNIVERSITY OF THESSALONIKI

INTRODUCTION: Fatigue is a complex phenomenon with numerous central and peripheral mechanisms contributing to its existence and magnitude. Limiting factors in performance located at spinal level can be examined with non-invasive methods, such as the H-reflex. During fatigue, afferent feedback and input from supraspinal centres may alter the α-motoneuron excitability and the level of presynaptic inhibition, which can be assessed by means of H-reflex. Regarding fatigue during youth, previous studies have shown that recovery after fatigue is faster in children than adults, possibly due to peripheral mechanisms. However, the α-motoneuron excitability and the input they receive from the Ia afferents may have implications to the faster recovery in children. Therefore, the purpose of this study was to examine the H-reflex during the recovery period after a fatigue protocol until exhaustion applied in children and adults.
METHODS: Fourteen women (age 22.2±3.2 years) and 17 prepubertal girls (age 11.2±1.0 years), performed voluntarily a sustained isometric plantar flexion at 30% of their maximal voluntary contraction (MVC) torque, until they could not reach the target torque for more than 5 s. The soleus H-reflex (every 10 s) and maximum M-wave (Mmax, every 30 s) were measured before and for 10 minutes after the fatigue protocol. Furthermore, MVCs were performed at 0, 3 and 6 min. after the fatigue protocol and compared to the pre-fatigue values. Peak to peak amplitudes of the H-reflex and Mmax as well as the MVC and soleus EMG values were statistically processed using a two-way (GROUP and TIME) repeated measures ANOVA model with alpha set at 0.05.
RESULTS: After fatigue the MVC plantar flexion torque and soleus EMG were decreased in both age groups but recovered faster in children. The H-reflex amplitude decreased for both age groups and recovered within 3 minutes. The Mmax revealed a potentiation during the first minute of recovery only for the women's group and recovered to the baseline values afterwards.
CONCLUSION: Although our data show that girls recover faster than women in terms of plantar flexion torque and soleus EMG, the H-reflex revealed the same behaviour in both age groups. This indicates that the Ia afferent feedback as well as type III and IV afferent inhibitory input may not contribute to the lower rate of recovery in women. In contrast, the potentiation of Mmax observed in women only, indicates possible changes in membrane excitability after fatigue that could have some implications to performance.

RIGOROUS ANALYSIS REVEALS CONSISTENT MOTOR UNIT FIRING ADAPTATIONS DURING MUSCLE FATIGUE

CONTESSA, P., KLINE, J.C., LETIZI, J., DE LUCA, G.

DELSYS & ALTEC INC.

INTRODUCTION: The study of motor unit firing behavior during fatigue reveals how muscle control adapts to the increasing demand of long duration or strenuous tasks, such as those often endured as part of sports training and exercise. However, inconsistencies in reports of fatigue-induced motor unit firing adaptations hinder the understanding of muscle control during fatigue. To clarify the control mechanisms of fatiguing muscles, we explored whether different approaches in the analysis of motor unit data may lead to inconsistencies in the observation of motor unit firing behavior during a repeated task.
METHODS: We investigated the firing behavior of individual motor units in a smaller muscle of the hand, the First Dorsal Interosseous (FDI), and in a larger muscle of the quadriceps, the Vastus Lateralis (VL), of five healthy subjects during constant force isometric contractions sustained at 30% and 50% maximal voluntary contraction force and repeated to exhaustion. We recorded sEMG signals during index

finger abduction (for the FDI) and leg extension (for the VL) using a four-channel dEMG array sensor (Delsys Inc.) place on the skin over the muscle. The signals were decomposed into their constituent motor unit action potential (MUAP) trains. The MUAP amplitude, the recruitment threshold and the firing rate of each motor unit was measured. Single-differential sEMG signals were recorded from surrounding muscles that may contribute to measured force.
RESULTS: We were able to identify four factors that contribute to inconsistencies in the observations of motor unit firing behavior during fatigue. They are: 1) the practice of grouping and averaging motor unit data within a contraction that obscures motor unit-specific firing properties; 2) the practice of analyzing motor unit firing rate as a function of recruitment threshold when recruitment threshold decreases with fatigue; 3) the practice of grouping motor unit data across different subjects that obscures subject-specific adaptions to muscle fatigue; and 4) changes in muscle co-activation that alter the relative contribution of different muscles to the fatigue tasks. When these factors were avoided in our study, consistent adaptations in firing behavior were observed across all subjects and muscles. That is, as fatigue develops, motor unit firing rates increase, new higher-MUAP amplitude motor units are recruited, and motor unit recruitment thresholds decrease.
CONCLUSION: These adaptations indicate that motor unit firing behavior responds to increasing excitation to the motoneuron pool of the muscle that compensates for decreasing muscle force generation capacity with fatigue.
Support: Research reported in this abstract was supported by the National Institute of Neurological Disorders and Stroke (R43NS093651 and R44NS077526), and by the De Luca Foundation, MA.

ACUTE AND DELAYED KNEE EXTENSOR FATIGUE AND MUSCLE DAMAGE FOLLOWING RESISTANCE TRAINING LEADING OR NOT TO FAILURE.

GONZÁLEZ-HERNÁNDEZ, J., COLOMER-POVEDA, D., TVARIJONAVICIUTE, A., CERÓN, J.J., JIMÉNEZ-REYES, P., MÁRQUEZ, G.
CATOLIC UNIVERSITY SAN ANTONIO DE MURCIA UCAM

INTRODUCTION: During resistant training (RT) the set configuration (volume, intensity, number of sets and repetitions, inter-set rest time, etc.) has a profound impact on mechanical, neuromuscular and biochemical responses (Río-Rodríguez et al. 2016) and may account for the long-term neuromuscular adaptations. In this regard, it has been previously demonstrated that RT sessions leading to failure produced higher levels of muscle damage (i.e.: increased creatin kinase (CK) values) than those performed not leading to failure (Gorostiaga et al. 2012). However, it remains unknown whether central and peripheral fatigue after sessions leading or not to failure are related with changes ocurring at biochemical level (i.e.: CK). Therefore, this study aimed to compare the acute and delayed effects of two different RT protocols, leading or not to failure, on central and peripheral fatigue, muscle damage and performance.
METHODS: Twelve trained men after three familiarisation sessions, performed two different RT protocols (with sets leading or not to failure) in a counterbalanced order one week apart. The protocol leading to failure consisted of 6 sets of 10 repetitions maximum (RM) of full squat, while the other protocol (not leading to failure) consisted of 6 sets of 5 repetitions with the same load of 10RM. The inter-set rest was 5 minutes for both protocols. Twitch interpolation technique was used to assess neuromuscular function of the knee extensor muscles before (Pre), immediately after each set (Post1…Post6), 60 minutes later (Post60min), 24h (Post24h) and 48h (Post48h) after the cessation of each training session. Muscle damage was inferred via serum CK measured before and after (60min, 24h and 48h) each training protocol.
RESULTS: Our results displayed a significant decrease ($P<0.05$) in maximal voluntary contraction, voluntary activation (central fatigue) and high frequency fatigue (100Hz potentiated twitch) during and after the performance of both training protocols. However, low frequency fatigue (10Hz potentiated twitch) was significantly higher ($P<0.05$) after the 3rd set of the protocol leading to failure when compared to the session not leading to failure. These higher levels of low frequency peripheral fatigue observed in the more challenging protocol (6x10RM) were evident even after 48h of recovery. Regarding muscle damage, we found a significant ($P<0.05$) increase in CK levels after both training protocols, however, our results also displayed significant higher levels of CK after the protocol leading to failure when compared to the other one ($P<0.05$ in the Post24h and Post48h).
CONCLUSION: Training leading to failure produces a greater extent of peripheral fatigue compromising the excitation-contraction coupling machinery and thus, performance. Furthermore, these peripheral impairments could be attributed to higher levels of muscle damage.
Gorostiaga EM et al. (2012). PLoS ONE, 7(7)
Río-Rodríguez D et al. (2016). PLoS ONE, 11(3)
Contact: jormigohe91@gmail.com

ETIOLOGY AND RECOVERY OF FATIGUE FOLLOWING HEAVY-RESISTANCE, JUMP, & SPRINT TRAINING

THOMAS, K., BROWNSTEIN, C.G., DENT, J., PARKER, P., GOODALL, S., HOWATSON, G.
NORTHUMBRIA UNIVERSITY

INTRODUCTION: Training methods that require maximal intensity efforts against light- and heavy-resistance are commonly used in the athletic preparation of athletes in a range of sports. Typically these sessions are separated by at least 48 hours recovery on the assumption that such efforts elicit marked fatigue of the central nervous system (CNS), but this posit has not been well-studied. The aim of the study was to assess the etiology and recovery of fatigue after heavy-resistance, jump, and sprint training methods.
METHODS: Ten male athletes completed three training sessions requiring maximal efforts that varied in their loading characteristics; i) heavy resistance exercise (10 × 5 back squats at 80% 1RM) (HRE); ii) jumping exercise (10 × 5 jump squats) (JUMP); iii) maximal sprinting (15 × 30 m) (SPRINT). Pre-, post- and at 24, 48 and 72 h post- participants completed a battery of tests to measure neuromuscular function using electrical stimulation of the femoral nerve, and single- and paired-pulse magnetic stimulation of the motor cortex, with evoked responses recorded from the knee extensors. Fatigue was self-reported at each time point using a visual analogue scale.
RESULTS: Each intervention elicited fatigue that resolved by 48 (JUMP) and 72 h (HRE & SPRINT). Decrements in muscle function (reductions in the potentiated quadriceps twitch force) persisted for 48 h after all exercise. Reductions in voluntary activation were present for 24 h after JUMP and SPRINT and 48 h after HRE. No other differences in CNS function were observed as a consequence of training.
CONCLUSION: Resistance, jumping, and sprint training requiring repeated maximum efforts elicits fatigue that requires up to 72 h to fully resolve, but this fatigue is not primarily underpinned by decrements in CNS function.

DOES MAINTAINED GROUP III/IV AFFERENT FEEDBACK AFTER HIGH-INTENSITY EXERCISE OF THE LEG CONTRIBUTE TO CROSSOVER FATIGUE IN THE ARM?

KENNEDY, D.S.1,3, RAPER, E.C.2, FIN, H.T.3, TAYLOR, J.T.3

1. UNIVERSITY OF TECHNOLOGY SYDNEY; 2. ROYAL NORTH SHORE HOSPITAL; 3. NEUROSCIENCE RESEARCH AUSTRALIA

INTRODUCTION: Cross-over fatigue occurs when fatigue of one muscle group is associated with a decrease in the ability to generate force in non-exercised muscles within the same limb (1) or between lower and/or upper limb muscles (2,3). The decrease in muscle force is thought to be mediated by afferent feedback from the exercised muscle. This study aimed to determine whether maintained fatigue-related group III/IV muscle afferent feedback from the quadriceps results in cross-over fatigue to the ipsilateral elbow flexor muscles.
METHODS: Sixteen subjects (mean age = 23, female=9) attended on two days. On both days, they performed a 2-min sustained quadriceps maximal voluntary contraction (MVC). Following this contraction, on one day blood flow to the quadriceps was occluded for 2 min to maintain muscle afferent feedback. During that time, subjects performed four elbow flexor contraction sets comprising one MVC and two submaximal contractions. Voluntary activation (VA) using transcranial magnetic stimulation (TMS), force (MVC), biceps motor evoked potentials (MEP), and pain (Borg scale) were recorded.
RESULTS: Maintained group III/IV afferent firing of the quadriceps had no effect on VA (93.3±5.3% on no-cuff day; 91.5±6.6% on cuff day (mean±SD); p=0.74) or torque (94.5±5.1% Peak MVC on no cuff day; 95.3±6.7% on cuff day, p=0.75) of the elbow flexors. Furthermore, there was no effect on the excitability of the motor-cortical output cells of biceps (MEP) (57.1±15.7% Mmax on no-cuff day; 52.7±16.4% on cuff day; p=0.88). Subjective pain ratings during maintained quadriceps ischaemia were higher (Borg: 6.0±1.6; p<0.001) compared to when the muscle was allowed to recover (2.6±2.1).
CONCLUSION: Despite high levels of group III/IV muscle afferent feedback after fatiguing leg exercise, torque and voluntary activation of the elbow flexors were unchanged. This suggests that group III/IV muscle afferent feedback does not mediate cross-over fatigue from the leg to upper limb, at least during multiple brief elbow flexor MVCs.

THE EFFECT OF FATIGUE ON REACTIVE STRENGTH IN SOCCER PLAYERS

STEWART, R.1, FLANAGAN, E.2, DITROILO, M.1

1 INSTITUTE FOR SPORT AND HEALTH, UNIVERSITY COLLEGE DUBLIN.

INTRODUCTION: Reactive strength denotes the ability of the musculotendinous unit to produce a powerful concentric contraction immediately following a rapid eccentric contraction. The reactive strength index (RSI) is a common method of quantifying reactive strength performance. However, for numerous sporting events it is important to consistently produce repetitive reactive strength. Few studies have investigated the relationship between maximal reactive strength and reactive strength fatigue. Therefore, this study aims to examine the effect of fatigue on RSI and its components.
METHODS: Nineteen semi-professional male soccer players (20.2±1.3 years; 76.9±5.6kg; 181.4±4.8cm) participated in a familiarisation and a testing session. Sessions consisted of a standardised warm up, a 10 to 5 repeated jump test (10/5) (Harper, 2011), and a 30 second repeated jump test (30RJT). Contact time (CT) and Jump height (JH) were measured using an Optojump photocell system (Microgate, Bolzano, Italy). RSI was calculated by dividing JH by CT. The 10/5 test determined participant's unfatigued, maximal RSI (RSImax). Subsequently, a median split categorised the data into low (n=10) and high (n=9) RSI groups. Data from the 30RJT was split into discrete five second phases and were analysed as percentages of RSImax. A two way (time and group) repeated measures ANOVA determined the effect of time and group on fatigue, with post hoc testing (Tukey) for analysis of group differences. The magnitude of effect was assessed using Cohen's d effect size (Rhea, 2004).
RESULTS: Participants completed 43±2 jumps during the 30RJT. RSImax scores for the low and high groups were 1.58 ±0.21 and 1.98 ±0.15 respectively. There was a significant effect of time for the 3 variables analysed (RSI and JH, p<0.01; CT, p<0.05), however no effect of group and no interaction between variables was detected. Large effect sizes were observed between RSImax and RSI at the 25-30sec time phase for both low (d=1.08) and high (d=2.3) groups. Even though no significant differences in RSI, CT and JH were identified between groups at any time phase, moderate to large effect sizes between groups were observed across time phases for RSI (d=0.52–1.01) and JH (d=0.59-0.87), with the low group consistently showing a higher percentage of RSI compared to high group. Trivial to moderate effects were observed between groups for CT (d=0.01-0.52).
CONCLUSION: The results of this study demonstrate that the 30RJT is an appropriate protocol to elicit reactive strength fatigue. Although differences in fatigue response between low RSImax and high RSImax groups were non-significant, large and moderate effect sizes were observed. Changes in RSI were predominantly attributed to fluctuations in JH, while much smaller changes were observed in CT. The results could inform the testing and training of reactive strength in soccer players.
REFERENCES: Harper, D., et al. (2011). BASES Student Conference.
Rhea, M. (2004). J Strength Cond Res 18: 918–920.

Oral presentations

OP-BN18 Advanced technology in biomechanic evaluation

MULTI-SENSOR AND VIDEO SYNCHRONOUS ACQUISITION AND ANALYSIS IN SPORTS ACTIVITIES

LIU, Y., CHEN, Q.

CHINA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: Sports data acquisition in sports training and competition mainly uses various kinds of sensors and video devices. With the rapid development of microelectronics technology and the rise of flexible circuits, multi-sensor can be mounted on a very small area of circuit board which brings great convenience for collecting sports data by using wearable devices. Video-based movement analysis has been widely used for sports technique and tactic analysis, such as Dartfish® Video Analysis Software from Switzerland and so on. Nevertheless, the motion monitoring by sensor and video is usually separated. It's not conducive to understand the sports data of users in each individual skilled movement, nor to accurately judge the reasonableness of the motion state of the users in the whole skilled movement. Therefore, the aim of this study was to design a multi-sensor and video synchronous acquisition and analysis system to meet the needs of field testing and field analysis of sports events.

METHODS: The proposed multi-sensor and video synchronous acquisition and analysis system includes four modules: sensor data acquisition subsystem, video acquisition device, synchronization equipment and software. Sensor data acquisition subsystem integrated a variety of types of sensors consisting of accelerometer, gyroscope, magnetometer, heart rate, and pressure sensor. The video acquisition device has the external trigger function, which can adjust the frame rate and the resolution. Time synchronization between the sensor data acquisition subsystem and video acquisition device is performed by the synchronization equipment. The computer software configures the whole system parameters and displays the data acquired by sensors and video. Besides, the data processing and analysis will be performed by software, including multi-sensor data fusion, synchronous analysis of sensor and video data, and so on. The validation of effectiveness and performance analysis is tested by swimming enthusiasts.
RESULTS: The effectiveness and applicability of the multi-sensor and video synchronous acquisition and analysis system are verified by experiments and site tests in natatorium. The test results show that the synchronous acquisition sensors data including acceleration, angular rates, terrestrial magnetic field, heart rate, depth of water and the video data can effectively reflect the motion state of the user. Data processing and analysis such as comparison of the force of the left and right arms in the freestyle, play an important role in sports technical analysis.
CONCLUSION: The effectiveness of the proposed multi-sensor and video synchronous acquisition and analysis system is demonstrated through the results. Researches on the multi-sensor and video synchronous acquisition and analysis system in future mainly includes: increasing the function of collecting user location information by using the integration of indoor and outdoor positioning technology, studies on the data processing and analysis to provide more suitable advanced motion parameters by using sensor data for sports techniques analysis in various types of sports, researches on improving the possibility of integration of more types of video acquisition devices to provide the most suitable services for various types of users.

SOCCER PERFORMANCE ANALYSIS AND INJURY PREVENTION USING WEARABLE ACCELERATION SENSOR.

MAGOME, T.1, GOUDA, N.2, TANAKA, T.3, YAMAGUCHI, T.3, NAKATA, K.1

1:OSAKA UNIVERSITY GRADUATE SCHOOL OF MEDICINE, 2,3: HITACHI,LTD

INTRODUCTION: To keep the role of QOL that can maintain physical health to the future is important. [1] Sports is responsible for that role, therefore it is also essential for the health promotion to prevent an injury in our daily life. Analysing the relationship between physical activity level and injury prevention in sports is important, but it still tends to be difficult today. In this study, we conducted the measurements using wearable acceleration sensor to classify and analyse the relationship between physical activity level and injury prevention among players belonging to professional soccer youth team in Japan.
[1] UN Inter-Agency Task Force on Sport for Development & Peace, 2003
METHODS: The measurements with wearable acceleration sensor were performed for two weeks. Players attached the acceleration sensors of the 20Hz sampling [2] to their arms and the momentum in soccer game and skill training was estimated. Relationship between physical activity level and injury prevention in the group was examined from the collected data.
[2] Tanaka T., et al., Life microscope: Continuous daily-activity recording system
with tiny wireless sensor, INSS 2008: 5th International Conference on Networked
Sensing Systems: 162165, 2008.
RESULTS: We extracted an interesting fact that the correlation between occurrences of the football injury and daily soccer performance. The variance of players' intensity data who got injured was much higher than the other players and it is statistically significant ($p<0.05$).
CONCLUSION: This study showed the relationship between daily physical activities, ball game and skill training, and injury occurrences by using a simple monitor in a daily setting. Having the positive impression for sports through a daily training will enhance the important awareness leading to injury prevention and health promotion. Continuous measurements are needed for further analysis. Therefore, the relative evaluation with this study is possible by comparing the results from the other data including acceleration of football players etc. To establish the scientific grounds leads to the evidence construction in the physical activities and contributes to the development of sports medicine. Based on this study result, we are going to develop the algorithm to predict the injury occurrences of athletes by applying the method we developed

COMPARISON OF LABORATORY METHODS FOR CALCULATING TOTAL JUMP HEIGHT AND DEVELOPMENT OF A CONSTANT TO IMPROVE FIELD BASED METHODS.

WADE, L., LICHTWARK, G., FARRIS, D.J.

THE UNIVERSITY OF QUEENSLAND

INTRODUCTION: Jumping is commonly used in research and athlete development. Measurement of total jump height (TJH) requires the measurement and summation of two discrete distances, heel raise (HR) and flight height (FH). The three most common laboratory methods to measure TJH are double integration of force plate data (DI), marker based video tracking (MARKER), and rigid-body modelling from motion capture data (MODEL). Although, presently these methods have never been compared directly [1, 2]. This project aimed to examine and contrast these methods as well as a hybrid (HYBRID) method for calculating TJH. As a result, a HR constant (HR-C) was created to be used with field based methods such as flight time (FT).
METHODS: TJH was defined as the displacement of the centre of mass (COM) between standing and jump apex. Participants (N=24, Mass = 71±9kg, Height = 174±8cm) performed 5 countermovement jumps on two force plates (1000 Hz). DI used integration of acceleration determined from net ground reaction forces to find COM take-off velocity (used to calculate FH) and displacement (HR). MODEL used 3D motion capture (200 Hz) to create a rigid body model to estimate COM position. MARKER averaged the 3D position of 4 pelvis markers to estimate COM position. MODEL and MARKER methods calculated HR and TJH as displacement of COM from standing to take-off or jump apex, respectively. HYBRID method calculated TJH using HR from MARKER and FH from DI [1]. Linear mixed modelling enabled method comparison. Mean standard deviations (STD) within participants were compared using a repeated measures ANOVA. FT method determined TJH based on time spent in the air and combined this with our estimated HR-C, modelled as the distance from medial malleolus to tip of 1st toe, minus the distance from medial malleolus to the ground. TJH of FT was compared with and without the HR-C, to TJH of HYBRID using Bland-Altman comparisons.
RESULTS: There was a main effect of method on TJH ($P < 0.001$) with the greatest difference between DI and MODEL; being 1.8 cm higher on average in DI. STD of TJH was significantly different only between DI and HYBRID ($P = 0.002$). Mean STD's of HR were less than half of TJH and were not significantly different between MARKER, HYBRID and MODEL ($P = 0.583$), however DI STD was higher than all other methods ($P = 0.007$). HYBRID vs FT reported -9.66 ± 1.47 cm bias. HYBRID vs FT + HR-C reported 1.79 ± 1.7 cm bias.

CONCLUSION: While all methods reported slightly different jump heights, mean STD differences between methods were relatively small (max = 3 mm) and therefore all 4 methods appear suitable for repeat measures of TJH in a research setting. HR was extremely consistent and well estimated by the constant we developed. TJH height bias using FT + HR-C was reduced by 8.3 cm compared to FT alone and therefore it is recommended that this constant be included when calculating TJH from FT.
[2] Aragon, L. Meas Phys Educ Exerc Sci, 4(4): 215-228, 2000
[1] Moir, G. Meas Phys Educ Exerc Sci, 12(4): 207-218, 2008

THE NUMBER OF TRIALS REQUIRED TO OBTAIN A TRUE REPRESENTATION OF BIOMECHANICAL FEATURES EXTRACTED DURING A SINGLE LEG HURDLE HOP EXERCISE

GRIFFIN, C.1,2, RICHTER, C.2, FRANKLYN-MILLER, A.2, MORIN, J.B.1
UNIVERSITY OF NICE SOPHIA ANTIPOLIS

INTRODUCTION: Lower extremity stiffness has been linked to running performance and injury risk(1) with various hopping tests used to measure stiffness(2). However, it is unclear how many trials are required for a forward hop exercise. The aim of this study was to determine the number of trials required to obtain a true representation of the biomechanical variables in a single leg hurdle hop task.
METHODS: Ten recreationally active males participated in 2 testing sessions 14 days apart involving a standardised warm-up including 3 familiarisation trials on each limb, before performing a forward hop over two 15cm hurdles, rebounding off a force platform in between. The participants completed 10 trials on each limb unshod with their arms akimbo, and were instructed to rebound as fast and as far as possible. Ten infrared cameras (250Hz; Vicon, UK) synchronised with two force platforms (1000Hz, AMTI, USA) were used to capture reflective markers placed at the pelvis (reference for centre of mass [COM]) and ground reaction forces (GRF). Motion and GRF data were filtered using a fourth order low pass Butterworth filter. Vertical stiffness (Kvert), peak GRF, contact time (CT), total hop distance from the start of the hop to the landing position (HD), and rebound distance from the force platform to the landing position (RD), were calculated and examined. Kvert was calculated as the ratio of GRF at the lowest CoM, to CoM displacement. A true mean was generated by a simulation where the mean of 7 randomly selected trials were calculated over 100 iterations and averaged. A correlation was used to judge from which trial a true representation could be expected, with a correlation threshold set at 0.9.
RESULTS: All trials for the variables of peak GRF, RD and HD demonstrated high correlations for both testing sessions from trial 3. While CT fluctuated within the first session, it demonstrated a high correlation in the second session from trial 3. Correlation of Kvert fluctuated over both sessions, while it reached its highest correlation (r=0.7) also at trial 3 in both sessions.
CONCLUSION: This study suggestets that 3 trials may be optimal to obtain a true representation for all measured variables in a single leg forward hurdle hop exercise. The low correlation (r=0.7) of Kvert and CT in the latter trials may be indicative of fatigue, movement variability, or may not be a reliable variable to obtain a representative measure. Overall, the single leg hurdle hop exercise test may be a convenient clinical tool for lower limb injury rehabilitation requiring less trials to be performed.
REFERENCES:
1. Butler, R.J., Crowell, H.P. Davis, I.M., 2003. CLIN BIOMECH, 18(6), pp.511-517.
2. Brughelli, M. Cronin, J., 2008. SCAND J MED SCI SPOR 18(4), pp.417-426.
Contact: ColinGriffin@sportssurgeryclinic.com

PLAYER MONITORING IN INDOOR SPORTS: VALIDITY OF INERTIAL MEASUREMENT UNITS TO QUANTIFY ACCELERATION VALUES

ROELL, M.1, ROECKER, K.1,2, GEHRING, D.1, MAHLER, H.1, GOLLHOFER, A.1
1: ALU , 2: HFU

INTRODUCTION: A growing interest in assessing physical demands in team sports has led to the development of various player monitoring systems. Their majority is specified for outdoor settings, whereas recently developed inertial measurement units (IMU) enable three dimensional measures of acceleration also indoors. However, gravity acting on the IMU and its unknown orientation relative to the global coordinate system are basic problems challenging the extraction of discipline relevant data in indoor sports. Sensor fusion algorithms solve these problems by estimating a device's orientation relative to gravity without the aid of external references (Valenti et al., 2015). Aim of this study was to validate two different sensor fusion algorithms as well as conventional gravity compensation applied to IMU signals to obtain acceleration values in all movement planes.
METHODS: Data of an IMU were compared to a 3D motion analysis (MA) system during simulated sports specific movement patterns (n=56). Low-pass filtering for gravity correction (LF) and two sensor fusion algorithms for orientation estimation (Complementary Filter, CF; Kalman-Filter, KF) were applied to the IMU's output. Mean and peak values for resultant acceleration (CF, KF, LF) were calculated as well as for acceleration and deceleration in each of the 3D-axis (CF, LF) and compared to MA system data.
RESULTS: Significant differences were found between LF and MA data but not between sensor fusion algorithms and MA. Higher precision and lower relative errors were found for CF (RMSE=0.05; CV=2.6) and KF (RMSE=0.15; CV=3.8) both compared to the LF method (RMSE=1.14; CV=47.6) regarding the resulting acceleration. Comparing both sensor fusion algorithms, CF revealed slightly lower errors than KF and additionally provided information about positive and negative acceleration in all three axes with moderate to good validity (CV=3.9–17.8).
CONCLUSION: The results show that after sensor fusion IMU-based acceleration values do not substantially differ from conventional kinematic data. Slight advantages of CF might result from its faster rate of convergence (Ricci et al., 2016). Analysis in global x-,y- and z-axis revealed acceptable validity, although superior results were visible for the z-axis compared to x- and y-axis, which is probably caused by a missing heading correction of the CF algorithm (Valenti et al., 2015). Overall, IMU-based tracking devices quantify acceleration values in all three axes with acceptable validity and provide the potential to become a meaningful tool for monitoring indoor sports.
REFERENCES:
Ricci L, Taffoni F, Formica D. (2016). PLoS ONE. 11:9.
Valenti R, Dryanovski I, Xiao J. (2015). Sensors. 15, 19302–19330.
CONTACT:
mareike.roell@sport.uni-freiburg.de

CONCURRENT VALIDITY OF FOUR SYSTEMS ASSESSING MOVEMENT VELOCITY IN THE FREE WEIGHT BACK SQUAT

MITTER, B., HELMREICH, V., HOELBLING, D., BAUER, P., STOECKL, M., BACA, A., TSCHAN, H.

UNIVERSITY OF VIENNA, INSTITUTE OF SPORT SCIENCE

INTRODUCTION: Monitoring and regulating resistance training based on barbell velocity feedback has increasingly drawn interest of researchers and practitioners over the past years (Jovanovic & Flanagan, 2014). To the extent of our knowledge, no study investigated the accuracy of required measurement technology in free weight barbell exercises with an appropriate gold standard so far. Therefore, the present investigation was designed to determine validity of four systems assessing movement velocity in the free weight barbell back squat by means of an approved reference technique (Windolf et al., 2008).
METHODS: Twenty-four competitive powerlifters (18 male and 6 female; age: 25.1±5.1 y; body mass: 99.2±15.1 kg; relative squat 1-RM: 1.96 ± 0.25 kg.kg-1) performed a test protocol with progressing loads at maximum voluntary concentric velocity to establish the 1-RM and load-velocity profile in the back squat. Tests yielded a total of 385 repetitions across various intensities. Movement velocity was recorded using 3D motion capturing (Vicon-460, i.e. gold standard) and four commercially available systems: GymAware (GA), Fitrodyne (FD), PUSH (PU) and Beast Sensor (BS). Validity analysis for vertical peak (PV) and mean velocity parameters (MV) included the calculation and interpretation of Pearson correlation coefficient (r), effect size of differences (ES), and the typical error of the estimate expressed as a coefficient of variation (CV). Fisher's r to z transformation was used to evaluate differences in correlations at a 95% confidence level.
RESULTS: Linear position transducers (GA and FD) showed a higher correlation (r: [.95, .99]), lower differences (ES: [-.05, -.29]) and lower typical error (CV: [1.81%, 12.06%]) in vertical velocity compared to inertia sensors PU and BS (r: [.84, .95], ES: [-.20, -.74], CV: [16.25%, 28.42%]). A Bonferroni-corrected comparison of correlations revealed significant differences between systems in all cases except for peak velocity between GA and FD (p=.03), as well as mean velocity between FD and PU (p=.30).
CONCLUSION: The findings of the present study are in line with previous research showing that linear position transducers provide a more accurate estimation of vertical velocity than inertia sensors (Banyard et al., 2017). Interestingly, there also appear to be divergent levels of accuracy within a technological category (i.e. linear position transducers, inertia sensors) and between velocity parameters amongst all evaluated systems.

Oral presentations

OP-PM80 Acute Exercise

RECREATIONAL TEAM HANDBALL: ACUTE PHYSICAL AND PHYSIOLOGICAL RESPONSES IN ADULT SEDENTARY FORMER PLAYERS

PÓVOAS, S.1,2, CASTAGNA, C.3,4, RESENDE, C.2,5, COELHO, E.6, SILVA, P.2,7, SANTOS, R.2,7,8, SEABRA, A.7, TAMAMES, J., LOPES, M.2,7, RANDERS, M.9, KRUSTRUP, P.9,10

1:CIDESD,2:ISMAI,3:ST-FIGC,4:UTV,5:CIFI2D,6:FAP,7:CIAFEL,8:ESRI,SE,FSS,UW,9:SHSC-SDU,10:S&HS,UE

INTRODUCTION: A third of the world population is not meeting the recommended daily physical activity guidelines (1). Thus, new exercise options should be studied, since lack of motivation to exercise is a major cause of sedentary behavior in adulthood (2). This study describes the acute physical and physiological demands of recreational team handball and evaluates whether it could be suggested as an exercise mode for fitness and health enhancement in adult sedentary men formerly trained in the sport.
METHODS: Fifteen 33-55 year-old sedentary former male team handball players were evaluated for activity profile, heart rate (HR), blood lactate and rating of perceived exertion (RPE) during 4 recreational matches. The matches (7v7) consisted of 2x30-min with a 10-min half-break, and were preceded by a standardized 15-min warm-up.
RESULTS: During the matches the players covered ~6 km, and changed match activity 388±70 times, of which high-intensity runs and unorthodox movements amounted to 59±18 and 26±26 per match, respectively. Jumps and throws were the most frequent highly demanding playing actions. Match average and peak HR were 82±6% and 93±5%HRmax, respectively. Players exercised at intensities between 81-90%HRmax for 47% (28±14 min) and >90%HRmax for 24% (14±15 min) of total match time. For only 9 min of total match time (11%) the players showed HRs equal or lower than 70%HRmax. Match average and peak blood lactate values were 3.6±1.3 and 4.2±1.2 mM, respectively. Post-match RPE was 4.8±2.5 AU (hard).
CONCLUSION: The recreational team handball players covered a higher total distance than their elite counterparts (3), with higher percentage of total time walking and lower standing still, as well as less activity changes, but similar time spent with high-intensity movements. Cardiovascular strain was similar to that found in elite team handball and recreational football players (3,4). This study results show that recreational team handball is an intermittent high-intensity exercise mode with physical and physiological demands in the range of those found to have a positive effect on aerobic, anaerobic and musculoskeletal fitness in adult individuals (4). Training studies considering recreational team handball as a health enhancing intervention are warranted.
References: 1. Hallal, P. et al. (2012). Lancet, 380(9838), 247-257. doi: 10.1016/S0140-6736(12)60646-1.
2. European Commission (2014). Special Eurobarometer 412 - Sport and Physical Activity report 2014.
3. Póvoas, S. et al. (2012). JSCR, 26(12), 3365-3375. doi: 10.1519/JSC.0b013e318248aeee.
4. Krustrup, P. et al. (2010). SJMSS, 20(Suppl 1), 132-135. doi: 10.1111/j.1600-0838.2010.01108.
spovoas@ismai.pt

HEART RATE MARKERS OF AUTONOMIC FUNCTION ARE UNCHANGED FOLLOWING MAXIMAL EXERCISE IN PATIENTS WITH MYALGIC ENCEPHALOMYELITIS/ CHRONIC FATIGUE SYNDROME

NELSON, M.J., BUCKLEY, J.D., THOMSON, R.L., BELLENGER, C.R., CLARK, D., DAVISON, K.

UNIVERSITY OF SOUTH AUSTRALIA

INTRODUCTION: There are no known objective biomarkers to assist with the diagnosis of Myalgic Encephalomyelitis/Chronic Fatigue Syndrome (ME/CFS). ME/CFS patients have been shown to exhibit an earlier onset of ventilatory threshold (VT) on the second of two progressive maximal exercise tests performed on consecutive days, which represents one of the only biomarkers of the condition. However, maximal exercise can cause significant post-exertional malaise and is therefore not an ideal method for differentiating between ME/CFS

patients and controls. Assessment of heart rate (HR) parameters which are known to track post-exertional fatigue may negate the need for maximal exercise testing to assist with ME/CFS diagnosis.
METHODS: 16 ME/CFS patients and 10 healthy controls underwent maximal exercise testing on two-consecutive days. HR parameters (including resting HR [RHR], HR variability [HRV], post-exertional HR recovery [HRR], and maximal rate of heart rate acceleration [rHRI]), ventilatory parameters, ratings of perceived exertion (RPE) and work rate (WR) were assessed on both days.
RESULTS: WR at VT decreased from day one to day two and by a greater magnitude in ME/CFS patients ($p<0.01$ group × time interaction). No interaction effects were found for any other parameters, including all HR parameters. ROC curve analysis of the percentage change in WR at VT revealed decreases of -6.3% to -9.8% maximised sensitivity and specificity respectively for distinguishing between those with ME/CFS and those without.
CONCLUSION: HR parameters are unchanged following maximal exercise in ME/CFS patients and are unlikely to be useful as diagnostic markers in this form. The decrease in WR at VT of 6.3-9.8% on the second day of consecutive-day maximal exercise tests may represent an objective biomarker of ME/CFS, and may assist with differential diagnosis between individuals who have ME/CFS and those who do not.

THE ASSOCIATION BETWEEN RUNNING ECONOMY AND RESPONSE OF C-REACTIVE PROTEIN TO MARATHON RUNNING IN COLLEGE RECREATIONAL RUNNERS

TAKAYAMA, F.1,2, AOYAGI, A.1, TAKAHASHI, K.1, NABEKURA, Y.1

1: UNIVERSITY OF TSUKUBA, 2: RESEARCH FELLOW OF JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE

INTRODUCTION: Running is a popular form of endurance exercise, with physical and psychological health-related benefits. However, strenuous running such as marathon running can disrupt numerous biomarkers. Among the biomarkers, C-reactive protein (CRP) is useful for assessing the extent of inflammation. Running economy, defined as the oxygen cost (O2 cost) for a given velocity of submaximal running, differs between individuals even when the maximal oxygen consumption (VO2max) is similar. Since runners generate energy based on the amount of oxygen consumed, O2 cost can estimate energy expenditure. Additionally, the CRP response is partially dependent on energy expenditure. This study aimed to investigate the association between running economy and the CRP response following marathon running.
METHODS: Sixteen college recreational runners (13 men, 3 women) who completed a marathon race within 4 hours 7 minutes 43 seconds±44 minutes 29 seconds (mean±standard deviation) were included. The VO2max and O2 cost were measured for all subjects 1-2 weeks before running the marathon using a treadmill running test. Before the race (PRE) and on days 1 (POST1), 2, and 3 after the race, blood samples were collected to assess inflammation.
RESULTS: The VO2max and O2 cost were 47.9-75.5 ml/kg/min (mean, 57.4) and 193.6–264.8 ml/kg/km (mean, 225.1), respectively. The CRP level significantly increased POST1 and remained high throughout the 3-day recovery period. Spearman correlation analysis revealed that the change in the CRP level (difference between PRE and POST1) was significantly correlated with the O2 cost ($r=0.619$, $p=0.011$), whereas it was not correlated with the VO2max ($r=-0.066$, $p=0.807$).
CONCLUSION: Our study revealed a positive correlation between the change in the CRP level and O2 cost, which suggested that inflammation in runners with excellent running economies (low O2 cost) was minor. Additionally, on assuming that the running economy was similar among runners during the race, the difference in energy expenditure was calculated to reach 37%. It is possible that differences in energy expenditure affected the extent of inflammation following the race. Kampus et al. (2008) reported that acute exercise-induced elevation of the CRP level may affect small artery elasticity, which is an important cardiovascular risk factor. Therefore, we recommend improving the running economy of runners to prevent excessive inflammation.
REFERENCE:
Kampus P. et al. (2008) Association between arterial elasticity, C-reactive protein and maximal oxygen consumption in well-trained cadets during three days extreme physical load: a pilot study. Physiol Meas., 29: 429-437.
CONTACT:
fuminori.takayama1990@gmail.com

AFFECTIVE AND SELF-EFFICACY RESPONSES TO ACUTE HIGH-INTENSITY INTERVAL TRAINING IN INSUFFICIENTLY ACTIVE YOUNGER AND MIDDLE-AGED MALE ADULTS

POON, E.T.C., SHERIDAN, S., CHUNG, A.P.W., WONG, S.H.S.

THE CHINESE UNIVERSITY OF HONG KONG

INTRODUCTION: High-intensity interval training (HIIT) has been recognized as an emerging trend in public health promotion (Thompson, 2017), but its age-specific differences in psycho-perceptual responses have yet to be investigated. The purpose of this study was to compare the psycho-perceptual responses after a single session of HIIT versus moderate-intensity continuous exercise (MICE) and vigorous-intensity continuous exercise (VICE) in young and middle-aged insufficiently active males respectively.
METHODS: Twelve young (age: 24.3 ± 1.7 yrs) and twelve middle-aged (age: 46.8 ± 7.5 yrs) healthy insufficiently active males were recruited. Using a within-subject, randomized cross-over design, participants undertook three main trials (with 7-day apart): HIIT (10 x 1-min run at 100% VO2max interspersed with 1-min active recovery), MICE (40-min run at 65% VO2max) and VICE (20-min run at 80% VO2max). Affective responses were assessed at 10 in-task time points for each trial, whereas self-efficacy and exercise preference were evaluated at the end of the final trial. These variables were analyzed separately for each age group (within-subject comparison). Two-way ANOVA with repeated measures (mode x time) was used to determine in-task affective response, while one-way ANOVA with repeated measures was used to compare self-efficacy and exercise preference.
RESULTS: In the young adult group, the in-task affective response scores were higher at 95% and 100% of exercise completed in HIIT than in MICE ($P < 0.05$), indicating a more positive affective response towards the end of exercise session. Middle-aged adults reported higher affective response scores in HIIT from 40% of exercise completed onwards than VICE ($P < 0.05$), suggesting a more positive affective response in HIIT than VICE. However, middle-aged adults displayed significantly lower exercise task self-efficacy scores towards HIIT (42.7 ± 25.3) and VICE (49.2 ± 23.9) than MICE (63.4 ± 18.3, both $P < 0.01$) based upon pairwise comparison. No significant difference in self-efficacy was observed in the young adult group. Additionally, only 17% of participants in the middle-aged group reported a preference to engage in HIIT as opposed to either MICE (50%) and VICE (33%). 33% of the young adults preferred HIIT, 67% preferred VICE, while none chose MICE as their preference.

CONCLUSION: Our findings revealed distinct affective and self-efficacy responses to acute HIIT versus both MICE and VICE in the two age groups which assists in our understanding of how individuals in various age populations perceive HIIT. This allows for both the design and implementation of effective exercise programs for public health, especially for insufficiently active individuals. Future research examining the long-term adherence to HIIT in different age populations is warranted.

CONSISTENCY OF ACUTE EXERCISE PERFORMANCE AND RESPONSE USING AN EFFORT-BASED INTENSITY PRESCRIPTION

OGRADY, C., HOPKER, J.H., PASSFIELD, L.

UNIVERSITY OF KENT

INTRODUCTION: Individual variability in training response is often seen in exercise training studies, indicating that the methods used to prescribe training (e.g. %VO2max), cannot elicit consistent responses between and within individuals (Mann, Lamberts, & Lambert, 2014). Effort-based training in which athletes are required to self-pace their effort provide an alternative method of prescription that may reduce the variability observed in acute training session stimulus. This study aimed to investigate the individual variability in the performance and acute physiological response of various training formats using an effort-based approach.
METHODS: 17 male competitive cyclists (VO2max: 59.44±8.17ml·kg·min-1) completed 9 exercise trials, using either short (S) or long (L) interval, or continuous (C) formats, each format repeated 3 times. Intensity prescription used a maximal session effort-based approach. The performance and physiological responses were analysed to identify the within-athlete (intra-individual) and between-athlete (inter-individual) variability using coefficient of variation (CV). Total variability is how much the within-athlete variability differs between all cyclists and is calculated as the CV across all cyclists for the intra-individual CV's.
RESULTS: Performance was different in the 3 formats (S; 382±54W, L 310±45W, C: 262±40W: P< 0.001), with no difference in heart rate (S: 164±9bpm, L: 163±9bpm, C: 164±10bpm). Average blood lactate during S & L was higher than C (9.49±2.71mmol & 9.07±2.1mmol vs. 6.26±1.97mmol, P<0.001). Average session RPE was highest in S & L compared to C (18±1 & 18±1 vs. 17±1, P < 0.001), final RPE was matched between all formats (S: 19±1, L: 19±1, C: 19±1). Intra-individual variability in session power output was highest in S (3.4%), and similar between L and C (2.8% & 2.6%). Inter-individual variability in session power was highest in C (15.3%), and similar between L and S (14.5% & 14.2%). Total variability of session power was lowest in L (54.6%), followed by C (69.0%), and S (87.5%). Intra-individual variability in expired gas responses was highest in S (5.8%), followed by C (5.3%) & L (4.9%). Inter-individual variability was highest in C (12.5%), and similar between S and L (10.5% & 11.0%). Total variability was highest in C (84.4%), followed by S (73.7%) and L (62.6%).
CONCLUSION: L interval format sessions display the greatest overall consistency in both performance & response compared to S and C sessions. Using long intervals (5min) and an effort-based intensity prescription elicits a more homogenous training stimulus compared to shorter intervals or continuous exercise. A more consistent training stimulus may translate into lower variability in observed adaptations to exercise training regimes.
REFERENCES:
Mann, T., Lamberts, R. P., & Lambert, M. I. (2014). High responders and low responders: Factors associated with individual variation in response to standardized training. Sports Medicine, 44, 1113–1124.
CONTACT:
[cmao3@kent.ac.uk]

ACUTE EXERCISE INHIBITS MITOCHONDRIAL L-CARNITINE SENSITIVITY IN AN INTENSITY-DEPENDENT MANNER: IMPLICATIONS FOR FUEL INTERACTIONS

PETRICK, H., HOLLOWAY, G.P.

UNIVERSITY OF GUELPH

INTRODUCTION: While exercise activates a number of metabolic processes, at higher power outputs a coordinated shift towards carbohydrate utilization occurs at the expense of fatty acid oxidation. The underlying mechanisms remain elusive, yet carnitine palmitoyl transferase-I (CPT-I) flux and creatine-independent phosphate shuttling are attractive control points subject to external regulation. We therefore examined if acute exercise altered 1) mitochondrial ADP and inorganic phosphate (Pi) sensitivity, or 2) the sensitivity of CPT-I to L-carnitine, in an intensity-dependent manner.
METHODS: We performed mitochondrial respiration experiments (Oroboros) in permeabilized muscle fibers of female C57Bl6 mice randomly assigned to remain sedentary (SED) or perform a single bout of low (LI, 15m/min, 5% grade, 90min) or high (HI, 20m/min, 15% grade, 30min) intensity treadmill running.
RESULTS: Acute exercise did not alter maximal respiratory capacity or Pi-supported kinetic properties. In contrast, the apparent ADP Km was increased following exercise, however this response was similar between LI (1093μM) and HI (1047μM) compared to SED (817μM, p<0.01), and therefore cannot contribute to the intensity-dependent shift in substrate utilization. We next examined CPT-I supported respiration, as reductions in intramuscular carnitine availability have been proposed to limit lipid oxidation at intense aerobic workloads. While L-carnitine sensitivity was comparable between SED (apparent Km=22.2μM) and LI (apparent Km=23.8μM), HI exercise attenuated this response almost 40% (apparent Km=36.2μM, p<0.03). Relating our kinetic models to known skeletal muscle metabolite concentrations predicts a 16% decline in CPT-I flux at higher power outputs, which is equally driven by reductions in L-carnitine content and sensitivity (~8% each). In support of this, we performed experiments utilizing substrate concentrations associated with each metabolic state, indicating lipid-supported respiration was 30% lower following HI (45pmol/sec/mg dry wt) compared to LI (65pmol/sec/mg dry wt, p<0.02). Moreover, only LI lead to improvements in L-carnitine sensitivity in the presence of malonyl CoA (lower apparent Km vs. SED), further indicating greater CPT-I mediated respiration at low but not high intensities of exercise.
CONCLUSION: These findings implicate CPT-I flux as a key event influencing metabolic interactions and aerobic energy production, as a decline in L-carnitine sensitivity, in addition to availability, with high intensity exercise could impair fatty acid oxidation.

Oral presentations

OP-PM79 Sports medicine and orthopedics mixed

HIP AND SPINE BONE MINERAL DENSITY ARE GREATER IN MASTER SPRINTERS, BUT NOT ENDURANCE RUNNERS COMPARED WITH CONTROLS

PIASECKI, J.1, MCPHEE, J.S.1, HANNAM, K.2, DEERE, K.C.2, ELHAKEEM, A.2, PIASECKI, M.4, DEGENS, H.1,3, TOBIAS, J.H.2, IRELAND, A.1

1MUSCULOSKELETAL PHYSIOLOGY RESEARCH GROUP, NTU, UK,2.SCHOOL OF HEALTHCARE SCIENCE, MMU, UK,3.MUSCULOSKELETAL RESEARCH UNIT, UOB, UK4.LSU, LITHUANIA, 5MRC-ARUK CENTRE FOR MUSCULOSKELETAL AGEING, UON,

INTRODUCTION: Regular running exercise may maintain skeletal health during ageing and there is burgeoning participation in masters athletics, particularly mass-participation endurance events. Whether endurance running offers any skeletal benefits remains unclear and it is also unknown whether clinically-relevant skeletal differences exist between sprint and endurance runners because most research in this area has examined peripheral bones of the limbs, not key clinical sites including the hip and spine which are susceptible to fracture.
METHODS: We recruited master sprint runners (28 men, 10 women, mean age 71±7y), master endurance runners (111 men, 38 women, mean age 70±6y) and non-athletic controls (29 men, 30 women, mean age 74±5y). Dual X-ray absorptiometry was used to assess hip and spine bone mineral density (BMD), lean mass and fat mass. Jump power was assessed with jumping mechanography. In athletes, vertical impacts were recorded over 7 days from a waist-worn accelerometer to determine whether skeletal benefits of sprint or endurance running were related to regularity or magnitude of impact loads. Details of starting age, age-graded performance and training hours were also recorded.
RESULTS: In fully-adjusted ANOVA models (adjusting for age, height, sex, fat mass, lean mass, absolute power), sprinter hip BMD was 10% and 14% greater than endurance runners and controls, respectively. Sprinter spine BMD was 88% greater than both endurance runners and controls (both $P < 0.05$). There were no differences in hip or spine BMD between endurance runners and controls. Whilst discipline (sprint/endurance), jump power, starting age, low and medium impacts were independent predictors of athlete hip and spine BMD, in stepwise regression, only sex and discipline were identified as predictors (both $P < 0.0005$).
CONCLUSION: Regular sprinting is associated with greater BMD at the fracture-prone hip and spine sites, but this was not the case for endurance runners whose BMD was similar to those of non-athletic controls. This suggests sprint training may reduce the age-related decline in BMD. These advantages in sprinters are partially explained by differences in vertical impacts, body composition and jump power compared with endurance master athletes. Further studies should investigate whether the advantages in hip and spine BMD in masters sprint, but not endurance runners, are explicable by differences in horizontal impacts, training history and/or nutritional status.

HIGH PLANTAR PRESSURE MAY POSITIVELY AFFECT BONE GEOMETRY AND STRENGTH IN MALE ADOLESCENT FOOTBALL PLAYERS

LOZANO-BERGES, G.1,2,3, MATUTE-LLORENTE, A.1,2,3,4, GÓMEZ-BRUTON, A.1,4,6, ESCAMILLA-GALINDO, V.2, ALFARO-SANTAFÉ, V.7, GONZÁLEZ-AGÜERO, A.1,2,3,4, VICENTE-RODRÍGUEZ, G.1,2,3,4, CASAJÚS, J.A.1,3,4,5

UNIVERSITY OF ZARAGOZA

INTRODUCTION: Bone microdamages caused by high-impact football loads increase bone remodeling activity (Schneider, 2011). However, the effect of these load intensities on bone geometry and strength has not been study yet. Thus, the aim of the present study was to compare bone geometry and strength parameters between adolescent football players with different plantar pressures monitored when performing specific-football drills.
METHODS: Forty male players (13.2 (0.5) y) from different Spanish football clubs participated in this study. Biofoot/IBV insoles were used to measure peak plantar pressures at non-dominant lateral foot, medial foot, forefoot, midfoot and rearfoot during a combination of some specific-football actions. A k-means cluster analysis was conducted to classify players into two different groups from pressures above-mentioned as follow: 15 football players with high pressures (HP; mean of all peak pressures 392.7 (68.2) kPa) and 25 with low pressures (LP; mean 261.0 (49.6) kPa). Bone geometry and strength were measured at the 38% site of the length of the non-dominant tibia by peripheral quantitative computed tomography (Stratec XCT-2000 L pQCT scanner). Multivariate analysis of covariance was performed to examine bone differences between football players with HP and LP, using weight and tibia length as covariates.
RESULTS: Football players with HP demonstrated higher total ($F(1, 35)=4.7$, $p=0.038$, partial eta squared=0.12) and cortical bone mineral content ($F(1, 35)=5.4$, $p=0.026$, partial eta squared=0.13) than those players with LP. Furthermore, total area ($F(1, 35)=1.2$, $p=0.284$, partial eta squared=0.03), total bone mineral density ($F1, 35=2.1$, $p=0.156$, partial eta squared =0.06), cortical thickness ($F(1, 35)=2.3$, $p=0135$, partial eta squared=0.06) and polar strength strain index ($F(1, 35)=2.7$, $p=0.109$, partial eta squared=0.07) were higher but not significantly different in football players with HP in comparison to those players with LP.
CONCLUSION: Developing high plantar pressures in some specific football actions might be associated with high bone geometry and structure parameters. On the other hand, the type of surface and footwear should be considered because of their influence with the impact received by the player (McGhie & Ettema, 2013).
REFERENCES:
McGhie D., Ettema, G. (2013). Am J Sports Med, 41(1), 177-185.
Schneider DL. (2011). The complete book of bone health. New York: Prometheus Books.
CONTACT:
glozano@unizar.es

FEAR AVOIDANCE BELIEFS AND MUSCLE STRENGTH EFFECT ON FUNCTIONAL OUTCOMES TWO MONTHS POST ARTHROSCOPIC SHOULDER INSTABILITY REPAIR

GOTTLIEB, U., SPRINGER, S.

ISRAELI DEFENSE FORCE, ARIEL UNIVERSITY

INTRODUCTION: Arthroscopic surgical repair of the shoulder is usually recommended when conservative treatment for shoulder instability (SI) fails. However, only less than half patients undergoing this procedure return to same level of activity. Psychological factors as well

muscle strength were shown to be associated with postoperative outcomes in musculoskeletal conditions. The purpose of this study was to determine the influence of fear-avoidance and shoulder muscles strength on functional status during the initial rehabilitation of people post arthroscopic repair of SI.
METHODS: Twenty-one soldiers (mean age 20.6±1.2 years) who underwent arthroscopic surgical repair due to SI participated in this study. Patients with known rotator cuff injury or prior injury in the contra-lateral shoulder were excluded. Baseline fear avoidance beliefs were assessed using the Fear Avoidance Belief Questionnaire (FABQ) up to two weeks post-surgery. Subjects received standard rehabilitation protocol. Follow-up examination at 7-8 weeks post-surgery and included the FABQ, functional assessment using the Disability of Arm, Shoulder and Hand questionnaire (DASH), and muscle strength. Internal rotation (IR) and external rotation (ER) maximal isometric strength were measured with the participants in a seated position, and the shoulder positioned at 45° abduction in the plane of the scapula. Muscle strength was calculated as the ratio between the operated and non-operated limb peak torque. Paired t-tests were used to compare between the FABQ and DASH scores at baseline and follow-up. Multiple linear regression analyses were conducted to investigate the effect of fear avoidance and muscles strength on functional status.
RESULTS: The level of fear avoidance decreased ($p<0.001$) and the functional status improved ($p<0.001$) at follow-up. Baseline FABQ score and IR strength on follow-up were significantly associated with follow up DASH score ($R^2=48.7\%$, $p=0.002$).
CONCLUSION: Post-surgical fear avoidance beliefs and IR strength may influence initial rehabilitation outcomes after a SI surgical repair. Although additional studies are needed to generalize these findings, practitioners should consider the current results during post-surgical repair of SI rehabilitation.

ROWERS WITH LOW BACK PAIN SHOW A DIFFERENT DISTRIBUTION OF ERECTOR SPINAE MUSCLE ACTIVITY DURING AN INCREMENTAL TEST TO VOLITIONAL EXHAUSTION

WILSON, F., MARTINEZ-VALDES, E., FLEMING, N., MCDONNELL, S.J., FALLA, D.

TRINITY COLLEGE DUBLIN

INTRODUCTION: Rowing is a highly repetitive activity involving cyclical flexion-extension and loading of the lumbar spine. Repetitive movements combined with high levels of muscle fatigue during training sessions and competitions; place the lumbar spine at a high risk of injury. Although rowing is one of the sports with the highest incidence of low back pain (LBP), there are a lack of studies investigating activation of the lumbar muscles and the potential change in activation with LBP. We aimed to assess the spatial distribution of erector spinae (ES) muscle activity in rowers with and without a history of low back pain during rowing, using high-density surface electromyography (HDEMG).
METHODS: Ten healthy rowers were the control group (CONT) (8 men, 2 women of 27 ± 18 yrs; 179 ± 8 cm; 77 ± 12 kg) and eight rowers with LBP history (5 men, 3 women of 32 ± 18 yrs; 179 ± 8 cm; 77 ± 8 kg) performed 7x4-min exercise bouts (rowing ergometer) until maximal exertion. Loads (W) were adjusted according to each athlete's best time in 2000m (loads increased at a rate of 15 to 45W p/bout according to performance level). HDEMG was recorded with two 13 x 5-electrode grids placed bilaterally over the lumbar ES while 2D sagittal-plane kinematics were acquired with an electrogoniometer (knee joint). HDEMG data was analyzed in three epochs according to the stroke phase (first epoch: full flexion to 66% of extension, second epoch: 66% of extension to 33% of extension and third epoch: 33% of flexion to full extension) for the first five exercise bouts. Root mean square (RMS) amplitude, mean spectral frequency (MF) and entropy of the HDEMG amplitude map were analyzed. In addition, the y-axis coordinate of the centroid of the RMS map (cranial-caudal direction) was used to assess changes in spatial distribution of ES activity.
RESULTS: As the rowing ergometer load increased, rowers with LBP history showed higher RMS amplitude for the ES bilaterally compared to the CONT ($p<0.01$). LBP rowers also showed less heterogeneity in ES activity as revealed by the entropy values, which did not decrease across the task as observed in the CONT group ($p<0.001$). In addition, rowers with LBP showed an opposite displacement of the centroid of the EMG amplitude map, with the LBP group showing a caudal shift of the centroid, while for the CONT group, a cranial shift was observed ($p<0.001$). No differences in MF were observed between groups ($p=0.5$).
CONCLUSION: Both the magnitude and distribution of ES activation differed in rowers with LBP compared to asymptomatic rowers. The more homogenous activation within the muscle combined with a caudal displacement of activity within the ES with progressive rowing in the rowers with pain, might suggest an inefficient pattern of ES activation as the load progressed (e.g. recruitment of a portion of the muscle with a shorter lever arm). Modification of the rowing technique in conjunction with feedback from HDEMG might prove useful in future studies.

DIFFERENCES IN VERTEBRAL COLUMN MORPHOLOGY BETWEEN BLUE AND WHITE COLLAR WORKERS USING A NON-INVASIVE METHOD

DVORÁK, M.1,2, CZIRÁKI, P.2, TÓTH, M.1

1.UNIVERSITY OF PHYSICAL EDUCATION; 2.ZÖLDPONT MEDIA AND SPORT ASSOCIATION FOR SPORT

INTRODUCTION: Sedentary behaviour during work time has a harmful effect on the health. Although a huge number of studies found a connection between daily sitting hours and cardio-metabolic status, obesity, metabolic syndrome, just some of them measured the influence on the musculoskeletal system, especially the spine. In this study we investigated the difference between the white collar workers and the blue collar workers in the same company.
METHODS: In this cross-sectional study the total of 188 white collar worker (male n=79, female n=109, age 43,6 ±10,8) and 46 blue collar worker (male n=38, female n=10, age 45,4±8,7) were measured with SpinalMouse® (Idiag, Volkerswill, Switzerland) noninvasive device. All participants were free of disease according to self-report. The device was used to measure the thoracic kyphosis angle, lumbar lordosis angle in neutral and flexion standing position, whilst thoracic - lumbar ratio (T/L) was calculated as an indicator of spine balance. The Matthiass test was used to assess changes in the measured angles upon loading (weight depends on sex and bodyweight) for 30 seconds. All tests were made by the same specialist.
RESULTS: Between the two groups of subjects, there were no significant differences in thoracic kyphosis and lumbar lordosis angles both in neutral and flexion standing position, and in Matthiass test. However, there were significant differences ($p<0,05$) in the T/L ratio in neutral standing position (white collar workers 1,98, blue collar workers 2,36), which was the opposite of the expected results.
CONCLUSION: Both the white and blue collar workers have spinal values below little more than the average, but except some results we did not find significant differences between them. Moreover, although we experienced the contrary results in T/L ratio (which means slightly decreased lumbar lordosis followed by poor sagittal balance), neither of the groups have pathological spine balance. The cause

might be that because of modernisation the blue collar workers spend most of their time in front of computers nowadays (like the office workers), just in 12 hours. Even more, the shift work has harmful effects for their health as well, according to other studies.
This study investigated the difference in vertebral curvature between blue collar and white collar workers, but found ambiguous results. For better understanding, we need further researches which contain not just sagital but frontal measurements with SpinalMouse® and use activity trackers for objective daily activity datas in both groups.

Oral presentations

OP-PM44 Cardiovascular diseases

A PROSPECTIVE COHORT STUDY TO ASSESS THE MECHANISM OF ACTION OF CLINICAL IMPROVEMENT WITH SUPERVISED EXERCISE IN PATIENTS WITH INTERMITTENT CLAUDICATTION (PREDICT STUDY)

HARWOOD, A.E., TOTTY, J., CARRADICE, D., WALLACE, T., SMITH, G.E., CHETTER, I.C.

HULL YORK MEDICAL SCHOOL

INTRODUCTION: Intermittent claudication (IC); ischaemic muscle pain precipitated by exertion, is the most common presenting symptom of peripheral arterial disease, affecting 20 % of the population over 70. IC is frequently associated with reductions in walking ability quality of life and physical activity levels. The USA, European and UK guidelines all recommend a supervised exercise programme (SEP) as first line treatment. Whilst there is evidence demonstrating walking improvements following a SEP, there is limited data on the mechanism behind this. Therefore this study aimed to explore the relationship between changes in clinical outcome and potential underlying candidate physiological mechanisms.
METHODS: A single centre prospective cohort study was undertaken at a vascular unit in England. Usual ethical approvals were granted. Following written informed consent patients were recruited for SEP, 3 times per week for 12 weeks. Measures recorded included; clinical indicators of lower limb ischemia, quality of life (QoL), cardiorespiratory fitness (CRF), flow mediated dilatation (FMD) and muscle strength and endurance (MSME). The primary endpoint the association between maximum walking distance (MWD) at 3 months, mechanism of action and patient characteristics. 100 patients were required to detect significance ($p>0.05$) at 90% power.
RESULTS: A total of 109 patients were recruited, with just 55 completing a full course of SEP. MWD and intermittent claudication distance was significantly improved at all time points. QoL was significantly improved at all time points in 7/9 and 4/5 domains of the SF36 and VascuQol respectively. Only VE/VCO2 was significantly improved with the SEP. All other markers of CRF did not demonstrate a significant improvement with exercise. FMD demonstrated at 50 % improvement but was not significant. MSME was significantly improved at all time points. Multivariate regression demonstrated CRF and QoL to be the most important factors for determining improvements in 12 week MWD.
CONCLUSION: SEPs are the recommended first line treatment for all patients diagnosed with IC and there have been several purported mechanisms of action in the literature that may lead to improvements following a programme. This study identified that cardiorespiratory fitness and muscle strength and endurance are the most likely candidates for improvements following exercise. Furthermore the anaerobic threshold appears to be the most significant predictive factor for 3 month MWD. Future studies should endeavour to prioritise these outcomes and address whether different exercise programme regimes have similar affects.

CARDIORESPIRATORY FITNESS AND HABITUAL PHYSICAL ACTIVITY IN ADULT RENAL TRANSPLANT RECIPIENTS

TRÁJER, E., TÓTH, SZ., PROTZNER, A., BOSNYÁK, E.1, SZMODIS, M., KOMKA, ZS., TÖRÖK, SZ., TÓTH, M.

UNIVERSITY OF PHYSICAL EDUCATION BUDAPEST

INTRODUCTION: Chronic renal failure is a progressive and irreversible syndrome. At the final stage of chronic kidney disease (end-stage renal disease, ESRD) a dialysis or renal transplant is necessary. Patients with ESRD have an altered psychological and physical status which results in decreased health-related quality of life. Being physically inactive leads to muscle atrophy and to the loss of absolute strength. Although a successful KTx improves quality of life, cardiovascular disorder is still the leading cause of mortality among kidney transplant recipients. Hypertension, diabetes mellitus, obesity and sedentary behavior are risk factors for cardiovascular disorders.
METHODS: 35 adult kidney transplant recipients (12 women, 23 men) participated in our study. Members of the Hungarian National Transplant Team (n=21 patients) represented the active kidney transplant recipient group. The control group consisted of 14 sedentary kidney transplant patients. After anthropometric measurements an incremental spiroergometric exercise test was performed on a cycle ergometer until exhaustion. Heart rate (HR) was monitored with a 12-lead electrocardiogram throughout the test. Capillary lactate concentration was taken at rest, test completion and 5 minutes after the test. Gas exchange parameters were measured during the exercise test using breath-by-breath analysis. The following maximal parameters were recorded: oxygen uptake (VO2peak), ventilation (VE), oxygen pulse (O2p) and load (P). The level of urea, serum creatinine (SeCr), estimated glomerular filtration rate (eGFR), hemoglobin and hematocrit were measured.Habitual physical activity was measured using an accelerometer-based assessment method on 7 consecutive days. The level of significance was set at $p \leq 0.05$.
RESULTS: There were no significant differences between the two study groups in body mass index, age, age of graft, hematocrit, hemoglobin, SeCr, eGFR and O2p. Hemoglobin, Urea ($p=0.010$), VO2peak ($p=0.009$), VE ($p=0.016$), P ($p=0.000$), LAC ($p=0.027$) and HR ($p=0.001$) showed significant differences between the two groups. There were also significant differences between the two groups in time spent in sedentary(SEDsum; $p=0.0094$), as well as moderate to vigorous physical activities intensity (MVPA) (MVPAsum; $p=0.0047$). Significant correlations were found in the study group between eGFR and VO2peak ($r=0.49$), VE ($r=0.51$), P ($r=0.54$), age ($r=-0.46$), graft age ($r=-0.44$), SeCr ($r=-0.87$), hemoglobin ($r=0.48$) and urea ($r=-0.68$). The relationship between LACmax and urea ($r=-0.48$), SeCr ($r=-0.41$) and eGFR ($r=0.48$) was also significant. Significant correlation was found in the control group between eGFR and VO2peak ($r=0.69$).
CONCLUSION: Habitual physical activity (for example organized sport programs, more time spent in MVPA and less sedentary behavior) improves cardiorespiratory capacity and physical performance among renal transplant recipients which is related to a better graft function and could increase metabolic capacity.

Oral presentations

OP-BN45 Cognitive training and performance

THE EFFECTS OF LOWER EXTREMITY VISUOMOTOR TRAINING ON COGNITIVE AND MOTOR PERFORMANCE – A RANDOMIZED CONTROLLED TRIAL

GIESCHE, F., ENGEROFF, T., NIEDERER, D., WILKE, J., SCHWARZ, S., VOGT, L., BANZER, W.

GOETHE-UNIVERSITY

INTRODUCTION: The ability to quickly and accurately adjust movement patterns in response to an external stimulus is a key demand for open skill sports performance (Scanlan et al. 2013) and effective injury prevention (Wilkerson et al. 2017). Although research focused mostly on physical abilities recent evidence suggests that cognitive and perceptual abilities might be considered as major discriminating factors for such open skill tasks (Scanlan et al. 2013). One approach to analyze and train these tasks are visuomotor choice reaction time (VMRT) paradigms (Wilkerson et al. 2017). Here, participants have to activate one out of multiple sensors in response to a visual sensory stimulus. This study analyses the impact of a self-administered VMRT training on cognitive processing of visual stimuli and motor performance.
METHODS: Twenty-two healthy, physically active individuals (24.7±2.4 years; 173±9 cm; 70.7±11.4 kg; 11 male) participated in a four-week randomized, controlled trial. Ten participants performed a lower extremity VMRT exercise (The QuickBoard, LCC, Memphis, United States of America); twelve participants served as controls. Training was performed in an upright standing position three times a week. Motor performance was assessed using drop jump, hexagon test, postural control, and lower extremity VMRT. The latter was also performed on the QuickBoard. Cognitive choice reaction (Cogstate Identification test) and inhibitory control (Stop-Signal task) were captured via validated computer-based neurocognitive testing in seated position.
RESULTS: Two-by-two ANCOVAs (time x group), with subjective attention as co-variate, revealed significant interaction effects for lower extremity choice reaction performance (from 13.6±.84 to 18.00 ± 1.63 hits per 10 seconds in the training group vs. from 14.00± 1.70 to 14.42± 1.24 in the control groupp; $p < .05$) as well as for change of direction speed (Hexagon; from 13.7± 1.6 s to 12.1 ± 1.4 s vs. from 12.1±1.42 s to 11.1± 1.6 seconds; $p < .05$). Cognitive processing tests and further motor performance measures revealed no interaction effects ($p > .05$).
CONCLUSION: The VMRT training affects the performance within comparable movement patterns with or without cognitive processing of visual stimuli. The improvements found in VMRT performance seem to be mediated by changes in task-related motor coordination skills (Paul et al. 2016) rather than changes in cognitive processing speed.

AN EEG INVESTIGATION OF THE NEURAL CORRELATES UNDERLYING THE PROCESSING OF KINEMATIC AND CONTEXTUAL INFORMATION ON ANTICIPATION IN CRICKET BATTING

SIMONET, M.

ST MARYS UNIVERSITY

INTRODUCTION: Anticipation refers to the ability to accurately predict the outcome of an opponent's actions ahead of the act itself. This ability is underpinned by the use of information from at least two broad sources, namely, the pick-up of low-level biological motion information from an opponent's movement kinematics (i.e., postural cues) and the use of high-level contextual information related to the event, such as game score or position of fielders. The neural correlates associated with the processing of these two information sources in expert athletes is yet to be investigated.
METHODS: The neural activity in 15 expert and 15 novice cricket batters when anticipating deliveries from bowlers in a video-based simulation task was recorded using electroenchephalography (EEG). Altogether, 120 videos clips were displayed across three conditions, including 24 clips where participants were only exposed to contextual information (game situation and field setting), 24 clips where only kinematic information was provided (bowler shown) and 72 clips with both information sources provided. Trials were occluded immediately after the ball release and anticipation accuracy measured by marking predicted ball location on scaled diagrams. Time-frequency analyses were used to assess any changes in electrocortical activity.
RESULTS: Initial results demonstrated that expert batters showed better anticipation accuracy across the three conditions. While there was no difference in anticipation accuracy between the kinematic and the contextual condition in the expert batters, the novices were better at anticipating in the kinematic condition compared to the contextual condition. Both groups were more accurate when both kinematic and contextual information sources were presented. The EEG data showed a decrease in the power of the alpha band (8-13 Hz) over sensorimotor areas in the kinematic condition, while in the contextual condition alpha synchronisation was observed over more frontal sites.
CONCLUSION: Anticipatory expertise in cricket batting relies on the ability to successfully process both kinematic and contextual information, as shown by the experts' skill advantage across the three conditions compared to novices, whose performance relies largely on processing kinematic cues only. EEG results suggest that bottom-up mechanisms are engaged when anticipatory decisions predominantly rely on kinematic cues, while contextual information processing appears to be supported by frontal regions involved in higher cognitive mechanisms. Findings have implications for those interested in identifying and enhancing the neural mechanisms involved in anticipation in sport.

THE EFFECT OF QUIET EYE AND HIGH ATTENTION TRAINING ON THE ACQUISITION, RETENTION AND TRANSFER OF A GOLF PUTT

WATTS, M., HAYES, S., BENNETT, S., CAUSER, J.

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: A longer Quiet Eye (QE) period, the final fixation before movement onset, has been associated with improved performance in various sporting tasks (Vickers, 1996). QE duration and performance have been found to be negatively affected by increased anxiety and attentional load, however, through QE training these effects may be negated (Vine & Wilson, 2011). Therefore, the aim of the current study was to examine whether QE training under single or dual-task conditions, compared to that of traditional technical training (TT), enhanced the acquisition, retention and transfer of a golf putt.

METHODS: A three-week training programme was designed with 36 novice participants being randomly assigned into one of three groups: Low Attention QE-trained (QELA), High Attention QE-trained (QEHA) or TT. 10 pre-test golf putts from 8ft were followed by 90 acquisition phase putts, 10 retention putts, 10 attention transfer test putts and 10 anxiety transfer test putts. Prior to the acquisition phases, both QE groups were shown an expert example of visual gaze during the same putt and were given instructions as to where to direct their gaze during their own putts. TT participants received the same video but with the gaze cursor removed and were given technical instructions of how to correctly swing their putter. The QEHA group was also required to perform a secondary, tone recognition task during all 90 of their acquisition phase putts. QE was measured using a Tobii Glasses 2 eye tracking system whilst mental effort and anxiety were recorded using the MRF-3 and RSME forms respectively.
RESULTS: Separate mixed-design ANOVAs were conducted on all dependent variables. All groups significantly reduced their performance error and increased their QE duration (QED) from pre-test to retention and both transfer tests ($p < .05$). Both QE trained groups performed significantly better than TT in both attention and anxiety transfer tests ($p < .05$), with QEHA performing significantly better than QELA in the attention test ($p < .05$). QED significantly reduced for the TT group in both attention and anxiety transfer tests ($p < .05$).
CONCLUSION: The results of the current study provide further support that QE training can help protect performance under increased pressure over that of TT (Vine & Wilson, 2011). Further, the study provides a valuable insight into the role of HA training in the acquisition, retention and performance under pressure of a golf putt. QE training, specifically under HA, can help to prevent significant decrements in performance under high attention and high anxiety situations.

THE EFFECT OF MINDFULNESS TRAINING ON COGNITIVE AND PHYSICAL PERFORMANCE IN ELITE YOUNG HANDBALL PLAYERS

STAIANO, W., NIELSEN MAJ, L., HOVGAARD-HANSEN, L., ROMAGNOLI, M., KIRK, U.

UNIVERSIDAD DE VALENCIA

INTRODUCTION: Mindfulness is the act of increasing present-moment awareness of physiological, mental, and environmental events without imposing judgment on the quality or meaning of them. The application of mindfulness-based intervention (MBI) to elite sport performance has recently become very popular as its practice increase decision-making, focus and attention in particular in fatigued states. The aim of this study was to test the efficacy of MBI in reducing fatigue and thus improving performance during a battery of generic cognitive and handball-specific physical tests in elite young handball players. The hypothese were that the combination of MBI and standard physical training (SPT) increases cognitive ability and handball-specific physical performance more than SPT alone.
METHODS: 24 young elite handball players from the same team were randomly assigned to two different groups: MBI and control. Both groups trained regularly during 6 weeks. However, the MBI group completed a mindfulness training program of 4 hours a week. Players were tested twice, at baseline and at completion of the training period. Cognitive performance was assessed with mind wandering test (SART) and 30-min STROOP test. Physical performance was assessed with the reactive agility test (RAT) and a handball specific agility test. Coefficient of mind wandering (CMW), reaction time (RT) and number of correct responses were measured for cognitive performance while 5 m sprint, decision-making time (DMT), time and hand mistake rate were parameters of physical performance. Data were analysed using mixed model ANOVAs.
RESULTS: Players in the MBI group showed a significant improvement in cognitive abilities compared to the control. CMW was significantly higher in the MBI group (pre 28.5; post 56.4) than in the control (pre 25.5; post 33.3). During the STROOP test the MBI group showed significant faster RT (pre 1026ms; post 749ms) compared to control (pre 1017ms; post 905ms); and a higher number of correct responses (MBI: pre 688; post 785 vs Control: pre 673; post 723). In the physical performance domain during the RAT, MBI group showed a significantly higher DMT (pre 1.78 sec; post 1.61 sec) compared to the control (pre 1.76 sec; post 1.74 sec) while time over 5 m sprint did not change significantly across groups. In the handball specific agility test the MBI group produced at post-test a significant lower rate of hand mistakes (pre 9; post 4) compared to the control (pre 8; post 7) and they completed the test in a faster time (pre 131 sec; post 121 sec) compared to the control (pre 129 sec; post 126 sec).
CONCLUSION: The results of this study provides evidence that the combination of MBI in addition to SPT improves both cognitive and physical abilities in elite young handball players. MBI seems to improve decision-making processes and reduce the negative effect of fatigue, both determinant factors for elite handball performance.

MECHANISMS UNDERLYING EXERCISE-INDUCED BENEFITS FOR INHIBITORY CONTROL IN ADOLESCENTS: CHANGES IN RETINAL VESSEL DIAMETERS AND THE ALLOCATION OF ATTENTIONAL RESOURCES

LUDYGA, S., HANSSEN, H., BRAND, S., PÜHSE, U., GERBER, M.

UNIVERSITY OF BASEL

INTRODUCTION: Accumulating evidence suggests that regular engagement in cognitively-challenging aerobic exercise elicits benefits for executive function (i.e. ability to use thought flexibly to guide action) in children and adolescents. However, less is known on the mechanisms that underlie exercise-induced improvements in this cognitive domain. Therefore present study investigated A) the effects of combined aerobic and coordinative training on the inhibitory aspect of executive function, and B) how changes in neurophysiological indices of inhibitory control and (retinal) microvasculature contribute to the observed effects.
METHODS: Using cluster-randomisation, 36 adolescents were allocated to an exercise and control group. The exercise group performed 20 min of aerobic and coordinative exercise during school-break time on 5 days per week over a period of 8 weeks. Before and after the intervention, the P300 component of event-related potentials elicited from a Stroop task was recorded using electroencephalography. Additionally, retinal photographs were taken to assess the central retinal arteriole equivalent (CRAE).
RESULTS: Based on analysis of variance, greater improvements of behavioural performance on the Stroop task were found in the exercise compared to the control group. Cluster-based permutation testing revealed similar effects for the P300 component. For CRAE, a trend towards a more pronounced increase in the exercise group was observed. Correlational analyses further showed that changes in P300 amplitude and CRAE were interrelated and both associated with improvements of behavioural performance over the intervention period.
CONCLUSION: The findings indicate that a combined aerobic and coordinative exercise program implemented during school-break time enhances adolescents inhibitory control. An increased allocation of attentional resources towards the cognitive task and favourable changes in retinal microvasculature provide some indications that the benefits for behavioural performance are due to improvements in both brain function and structure.

COMPARISON OF COGNITIVE PERFORMANCE AFTER AN ACUTE BOUT OF MODERATE INTENSITY BACKWARD AND FORWARD EXERCISE

GROBLER, L., TERBLANCHE, E.

UNIVERSITY OF STELLENBOSCH

INTRODUCTION: Literature suggests that acute bouts of cardiovascular exercise positively affects executive cognitive function (Chang et al., 2015), however, previous research is limited to forward modes of exercise. For most individuals, backward locomotion is a novel task, requiring greater inputs from the prefrontal cortex and skeletal muscles. However, little is known about the influence of backwards locomotion on executive function. Thus, the aim of this study was to compare the effect of an acute bout of forward (FW) and backward (BW) exercise on executive function.
METHODS: 17 trained participants (age: 19-24 years) volunteered for this cross-over design study. All participants were inexperienced in BW running. Participants performed three familiarisation sessions, where after 20 minute acute bouts of FW and BW running on a motorised treadmill was completed at a moderate intensity (65% of heart rate reserve) (Chang et al., 2015) and on separate days. 20-30 minutes post-exercise, participants completed a modified computer-based Stroop test. The reaction times of the simple (ST) and complex tasks (CT) of the Stroop were analysed. Interference scores (IS) were calculated by subtracting the reaction time of the simple from the complex tasks (Coetsee et al., 2017). T-tests and Cohen's d effect sizes were used to test for statistical significance.
RESULTS: There were no statistically significant differences in the cognitive performance of the participants for the ST (FW: 20.83 ± 2.85ms; BW: 20.83 ± 2.63ms), the CT (FW: 28.57 ± 5.89ms; BW: 26.70 ± 4.18ms), or the IS (FW: 7.74 ± 4.07ms; BW: 5.87 ± 2.85ms) of the Stroop task ($p > 0.05$). Cohen's d effect sizes for the three outcomes were 0.00 (ST), 0.37 (CT) and 0.53 (IS), indicating no to small practically faster reaction times during BW running than FW running.
CONCLUSION: To the authors knowledge this is the first study attempting to determine the influence of BW in comparison to FW exercise on cognitive function. It was expected that the novelty of BW exercise would induce faster reaction times in the Stroop test, however, results show that there are likely only negligible differences in the reaction times of trained individuals after a bout of FW and BW exercise. This may be attributed to the intensity at which the exercise was completed, as previous literature has shown higher intensity exercise to be more effective in the facilitation of neuronal efficiency (Wohlwend et al., 2017).
References: Chang Y.K. et al. (2015) Med Sci Sports Exerc 47(1):159-165
Coetsee, C. & Terblanche, E. (2017) Eur Rev Aging Phys Act 14(1):13
Wohlwend, M. et al. (2017) Front Psychol 8:406

Oral presentations

OP-SH10 Exercise effects on cognitive functioning and emotional responses

INFLUENCE OF ACUTE HIGH-INTENSITY INTERVAL TRAINING BOUT ON COGNITIVE PERFORMANCE

CASOLO, A.1, ANTONIETTI, A.2, GAGGIOLI, A.2, TOMIO, N.2, CAZZOLA, C.2, BRUSEGHINI, P.2,3, GALVANI, C.2

1 UNIVERSITA DEGLI STUDI DI ROMA

INTRODUCTION: High-intensity interval training (HIIT) appears to be a time-efficient and safe exercise, promoting improvements in aerobic fitness and in some cardiometabolic risk factors in both healthy subjects or clinical patients1. Acute bouts of exercise have an influence on cognitive function even if the exercise-cognition relation is complex, depending on the type, duration and intensity of exercise and the type of the cognitive task required2. The aim of this study was to analyze the influence of an acute bout of low volume-high intensity interval training (LV-HIIT) on visual-spatial ability.
METHODS: Thirty-six healthy active young women (age: 22.0±1.4 yr; BMI: 21.4±1.9 kg/m2; V'O2max: 40.5±3.8 mlO2/kg/min) engaged in (1) a LV-HIIT session, consisting of 3 repeated 20s Wingate against a resistance of 5.0% body mass interspersed by 2 min of active recovery3 followed by a cognitive training (LV-HIIT, N=18) or (2) a control session, consisting of a same time period of listening to music (CON, N=18). The day before and immediately after each experimental session, cognitive performance was assessed by the Paper Folding & Cutting Test (PFC)4 and Mental Rotation Test (MS, MRT)5,6.
RESULTS: A significant ($p<0.0001$) decrease in mean power output and a significant ($p<0.001$) rise in Borg Scale were found (mean power: Bout1 389±45 W, Bout2 373±52 W, Bout3 357±61 W; Borg Scale: Bout1 3±1 RPE, Bout2 4±2 RPE, Bout3 6±2 RPE), detecting an increased fatigue state in the LV-HIIT group. The time to complete the PFC test was significantly ($p<0.05$) lower (pre: LV-HIIT 456±129 s, CON 429±129 s; post: LV-HIIT 240±89 s, CON 226±77 s) and the number of errors significantly ($p<0.001$) decreased in the post test (pre: LV-HIIT 9±3 n, CON 9±3 n; post: LV-HIIT 13±2 n, CON 12±3 n) compared with pre test for both groups.
CONCLUSION: Our study demonstrated that a LV-HIIT session does not impair cognitive performance on visual-spatial ability in healthy active young women when mediated by cognitive training, confirming, in accordance with Alves7, that cycling could be associated with enhanced performance after exercise regardless exercise intensity.
REFERENCES:
1 Gibala MJ. (2012). J Physiol, 590(5):1077-84.
2 Lambourne K. (2010). Brain Res, 1341:12-24.
3 Gillen JB. (2014). Med Sci Sports Exerc, 46(5):S557.
4 Thorndike R. (1986) Chicago: Riverside.
5 Shepard RN. (1971). Science, 171(3972):701-3.
6 Vandenberg SG. (1978). Percept Mot Skills, 47(2):599-604.
7 Alves CR. (2014). Percept Mot Skills, 118(1):63-72.
CONTACT:
christel.galvani@unicatt.it

EFFECTS OF PHYSICAL ACTIVITY INTERVENTIONS ON COGNITIVE AND ACADEMIC PERFORMANCE IN CHILDREN AND ADOLESCENTS: A NOVEL COMBINATION OF A SYSTEMATIC REVIEW AND RECOMMENDATIONS FROM AN EXPERT PANEL.

SINGH, A., VAN DEN BERG, V., SALIASI, E., DE GROOT, R.H.M., JOLLES, J., CHINAPAW, M.J.

VU UNIVERSITY MEDICAL CENTER

INTRODUCTION: The physical and mental health benefits of PA are widely acknowledged, but less is known about the potential effects of PA on cognitive and academic performance. A number of reviews on this topic have been conducted during the last decade, mainly concluding that PA is positively associated with cognition and with structural and functional brain health and a neutral association with academic achievement for children. Not all of these reviews were systematic, took into account the methodological quality of the studies included, and were exclusively looking at intervention studies. Above all, most reviews summarized the existing evidence at study level. Therefore, the aim of this review was to summarize the current evidence on the effects of physical activity (PA) interventions on cognitive and academic performance in children, and formulate research priorities and recommendations.
METHODS: We performed a systematic review (following PRISMA guidelines) with a methodological quality assessment and an international expert panel. We based the evaluation of the consistency of the scientific evidence on the findings reported in studies rated as of high methodological quality.
RESULTS: Eleven (19%) of 58 included intervention studies received a high quality rating for methodological quality: four assessing effects of PA interventions on cognitive performance, six assessing effects on academic performance, and one on both. All high quality studies contrasted the effects of additional/adapted PA activities with regular curriculum activities. For cognitive performance ten of 21 (48%) constructs analysed showed significant beneficial intervention effects of PA, while for academic performance, 15 of 25 (60%) analyses of the high quality studies found a significant beneficial effect of PA. Across all five studies, assessing PA effects on math, beneficial effects were reported in six out of seven (86%) outcomes.
Experts put forward 46 research questions. The most pressing research priority cluster concerned the causality of the relationship between PA and cognitive/academic performance. The remaining clusters pertained to PA characteristics, moderators and mechanisms governing the 'PA – performance' relationship and miscellaneous topics.
CONCLUSION: There is currently inconclusive evidence for beneficial effects of PA interventions on cognitive and overall academic performance in children. We conclude that there is strong evidence for beneficial effects of PA on math performance.
The expert panel confirmed that more 'high quality' research is warranted. By prioritizing the most important research questions and formulating recommendations we aim to guide researchers in generating high quality evidence. Our recommendations focus on adequate control groups, adequate sample size, the use of valid and reliable measurement instruments for physical activity, cognitive and academic performance and analysis.

AN ACUTE BOUT OF HIGH-INTENSITY INTERVAL EXERCISE MAKES YOUNG MEN SMARTER

COETSEE, C., TERBLANCHE, E.

STELLENBOSCH UNIVERSITY

INTRODUCTION: From a health perspective, cognitive ability is an essential aspect in maintaining a high quality of life. Most studies report that acute aerobic exercise cause a small but significant improvement in cognitive function. While studies investigated the effects of traditional exercise modalities on cognitive function, less is known about the effect of high-intensity interval exercise (HIIE). The purpose of this study was to investigate the acute effect of HIIE on cognitive function in healthy young men.
METHODS: Twenty healthy young men (mean age 20.7 ± 1.6 years) were randomly assigned to a HIIE group (n = 10) or a control (CON) group (n = 10). The HIIE treadmill protocol consisted of ten 1-minute intervals at 90-95% HRmax interspersed with 1-minute active recovery intervals performed at 60-70% of HRmax, while the CON group did a stretching session. Two categories of the Stroop task were included to measure cognitive function, with the neutral category (simple task) assessing information processing speed and the incongruent category (complex task) assessing executive cognitive function.
RESULTS: There was a statistically significant improvement in reaction time on the incongruent category of the Stroop task following a single HIIE session ($P = 0.004$), but no change was observed for the neutral category ($P = 0.061$). The CON group showed a statistically significant improvement on the neutral category ($P = 0.044$), but no significant change was observed for the incongruent category ($P = 0.120$). Trial accuracy did not show any significant within-group difference for either Stroop task category ($P > 0.05$).
CONCLUSION: Some authors have previously suggested an inverted-U relationship for improvement in cognitive function following exercise (Kashihara et al, 2009). It was proposed that improvements may only be found up to an optimal point, and if intensities increase past this point it would result in detriments in cognitive performance. Alves et al. (2014) reported results to the contrary in middle-aged adults. The researchers found that an acute HIIE cycling session resulted in improvements in executive cognitive function. The results of the present study also show that an acute session of HIIE does not cause detrimental effects on cognitive performance and significantly improves executive cognitive function in healthy young men. Future studies are needed to shed light on this dose-response relationship between exercise intensity and cognitive performance in younger adults.
References:
ALVES, C.R.R., et al. (2014). Percept Mot Skills, 118(1): 63-72.
KASHIHARA, K., et al. (2009). J Physiol Anthropol, 28(4): 155-164.

EFFECTS OF ACUTE EXERCISE AND SELF-SELECTED MUSIC ON WORKING MEMORY IN YOUNG ADULTS

HUNG, T.

NATIONAL TAIWAN NORMAL UNIVERSITY

Effects of Acute Exercise and Self-Selected Music on Working Memory in Young Adults
Tsung-Min Hung1, Yu-Jung Tsai1, David Garrido Catalán1, & Chung-Ju Huang2
1. Department of Physical Education, National Taiwan Normal University, Taiwan
2. Graduate Institute of Sport Pedagogy, University of Taipei, Taiwan
Introduction: The study aimed to explore the effects of a single bout of moderate intensity exercise accompanied with self-selected music on affective states and cognitive performance. In particular, to provide evidence of positive affect and arousal moderation by self-selected

music after exercise; and offer behavioral and neuroelectrical information of verbal working memory performance due to exercise+music combination.
Methods: Thirty-seven healthy young adults (20-35 years old) participated in two exercise conditions and a video-watching control condition. Exercise conditions consisted of 5-min of warm-up, 25-min of jogging at moderate intensity (approximately 60% HR reserve) with and without music, and 5-min of cool down. Aural versions of Sternberg working memory test were administered after each condition.
Results: Positive affect and feeling states were significantly enhanced after exercise with self-selected music. Furthermore, shorter RT was observed for both exercise conditions compared to control condition. In addition, a shorter P3 latency and a smaller P3 amplitude at frontal region was showed for exercise + music compared to control condition.
Discussion: A single bout of aerobic exercise of jogging with/without music at moderated intensity resulted in improved working memory performance. However, only exercise + music further showed improvement at the neural level and offered an appreciable improvement on emotional wellness. Interestingly, exercise+music could induce more efficient information processing as reflected by shorter P3 latency while at the same time required less resources indicated by smaller P3 amplitude at frontal region. P3a is thought to reflect the engagement of the frontal lobe and other cortical areas such as the auditory cortex in a conscious evaluative process elicited by a novel and unpredictable "bottom-up" stimuli (Polich, 2007). This finding is similar to perceptual priming that resulted in more efficient and faster response to a stimulus and decreased hemodynamic responses in prefrontal cortex (Bunzeck et al., 2006). In conclusion, self-selected music combined exercise not only provides cognitive benefits but also brought about more pleasant exercise experience that may have implications for increasing exercise adherence.
Contact: ernesthungkimo@yahoo.com.tw

EFFECTS OF MUSIC ON AUTONOMIC CONTROL AND EMOTIONAL RESPONSE DURING EXERCISE

HSIAO, C.S., CHU, I.H.

KAOHSIUNG MEDICAL UNIVERSITY

INTRODUCTION: Many people listen to music during exercise. In previous studies, music has been shown to increase running performance and enhance positive emotion . Moreover, several studies indicated that listening to music could affect autonomic control . Previous research reported that there is an association between the autonomic control and emotional response, and that the better the autonomic control, the better the emotional response regulation . However, studies that investigated the effects of music on autonomic control and emotional response during exercise are scarce.The aim of the study was to investigate the effects of music on autonomic control and emotional response during exercise.
METHODS: Ten participants were recruited for the study. All of the participants completed one exercise test and two experimental conditions which included running with music and running without music in a randomly assigned order. In both experimental conditions, participants were running at an intensity of 70% heart rate reserve. Felt Arousal Scale and Feeling Scale were used to evaluate emotional response during running. Heart rate variability was measured before and after running to assess the effects of music on autonomic control.
RESULTS: HRV decreased significantly after both running with music and without music conditions. There was no significant difference between the two conditions in HRV changes. The FS scores of the running with music condition were significantly higher at 6 min, 9 min, 12 min, and 15 min as compared to the running without music condition. The FAS scores of the running with music condition were significantly lower at 12 min and 15 min as compared to the running without music condition.
CONCLUSION: The preliminary results of this study suggest that listening to music during exercise may have positive impact on emotional responses. The negative emotions appeared to be attenuated while running at high intensity. On the other hand, listening to music did not seem to affect HRV responses after running. Also, this study did not find any associations between the autonomic control and emotional response. Future studies with larger sample sizes are needed to further investigate the effects of music on autonomic control and emotional response during exercise.

INVESTIGATION OF THE EFFECT OF PHYSICAL ACTIVITY ON SECONDARY SCHOOL STUDENTS METACOGNITIVE LEARNING STRATEGIES AND CREATIVITY LEVELS

TEKIN, M.1, SAVAS, M.S.2

1 KARAMANOGLU MEHMETBEY UNIVERSITY SCHOOL OF PHYSICAL EDUCATION AND SPORTS, 2 AKSARAY UNIVERSITY SOCIAL SCIENCES INSTITUTE PHYSICAL EDUCATION AND SPORTS DEPARTMENT

Introduction: Creative thinking skills of the individual play an active role in the development of the individual.The development of motor skills is important for the development of this effective role.Effective use of both creativity and imaginative learning skills will dynamically interact with motor skills to enable the individual to use learning processes more effectively and to think independently in the educational environment by revealing new ideas.The purpose of this studyis to investigate the effect of physical activity on secondary school students metacognitive learning strategies and creativity levels.
Method
The research group was made of 5th,6th,7th,8th 44 boy,28girls,72(age=11.2917+1.08040) in total studying secondary school located in the Karaman province to achieve the purpose of the research,Creativity Scale developed by Torrance(1966) adapted to Turkish by Aslan (2001) and Metacognitive Learning Strategies Determining Scale By Cögenli and Güven(2014)were based on and applied to the students that participated in the research.15 weeks of instruction in physical education and sports courses including of physical activity and In the study, an experimental research design with pre-test/post-test and control group was used.
In the analysis and assessment of the data, Shapiror Wilk Test, Paried Samples t-Test, and Pearson correlation test,Two-WayAnova for MixedMeasures Test was used and significance was taken as $P<0.05$
Results: Within this study;there was a significant difference between the results of the experimental and control groups;and there was significant difference between post-test results of the experimental and control groups.
Also,According to research results;there was a significant difference between total scores mean for fluency,originality, abstractness of titles, enrichment,resistance to early close, creativity forces list of in favor of post test, in primary students that participated Experimental study
When the obtained results were examined for the lower dimensions of TTCT Verbal Form B there was a significant difference between total scores mean for fluency,flexibility and originality, scores of in favor of post test
Discussion: As a result of this study; reveals that the physical activity applied to secondary school students positively influences the level of students imaginative learning strategies and creativity.

These findings us;The most important purpose of physical activity is; not only to improve the attitudes and skills of individuals,same time, demonstrates that the cognitive, social and affective levels of individuals are improved
References: Aslan, E. (2001).Turkish Version of Torrance Creative Thinking Test,Marmara University Atatürk Education Faculty Education Sciences Journal,14,19-40
Cögenli And Güven (2014)Validity And Reliability Of Metacognitive Learning Strategies Determining Scale,Dicle University Ziya Gökalp Education Faculty Journal,22(2014)283-297
Contact: 1 murattekin76@gmail.com

Oral presentations

OP-SH19 Psychological aspects of sport and exercise; history

A QUALITATIVE APPROACH ON MOTIVES AND ASPECTS OF RISKS IN HIGH-RISK SPORTS

FRÜHAUF, A., KOPP, M.
UNIVERSITY OF INNSBRUCK

A qualitative approach on motives and aspects of risks in high-risk sports
Frühauf,A.1; Kopp,M.1
1: University of Innsbruck, Austria
Introduction: Largely seen through the one-dimensional view of sensation seeking, recent research has shown that there are multiple motives for high-risk sport participation [1]. However, most of the research was based on a questionnaire approach or on qualitative analyses including only few high-risk sport participants [1, 2]. This may have biased reported motives of high-risk sports. Therefore, the aim of the present study was to better understand the motives, benefits and risk-related aspects of specific high-risk sport participants, using a qualitative approach in a large sample.
Methods: Semi-structured interviews were conducted with several high-risk sport participants 50> including freeride skiers and snowboarders, wingsuit flyers, big wave surfers and alpinists. All participants were highly experienced, of different age, gender and profession. Analyses were done using MAXQDA software following a code theme approach.
Results: Themes were separated according to sport participation type. The majority of participants were freeriders with the five emerging themes of Challenge , Friends , Nature , Balance and Freedom . Those motives were shown upon different extent in the disciplines of wingsuit flying, big wave surfing and alpinism. With regard to risk management, participants decided upon a risk calculation strategy which included multiple factors . Trusting in one's own abilities, avoiding negative fear and having trusted partners were among the protective factors. Changes in behavior were reported to occur after experienced accidents and close calls. Relations to risky health behaviors such as gambling and fast driving were not detected in the cohort since most participants only reported to take risks when they were in charge of the outcome. Deliberately seeking out dangerous situations was not a motive.
Discussion: High-risk sports were shown to provide positive effects through participation especially in terms of self-efficacy and well-being. The major motivational drivers for participants were named as: challenging oneself, experiencing nature, contributing to deep friendships, practicing the high-risk sport as a counterbalance to everyday life and escaping from restrictions. Contrary to prior research reports on sensation seeking, experienced high-risk sport participants do not search the risk; they seem to minimize it based on knowledge and experience.
References: 1. Barlow M, Woodman T, Hardy L <2013> Great expectations: different high-risk activities satisfy different motives. J Pers Soc Psychol 105<3>: 458–475.
2. Willig C <2008> A phenomenological investigation of the experience of taking part in extreme sports. J Health Psychol 13<5>: 690–702.
Contact: anika.fruehauf@uibk.ac.at

INJURIES IN PROFESSIONAL SOCCER AND IMPLICIT PERSONALITY TRAITS

SPRECKELS, C., WOLLESEN, B.
UNIVERSITY OF HAMBURG

Injuries in professional soccer and implicit personality traits
Spreckels, C.[1] & Wollesen, B. [1]
[1] UHH (Hamburg, Germany)
Introduction: Investigation showed that 5% - 10% (Kleinert 2012) of all injuries in sports are caused by psychological reasons. Due to a higher level of stress a higher level of muscle tension could be responsible for a lot more injuries in soccer. Lazarus (1974) showed that perceiving a situation as stressful is an individual process, what underlines that multiple psychosocial factors could interact with the increase of injury vulnerability. Ivarsson, Johnson and Podlog (2013) investigated personality traits of soccer players like trait anxiety or perfection and state stress-level are predictors for injuries. Podlog (2017) found out that in addition to the higher muscle tension which could cause especially muscle injuries there is another responsible factor: The stress conditioned wrong decision which a player might take when he finds himself in a stressful situation. If and how this process is caused by individual unconscious personality traits is the object of this investigation.
Methods: N= 250 professional soccer players, age: 24,5 ± 7 years. Medical informations of 58 players include absence of training and competition. Due to the investigation that implicit personality traits like fear of failure are responsible for experiencing situation as stressful we used the implicit personality trait test visual questionnaire (ViQ) which is developed in support of the personality system interaction theory (PSI) of Kuhl (2001). He postulates the 4 main characters worker, teamplayer, creative and dominant combined with the 4 motivational factors, which sums up to 16 different types. The medical informations of the 58 soccer players were correlated in a crosstab calculation (SPSS 23) with personality traits.
Results: Results show that the 2 certain types out of 16, who theoretically feel more competitive stress than the 14 others, are more often absent from training and competition because of injuries. It is the teamplayer, who needs good relationships and appreciation with a high need for security which is accompanied by a prevalent negative affect system. These results show that there is a correlation (,618; p=0,05) between implicit personality traits and injury vulnerability.

Conclusions
To know the vulnerability of certain personality types in advance should be a good argument to put athletes in general but especially these 2 personality types in a proactive mental training program including adaptive coping techniques like accepting defeats or positive reframing to minimize their stress level.
References: Ivarsson A, Johnson U, & Podlog L (2013). Psychological predictors of injury occurrence: a prospective investigation of professional Swedish soccer players. Journal of sport rehabilitation, 22 (1), 19-26 PMID: 23404909
Kuhl, J (2001): Motivation und Persönlichkeit. Göttingen: Hogrefe
Contact: christian.spreckels-2@uni-hamburg

SPORT SUPPLEMENT USE PREDICTS DOPING LIKELIHOOD VIA SPORT SUPPLEMENT BELIEFS

HURST, P., BOARDLEY, I., KAVUSSANU, M., RING, C.
UNIVERSITY OF BIRMINGHAM

Introduction: The gateway hypothesis posits that athletes are at risk of progressing to doping if sport supplements are already used for performance enhancement. Recent research has indicated that athletes with stronger beliefs in the effectiveness of sport supplements in improving performance are more likely to use sport supplements (1). Hypothetically, therefore, if athletes' beliefs about sports supplements influence supplement use, and if supplement use predicts doping (i.e. the gateway hypothesis), it is reasonable to suggest a relationship between beliefs about supplements and doping likelihood. However, this relationship remains untested. This study aimed to test the mediating role of sport supplement beliefs on the relationship between sport supplement use and doping likelihood.
Method
Four hundred and eighty one competitive athletes (mean ± SD: age = 19.6 ± 2.2 yrs, hour per week training = 6.3 ± 4.5, years competing = 5.9 ± 4.6) were recruited from sports clubs and asked to complete measures of sport supplement use, sport supplement beliefs and doping likelihood.
Results: Sport supplement use was associated with sport supplement beliefs ($r = 0.46$, $p < 0.01$) and doping likelihood ($r = 0.14$, $p < 0.01$), and sport supplement beliefs were correlated with doping likelihood ($r = 0.22$, $p < 0.01$). Mediation analysis indicated that sport supplement beliefs significantly mediated the relationship between sport supplement use and doping likelihood ($\beta = 0.20$, 95% CI = 0.10 to 0.30), whereas sport supplement use was not directly related to doping likelihood ($\beta = 0.04$, 95% CI = -0.05 to 0.15).
Conclusion
The results of this study indicate sport supplement use predicts doping likelihood via sport supplement beliefs. These findings provide novel evidence to suggest that athletes using sport supplements are more likely to dope due to their belief in the effectiveness of these substances and could help further explain why athletes using sport supplements are more likely to progress to doping (i.e. gateway hypothesis).
1. Hurst, P., et al., Development and validation of the Sports Supplements Beliefs Scale Perform Enhanc Health, 2017.

PHYSICAL ACTIVITY-RELATED HEALTH COMPETENCE: USING THE PARC-AVE STUDY FOR AN EXTENDED MODEL VALIDATION

CARL, J., SEMRAU, J., PFEIFER, K.
DEPARTMENT OF SPORT SCIENCE AND SPORT

Introduction: Recently, the concept of physical activity-related health competence (PArC) has been introduced to the field of health-enhancing physical activity. In addition to considerable elaborations on a theoretical level, it is further necessary to validate PArC in a holistic manner. Therefore, the goal of the present study was to extend existing validations of the PArC model.
Methods: Data was taken from the baseline assessment of the PArC-AVE study that centered on the PA behavior of apprentices from the nursing care and car mechatronics sector (n=745, age: 19.1±3.4 years). Confirmatory factor analyses (CFA) were undertaken to re-check the factorial structure of an existing three-factor model and to examine the factorial structure of an extended nine-factor model (38 Items). Subsequently, the model was expanded to a structural equation model to analyze associations with the physical activity behavior.
Results: The CFA indicated a good overall fit for the three-factor model as well as for the extended nine-factor model ($\chi^2/df=2.60$, RMSEA=0.046, SRMR=0.042). Even a model including the second-order factors movement competence, control competence, and self-regulation competence revealed an acceptable fit ($\chi^2/df=2.90$, RMSEA=0.051, SRMR=0.066). However, compared with initial validations, the competence facets in this study explained a surprisingly low variance ($R^2=0.131$) in the amount of physical activity.
Discussion: Within the present study, it was possible to work out and validate a nine-factor model on PArC in which the facets could be assigned to three overarching competence domains. A further study is necessary to cross-validate the extended model and to put more focus on associations with physical activity.
The study was funded by the German Federal Ministry for Education and Research (BMBF)
Keywords: Physical activity-related health competence, model validation, health-enhancing physical activity, physical activity behaviour

ADOLESCENT'S PHYSICAL ACTIVITY AND SLEEP DURATION: ASSOCIATION WITH PARENTAL ROLE MODELING INFLUENCE AND PARENTING STYLE

SHI, Y., YU, J.J., HUANG, W.Y., WONG, S.H.S.
THE CHINESE UNIVERSITY OF HONG KONG

Background: Research has shown that parental role modeling has important influences on physical activity and sleep duration of young children, but this relationship is unclear among adolescents. Meanwhile, no study investigated the influence of parenting styles on the physical activity and sleep duration of adolescents. This study therefore examined the association of adolescent's physical activity and sleep duration with parental role modeling and parenting style.
Methods: One thousand and thirty-nine adolescents and parents from Hong Kong participated in this study. Adolescents wore the waterproof activPALTM for 7 consecutive days, time (minutes) spent in moderate-to-vigorous intensity physical activity (MVPA) and sleep duration (hours) of the adolescents were calculated. Physical activity (light intensity physical activity (LPA), MVPA) of parents and sleep duration were collected using self-reported questionnaires. Parenting style were measured by adolescent reported Parenting Styles and Dimensions Questionnaire (PSDQ). Linear mixed models (LMM) were conducted to assess the relationship between parents' role model-

ing of LPA and MVPA, parenting style and the MVPA of adolescents (girls or boys). Association between parents' role modeling of sleep duration, parenting style and the sleep duration of adolescents were also investigated by LMM. Analyses were split by girls and boys.
Results: Of all the participants, data from 656 pairs of adolescents and their parents (adolescents: 14.6 ± 1.6 years, 48% of girls; parents: 46.0 ± 7.1 years, 60% of mothers) were available and valid for analyses. Adolescents had 39.5 ± 15.6 mins/day of MVPA and 8.0 ± 0.9 hours/day of sleep duration, with no gender difference. Parents had 87.3 ± 121.4 mins/day of LPA, 56.8 ± 126.5 mins/day of MVPA, and 7.4 ± 1.2 hours/day of sleep. Mothers slept longer than fathers (7.5 ± 1.1 vs 7.2 ± 1.2 hours/day). Fathers parenting boys more authoritative than girls (26.0 ± 12.2 vs 23.3 ± 11.7). Results showed that there was no significant relationship between adolescents' physical activity and parental role modeling. Authoritative parenting style from father was inversely associated with MVPA of sons (-0.49, 95% CI = -0.95 to -0.03 mins/day). Sleep duration of mother was associated with sleep duration of daughters (0.20, 95% CI = 0.02 to 0.36 hours/day), with a similar association between father and sons (0.16, 95% CI = 0.01 to 0.32 hours/day).
Conclusions: Parental role modeling has influence between mother-daughter pairs and father-son pairs for sleep duration. Adolescent boys are less physically active when their fathers had a more authoritative parenting style. Further studies could investigate more mechanics of parenting style influence on physical activity of adolescents.

AESTHETICS OF AFRICAN DIASPORA: RELATIONS BETWEEN THE FLOURISHES OF CAPOEIRA (BRAZIL) AND THE ACROBATIC PANTHER DANCE (IVORY COAST)

PASQUA, L., TOLEDO, E.

UNICAMP

Introduction: The African Diaspora resulting from the slave trade allowed the cultures of different regions of Africa to cross the Atlantic and reach new spaces, transforming these territories into a melting pot of corporal practices that have been re-signified (Deschil Obi, 2008; Costa e Silva, 2011). This research aims to establish relations between capoeira (Brazil) and the acrobatic panther dance (Ivory Coast).
Methods: This is a documentary analysis whose research source is the video The Panther Dance, part of the documentary The bridge of spirits produced by New Atlantis Wild, in order to identify elements related to Capoeira in general, arranged in books and articles of the area. The categories of analysis were: characterization of cultural manifestation, musicality and body elements.
Results: As for the characterization of cultural manifestation, panther dance is part of the Senufo culture in Ivory Coast which a demonstration dispute takes place, in which different clans demonstrates their abilities, performed in a circle form with male individuals , dressed as panther clothes. In Capoeira the contest takes place in the form of a struggle, in which two people establishes a corporal dialogue with another, performed in a circle form, with individuals of both sexes, dressed in clothes from their capoeira group. The musicality is present in both, with similar instruments, in the acrobatic dance there is an instrument similar to berimbau. As for the body elements, acrobatic dance presents acrobatics and dances while capoeira strokes, rotateds strokes, defenses, unbalanced movements, and may or may not appear acrobatic elements, the well-known flourishes (Pasqua, 2011). We highlight that we found similar acrobatic elements between panther dance and capoeira, namely in portuguese: bananeira, parada de cabeça, aú de frente, pulo do gato, giro de cabeça, mortal e mola.
Conclusions
In conclusion the panther dance presents different dynamics from Capoeira, but there are similar elements, such as the fact that it happens in a circle form, followed by instruments and singing and acrobatic body elements that resemble the flourishing. In panther dance, the flourishing presents a character of challenge and demonstration, while in capoeira the flourishing takes on importance depending on the goal of the game, from challenge, demonstration, to ambush and theatricality.
References: Costa e Silva, A. (2011). Um rio chamado Atlântico: A África no Brasil e o Brasil na África. Rio de Janeiro (Brasil), Nova Fronteira.
Desch Obi, T. J. (2008).Fighting for honor: the history of african martial art traditions in the atlantic world. Columbia: University of South Carolina
New Atlantis Wild. The Panther Dance. (2013, Junho 20). Recovered from https://www.youtube.com/watch?v=2OAD5LJj2Jo
Pasqua, L. (2011). O floreio na Capoeira. Dissertação de Mestrado. Faculdade de Educação Física – Universidade Estadual de Campinas. Campinas, SP.
Contact: liviapasqua@yahoo.com.br

15:45 - 17:15

Invited symposia

IS-PM07 The application of novel exercise interventions to maximise benefit in health and disease

THE UTILITY OF TRANSCUTANEOUS NEUROMUSCULAR ELECTRICAL STIMULATION IN COPD

MADDOCKS, M.

KINGS COLLEGE LONDON

Impaired skeletal muscle function is a common feature of COPD, particularly in the lower limbs, and contributes to increased morbidity and mortality. There is substantive evidence demonstrating the benefit of resistance exercise (RE) training in COPD and it is currently recommended RE training should be incorporated into rehabilitation programmes for this group. However, not all patients with COPD are able to perform conventional voluntary RE training of sufficient intensity to bring about meaningful gains in muscle function. This may be due to limiting symptoms, advanced deconditioning, acute exacerbations and/or hospitalisation.
Transcutaneous neuromuscular electrical stimulation (NMES) provides a non-volitional means of evoking muscle contraction that places minimal demand on the cardiorespiratory system and does not induce a significant ventilatory response. NMES may therefore be an effective strategy for targeting skeletal muscle function in instances where voluntary RE training cannot be tolerated. Increasing evidence from clinical trials supports this application of NMES. Gains in muscle strength are consistently shown, and in groups where impaired muscle function limits whole body exercise, changes in the peripheral muscle are associated with improved exercise capacity.

THE APPLICATION OF HIGH-INTENSITY INTERVAL TRAINING (HIIT) PREHABILITATION TO MAXIMISE POST-SURGICAL RECOVERY

PHILLIPS, B.

UNIVERSITY OF NOTTINGHAM

There are over 3.5 million new cancer cases in Europe each year, with prostate and colorectal cancers the second and third most common cancers, respectively. Indeed, when combined with breast and lung cancer, these four cancers represent over half the overall burden of cancer in Europe1. As we experience demographic ageing across Europe, one clinical implication of this is that more older individuals are presenting for surgical treatment of cancer. Cardiorespiratory fitness and muscle mass both decline with advancing age, each independently increasing the morbidity and mortality associated with surgery2,3, subsequently delaying or preventing return to normal activities4. Therefore, interventions that are able to improve cardiorespiratory fitness and muscle mass in older cancer patients before surgery hold much therapeutic potential. In the UK, cancer guidelines impose a 31-day target time to operation from decision-to-treat5 and as such, any pre-surgical interventions must be applicable within this time-frame. We have previously shown that a time-efficient high-intensity interval training (HIIT) programme, can be used to improve the cardiorespiratory fitness of older individuals age-matched to those most commonly presenting for colorectal cancer surgery, within 31-days6, with this HIIT protocol also eliciting increases in lean leg mass. This HIIT protocol was deemed acceptable and enjoyable by healthy older adults, with the time-efficiency of this protocol (15-minutes per session), addressing one of the most commonly cited barriers to exercise. This same HIIT protocol was not however able to improve the cardiorespiratory fitness of colorectal cancer patients prior to surgery, despite a trend for increased lean leg mass and improved exercise performance. Conversely, the cardiorespiratory fitness of urological cancer patients was improved by this same exercise regime with concomitant increases in lean leg mass and the expected increase in exercise performance. Although not yet fully elucidated, proposed mechanisms for this heterogeneity of exercise adaptation between cancer types include variations in systemic disease burden and the degree of anabolic resistance7. Further research is required to explore these mechanisms fully and to optimise prehabilitation for different cancer types.

1Ferlay et al., European J Cancer, 2013.
2West et al., British J Surgery, 2014.
3van Vugt., PLoS One, 2017.
4NCIN.org.uk (2018)
5Bhalla et al., Techniques in Coloproctology, 2014.
6Boereboom et al., Techniques in Coloproctology, 2016.
7Williams JP et al., American J Clinical Nutrition, 2012.

ECCENTRIC EXERCISE IN MAXIMIZING PATIENT REHABILITATION

HOPPELER, H.

UNIVERSITY OF BERN

In concentric contractions muscle activation produces torque that is greater than the resistance encountered. This leads to muscle shortening and positive work is done. In eccentric contractions, the load applied to the muscle is larger than the torque that it produces. As a consequence, the activated muscle undergoes lengthening and negative work is done. Physiological properties differ between concentric and eccentric contractions. The torque that is produced by muscle tissue in eccentric muscle contractions is several times higher than that during concentric contractions. Muscle tissue can thus be subjected to higher stress during eccentric than during concentric contractions. Acute high-load eccentric contractions can lead to severe muscle and tendon damage. Repeated low-load eccentric contractions are responsible for delayed onset muscle soreness (DOMS). Eccentric contractions are more difficult to control as integrated EMG levels of eccentric contractions are only half those of same load concentric contractions. The metabolic energy required to fuel negative work is typically four fold lower than that required to produce the same amount of positive work. This makes moderate load eccentric exercise an excellent choice for the rehabilitation of patients with limited aerobic performance capacities. In these patients muscle tissue can be subjected to high mechanical loads that could not be achieved with concentric exercise due to metabolic constraints. For similar reasons we have used eccentric exercise in elderly patients with the aim of preventing sarcopenia. Eccentric exercise training is best performed on specifically designed eccentric ergometers which allow for controlled application of negative work. Eccentric exercise programs best start at very low loads such as 50-70 Watts and for short, 5 minute, periods. Loads are increased gradually. We aim for a total of 20 minutes of eccentric training divided into four blocks of 5 minutes with 2 minutes pause. Depending on the training goal, target loads of 250 to 350 Watts can be reached in 2-3 weeks. We do not train more than 3 times per week. If the ramping of the load is carried out carefully, unwanted muscle soreness is circumvented completely. Currently available data on moderate load eccentric exercise suggests that training regimes of 2 to 6 months result in muscle strength gains similar to those achieved with classical high-load strength training. Eccentric exercise protocols have been used in various patient populations such as patients with cardiopulmonary diseases, neurological diseases, metabolic diseases, patients with arthrosis and tendinopathies, patients in rehabilitation after anterior cruciate ligament injury and cancer survivors. Currently the results of these interventions are encouraging but the evidence for effect size is scarce and the choice of training protocols is still experimental.

Invited symposia

IS-SP01 THE APPLICATION OF SCIENCE AND PRACTICE TO OPTIMISE SPORTING PERFORMANCE - SPONSORED BY CATAPULT

DEVELOPING SCIENCE FOR PRACTICE

TWIST, C.

UNIVERSITY OF CHESTER

Understanding the efficacy of training and nutritional interventions and their influence on performance is necessary before practitioners can apply them to practice. While the assessment of an individual's physical qualities is often used as a proxy for performance, practitioners and coaches would be better informed if they understood the interventions influence on match- or training-related activity before

selecting it for real-world use. Training and match play are influenced by numerous contextual factors that mean studying the efficacy of any training or nutritional intervention in a real-world setting is problematic. Controlled simulations that replicate training or match play are offered as a model to understanding how conditioning or nutritional manipulations might influence an individual's performance capabilities. These studies typically employ simulation models that are reliable, yet their ability to replicate important elements of match play and training are often compromised. Understanding the strengths and challenges of these simulation models is essential if they are to be of use in developing science that informs practice.
This talk will explore a series of studies to develop a simulation model that has then been applied to understand the efficacy of various conditioning and nutritional interventions on the match and training performance characteristics of rugby players. The strengths of such research approaches will be presented in the context of how these data might be used to inform applied practice. The limitations of these types of study will also be considered, alongside highlighting the challenges of replicating the activity characteristics of athletes during training and match play.

ACCESSING SCIENCE FROM POLICY AND PRACTICE

JONES, B.
LEEDS BECKETT UNIVERSITY

Practitioners and policy makers are required to make decisions to inform training practices, competition structures and develop sport. Decisions should be informed by available evidence, which has been developed through rigorous scientific research. While this appears a logical approach, it can be problematic. Applying scientific studies to policy and practice can be challenging, given the different methodologies, data analysis and reporting methods used between studies. Furthermore, while academic researchers in sports science may focus on the development of knowledge through efficacy studies, the effectiveness of this knowledge to real-world practice is sometime unknown.
This talk will challenge the application and usefulness of scientific research to real-world problems, policy and practice. It will highlight the need for more effectiveness studies, and provide potential solutions to increase the usability of scientific research in policy and practice.

BLENDING SCIENCE AND PRACTICE

ROE, G.
LEEDS BECKETT UNIVERSITY

Best practice requires the integration of scientific evidence and practical knowledge. A challenge for practitioners working in the field is staying up-to-date with the latest research and applying it in practice. The scientific literature within a discipline (e.g., physiology or biomechanics) can act as a good start point, but given the multidimensional complexity associated with sports performance, it is often reductionist to apply evidence from only one discipline. A particular aspect of athlete care where this becomes problematic is the rehabilitation and return to performance of injured athletes. When supporting the return to performance of an athlete following injury, a blend of science from clinical (i.e. physiotherapy and sports medicine), sports performance (i.e. physiology, biomechanics, strength and conditioning, sports science) and coaching is required, in addition to the contextual factors unique to the athlete and sport.
This talk will discuss the application of blending science and practice during the return to performance process in rugby union players and will provide examples of how information from various disciplines can be merged to optimise performance.

Invited symposia

IS-PM13 Blood flow-restricted exercise; mechanisms, training responses and applications in sport and rehabilitation.

BLOOD FLOW-RESTRICTED EXERCISE; A GOOD ALTERNATIVE TO TRADITIONAL HEAVY-LOAD STRENGTH TRAINING FOR MUSCLE HYPERTROPHY AND INCREASED STRENGTH?

RAASTAD, T.
NORWEGIAN SCHOOL OF SPORT SCIENCES

Low load resistance exercise (~20-50% of 1 RM) in combination with blood-flow restriction (BFR) by the use of pressure cuffs has repeatedly been shown to induce muscle hypertrophy in both untrained individuals and in highly trained athletes. Accordingly, low-load blood flow restricted resistance exercise (BFRRE) has been suggested as an effective alternative to traditional heavy-load strength training (HLS) in increasing muscle size and strength in untrained as well as elite athletes. The reported increase muscle strength is, however, in some studies lower than with HLS, and there seems to be a marked difference between BFRRE and HLS in tendon adaptations. Furthermore, BFRRE is claimed to be a gentle exercise form with short recovery needed after exercise. Consequently, some high-frequency BFRRE training protocols have shown impressive results with regard to rapid hypertrophy, but there are also reports of severe muscle damage in athletes after BFRRE. Because of the low load, BFRRE is often used in early rehabilitation after injuries and some athletes use BFRRE in deloading periods where they want to maintain the muscle mass while reducing the stress on bones and tendons. The aim of this presentation is to discuss the potential for BFRRE in normal training an in rehabilitation and to point at some benefits and limitations that should be considered when training is planned for different groups.

MECHANISMS OF MUSCLE HYPERTROPHY INDUCED BY BLOOD FLOW-RESTRICTED EXERCISE

WERNBOM, M.
CENTER FOR HEALTH AND PERFORMANCE

Because of the many potential applications of BFRRE, it is of great interest both from a practical standpoint and from a basic research point of view to try to clarify how occlusion training induces gains in strength and muscle size. Several stimuli have been suggested as possible upstream triggers of adaptations in muscle size and strength, including (but not limited to):
• Motor unit recruitment and consequent mechanical loading of the active muscle fibres

• Metabolic stress
• Ischemia-reperfusion and consequent formation of reactive oxygen and nitrogen species
• Release of growth factors and hormones
• Cell swelling
• Muscle damage
Downstream, changes in muscle size and strength may be mediated by:
• Increased muscle protein synthesis
• Decreased muscle protein breakdown
• Satellite cell activation, proliferation and subsequent myonuclear addition
The aim of this presentation is to discuss some of these mechanisms and possible upstream stimuli behind these effects, and the evidence for each of them.

THE EFFECTS OF BLOOD FLOW-RESTRICTED EXERCISE AS A COUNTERMEASURE AGAINST DISUSE ATROPHY

PLOUTZ-SNYDER, L., DOWNS, M., HACKNEY, K.

UNIVERSITY OF MICHIGAN, KBRWYLE, NORTH DAKOTA STATE UNIVERSITY

INTRODUCTION: Introduction: Loss of skeletal muscle cross-sectional area (CSA) and function is a consequence of disuse such as in spaceflight, bed rest, or unilateral lower-limb suspension (ULLS). High-load (HL) resistance exercise or low-load blood flow restricted (BFR) exercise are effective training techniques to improve muscle strength and CSA in ambulatory participants. Recent evidence suggests the anabolic response to training stimuli are blunted during unloading or disuse conditions (i.e. anabolic impairment, prompting the need to explore the effectiveness of each type of resistance exercise training during both weight bearing and non-weight bearing. This study examined the muscular exercise training adaptations from HL and BFR resistance exercise training during weight bearing and non-weight bearing.
Methods: Participants performed all ambulatory activity on crutches for 25 days, while wearing one shoe with a 10-cm sole on the right foot. This eliminated ground contact by the left foot, thereby unloading the left lower limb. The right limb continued to have ground contact and remained weight-bearing throughout the ULLS period. By training both legs, this experimental design allowed for the direct comparison of the training program in loaded and unloaded muscle. Participants were assigned to a training group: HL resistance exercise (n=6) or BFR exercise (n=7). Training consisted of 3 sets each of supine leg press and plantar flexion with as many repetitions as possible to volitional fatigue. HL used loads of 70-80% of 1 repetition maximum and BFR used loads of 20-30% with continuous inflation pressure. Muscle CSA, strength, and endurance data from the upper and lower legs were obtained the week prior to starting ULLS (Pre-ULLS) and on either day 24 or 25 of ULLS (Post-ULLS).
Results: In weight-bearing legs HL and BFR increased knee extensor and plantar flexor CSA and strength. In non- weight bearing legs both knee extensor and plantar flexor muscle CSA and strength increased in the HL group, but decreased in the BFR group. Dynamic leg press endurance increased with HL and BFR training in the weight bearing legs and was maintained in the unloaded legs with both types of training.
Discussion: HL and BFR resistance exercise were both effective exercise programs for the weight-bearing leg. However, BFR exercise was not as effective as HL resistance exercise in the nonweight-bearing leg. These data show that exercise that improved muscle CSA and strength in ambulatory weight-bearing conditions was not sufficient to maintain muscle function during unloading.

Invited symposia

IS-PM03 Can exercise hurt your heart?

EXERCISE IS MEDICINE: AT ANY DOSE?

EIJSVOGELS, T.M.H.

RADBOUD UNIVERSITY MEDICAL CENTER

INTRODUCTION: Habitual physical activity and/or regular exercise training are effective strategies to reduce cardiovascular morbidity and mortality. Therefore, the World Health Organization recommends adults to engage in at least 150 min/week of moderate intensity aerobic activities or 75 min/week of vigorous intensity aerobic activities, or an equivalent combination thereof. Despite these international recommendations, only a minority of the population meets the proposed criteria, whereas sedentary behaviour becomes increasingly prevalent.
METHODS: This lecture will discuss the dose-response relationship between aerobic exercise volumes and the associated health benefits. For example: what is the lowest effective dose of exercise needed to elicit a risk reduction? What are health benefits of higher exercise volumes? What is the optimal dose? Does exercise intensity matter when prescribing exercise? Should I exercise more or reduce my time spent sitting? Is there is there evidence for an upper limit beyond which additional exercise training does not induce additional health benefits?
RESULTS: While physical inactivity is a problem for the majority of the general population, the popularity of endurance exercise races and the average age of its participants have increased worldwide over the last 3 decades. Completing 42 km marathon or similar endurance events has become a personal goal for many individuals. This provides an impetus for both from the medical and lay community to understand the effect of extreme endurance exercise on cardiac health.
CONCLUSION: Recent studies suggested that extreme exercise volumes may attenuate longevity and accelerate atherosclerotic coronary artery disease. Available evidence from physiological, epidemiological and cardiac studies will be discussed to place these observations in an appropriate perspective and answer the question whether exercise is medicine at any dose.

EXERCISE-INDUCED DAMAGE: EVIDENCE FROM BIOMARKERS AND ECHOCARDIOGRAPHY

GEORGE, K.

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: There has been a significant amount of speculation recently that extremely high volumes of endurance exercise may lead to cardiac damage and/or cardiac dysfunction. Further it has been proposed that these phenomena are linked.
METHODS: .
RESULTS: Firstly, we will present a historical timeline of studies that have demonstrated increased concentrations of cardiac biomarkers of damage (e.g. cardiac troponin T) after strenuous exercise. We will then try to unpick the clinical implications of this data and reflect on putative mechanism(s). This content will reflect changes in assay availability and the application to a range of different populations and exercise loads.
Further we will present a historical timeline of studies that have demonstrated a reduction in systolic or diastolic function in the early recovery period from strenuous exercise. We will reflect on data related to both the left and right ventricles and will document the significant technical developments in echocardiography that have illuminated this field. We will discuss the clinical impact of such changes and address a limited evidence-base related to mechanistic underpinnings.
Finally, we will review available evidence that these two issues (cardiac damage and cardiac dysfunction) are directly related to one another.
CONCLUSION: We will summarise the evidence-base to date, reflect on continuing research priorities and provide initial reflections on how this information aligns with the central belief that exercise is a potent medicine.

CARDIAC REMODELING TO EXERCISE TRAINING: PHYSIOLOGICAL VERSUS PATHOLOGICAL RESPONSES

SCHARHAG, J.

TECHNICAL UNIVERSITY MUNICH

Already since the legend of the ancient marathon run of Pheidippides, possible exercise induced cardiac damage is under debate. Although a lot of studies in elite athletes have shown the physiological nature of the athletes heart, studies from recreational up to competitive athletes on exercise induced increases in cardiac biomarkers, myocardial late gadolinium enhancement in cross sectional studies, elevated coronary calcification, or a transient decrease in ventricular function after prolonged strenuous endurance exercise heated up the discussion within the last years. However, many methodological differences between the studies and studied subjects have to be taken into account. Therefore, the presentation aims to give an overview on current studies which describe physiological and pathological responses to exercise training and competition.

Invited symposia

IS-BN02 The Effects and Mechanisms of How Exercise interventions Reduce Old Adults' Mobility Impairments

CRITICAL FACTORS TO DOSE EXERCISE INTERVENTIONS IN THE PREVENTION OF AGE-RELATED MOBILITY LOSS

GRANACHER, U.

UNIVERSITY OF POTSDAM

INTRODUCTION: As the proportion of senior citizens increases in western industrialized societies, there is the need to identify old adults with first signs of limited mobility in order to delay the onset of mobility disability and subsequent loss of autonomy through the implementation of adequate intervention programs. According to Newfield and colleagues [1], mobility limitation is defined as a state of impaired mobility, a condition in which an individual experiences a limitation in independent physical movement, or is at risk for experiencing limitations. Owing to the rather broad definition of mobility limitation, prevalence rates range from 20 to 50 % for seniors age =65 years [2, 3]. Thus, there is the need to develop and implement adequate training programs for the prevention of age-related mobility impairments. While there is ample evidence for the general effectiveness of balance and/or resistance training to maintain mobility and prevent disability in seniors [4, 5], less is known regarding the required exercise dose.
Thus, the aims of my presentation will be threefold: (i) to present data on the importance of balance and muscle strength for mobility in seniors, (ii) to describe and discuss the general effectiveness of balance and resistance training on mobility related outcomes in seniors based on an extensive review of the literature, and (iii) to present critical factors related to the dose of balance and resistance training to provoke practically and clinically relevant responses in healthy seniors. Practitioners, therapists, rehab experts, and exercise scientists will benefit from the presentation by learning how to adequately implement balance and resistance training in primary prevention using sufficient dosage.
References: 1. Newfield, S.A., et al., Cox's clinical applications of nursing diagnosis: adult, child, women's, mental health, gerontic, and home health considerations2007, Philadelphia: F. A. Davis Company.
2. Shumway-Cook, A., et al., Mobility limitations in the medicare population: Prevalence and sociodemographic and clinical correlates. J Am Geriatr Soc, 2005. 53(7): p. 1217-1221.
3. Guralnik, J.M., et al., Lower extremity function and subsequent disability: consistency across studies, predictive models, and value of gait speed alone compared with the short physical performance battery. J Gerontol A Biol Sci Med Sci, 2000. 55(4): p. M221-M231.
4. Judge, J.O., Balance training to maintain mobility and prevent disability. Am.J.Prev.Med., 2003. 25(3 Suppl 2): p. 150-156.
5. Beijersbergen, C.M.I., et al., Power Training-induced Increases in Muscle Activation during Gait in Old Adults. Med Sci Sports Exerc, 2017. 49(11): p. 2198-2025.
Contact: urs.granacher@uni-potsdam.de

RECOVERY OF LOST MOBILITY IN FRAIL OLDER ADULTS: EVIDENCE OVERVIEW

SHERRINGTON, C.

UNIVERSITY OF SYDNEY

The benefits of resistance training for older people are often discussed. Many trials have now also evaluated the impact of "neuromotor" exercises that, as defined by the American College of Sports Medicine, involve balance, agility, and coordination. These exercises focus more on motor skill and appropriate muscle activation rather than on greater maximum force generation. This talk will outline systematic review (from a Cochrane review underway1) and clinical trial evidence for the effectiveness of neuromotor exercise in regaining mobility in frail older people with reference to trials indexed on PEDro (the Physiotherapy Evidence Database www.pedro.org.au) including trials of home-based neuromotor exercise undertaken by the presenter and colleagues (eg2,3,4).

References: 1. Fairhall N, Sherrington C, Cameron ID. Mobility training for increasing mobility and functioning in older people with frailty. Cochrane Collaboration systematic review protocol. Issue 5. (2013).

2. Sherrington C, Fairhall N, et al. Exercise and fall prevention self-management to reduce mobility-related disability and falls after fall-related lower limb fracture in older people: protocol for the RESTORE (Recovery Exercises and STepping On afteR fracturE) randomised controlled trial. BMC Geriatrics 16:34 (2016).

3. Fairhall N, Sherrington C et al. Effect of a multifactorial interdisciplinary intervention on mobility-related disability in frail older people: randomised controlled trial. BMC Medicine 10 (1) 120 (2012).

4. Sherrington C et al. A post-hospital home exercise program improved mobility but increased falls in older people: a randomised controlled trial. PLOS ONE. 9:9 (2014).

MECHANISMS OF HOW EXERCISE INTERVENTIONS REDUCE OLD ADULTS' MOBILITY LOSS THROUGH GAIT SPEED MAINTENANCE

HORTOBAGYI, T.

UNIVERSITY OF GRONINGEN MEDICAL CENTER

INTRODUCTION: Walking ability is a cornerstone of quality of life . Observations of gait in old age and under a variety of clinical conditions suggest that humans adapt their gait mechanics to environmental and biological constraints .

METHODS: The presentation will review two elements of the data concerning gait.

RESULTS: Part I the presentation will integrate the evidence from inverse dynamics, modeling, and neural activation data to support the concept of biomechanical plasticity of human gait . Part II will address how exercise interventions help minimize the age-related slowing of gait speed . It will, somewhat provocatively, also draw attention to a virtually complete lack of understanding of the biomechanical mechanisms mediating the intervention-induced gait speed increases in aging humans.

CONCLUSION: Practitioners, basic and applied exercise scientists, and rehab experts will all benefit from the presentation by learning how gait speed is emerging as a fundamental function, representing the sixth vital sign.

Oral presentations

OP-PM69 Team sports

BENEFICIAL EFFECTS OF SMALL-SIDED GAMES AS CONCLUSIVE PART OF WARMUP ROUTINE

DELLO IACONO, A., VIGOTSKY, A.D., LAVER, L., HALPERIN, I.

THE ACADEMIC COLLEGE AT WINGATE

INTRODUCTION: The aim of this study was to compare the effects of small sided games (SGG) and traditional warm-up (WU) strategies on neuromuscular, physiological and perceptional responses of elite handball players.

METHODS: A randomized, crossover study design was implemented in which 12 male players completed a general 8 min WU which was concluded with an 8 min section of either specific handball shooting drills or 3 x 2 min of SSG with a passive recovery of 1 min between bouts. By the mean of a force plate, countermovement jumps (CMJ) and plyometric press-ups (PP) were assessed before and immediately after the WU regimens, heart rate (HR) was assessed during the WUs and rating of perceived effort (RPE) was only assessed after the WUs. Linear mixed-models and permutation tests were carried out to assess the effects of SSG relative to a traditional WU.

RESULTS: The results revealed marked improvements in vertical jump [Δ = +2.67 (95% CI = 1.97 – 3) cm], eccentric force during the CMJ [Δ = −2.19 (−3.56 – −0.82) N], peak eccentric force during the CMJ [Δ = +3.05 (2.18 – 3.92) N], peak concentric force during the CMJ [Δ = +2.45 (2.02 – 2.89) N], vertical jump power [Δ = +3.02 (2.29 – 3.74) W], eccentric PP force [Δ = +1.52 (1.19 – 1.85) N], concentric PP force [Δ = +1.73 (1.19 – 2.27) N], and PP power [Δ = +2.06 (1.37 – 2.76) W] relative to the traditional warm-up. Permutation tests did not reveal any remarkable differences between SSG and traditional warm-up conditions in RPE (Δ = +0.08; z-score = 0.44; p = 1.00) or mean HR (Δ = +1.42; z-score = 1.88; p = 0.08).

CONCLUSION: This study point to the effectiveness of SGG as a WU strategy. Compared to a more traditional handball WU, SSG led to greater benefits even the HR and RPE are similar and when matched for WU duration among elite level athletes. It is thus speculated that the superior effects of the SGG WU are related to muscular potentiating effects, however, this reminds to be directly investigated in future studies. Coaches should consider implementing SSG not only as a training strategy, but also as WU considering its beneficial effects on relevant athletic performance.

DOES MAN-MARKING INFLUENCE RUNNING OUTPUTS AND GAME INTENSITY DURING SMALL-SIDED SOCCER GAMES?

KILDING, A.E., AASGAARD, M.

AUT UNIVERSITY

INTRODUCTION: Small-sided games (SSGs) are an effective training tool for physical development in soccer [1]. SSGs can be modified in several ways to manipulate the physical demands to best match player characteristics and session objectives. The aim of this study was to compare the physiological, perceptual and time-motion characteristics of man marking (MM) versus non-man marking (NMM) SSGs.
METHODS: In an acute cross-over design, 8 amateur soccer players (mean age ± SD: 23.6 ± 3.3 years) played 2v2, 3v3 and 4v4 SSGs, on separate days, adopting either MM or NMM rules. During each game, physiological (heart rate, HR), GPS-derived running outputs, and perceptual measures (rate of perceived exertion, RPE) were determined.
RESULTS: Small to moderate (unclear) differences in mean percent HR (%HRave) (%Δ = 1-2.7%; ES = 0.22 to 0.65) were observed between MM and NMM. Comparisons between varying player number in MM indicated a decrease in %HRave with increased player numbers (%Δ = -1.6-3.5%; ES = 0.39 to 0.86). Perceptual load increased with MM compared to NMM (%Δ = 6.7-17.6%; ES = 0.66 to 2.09), while increases in player numbers (MM only) reduced RPE output (%Δ = 9.4-24.3%; ES = 1.14 to 3.61). Time-motion characteristics revealed substantially greater total distance covered in MM irrespective of player number (%Δ = 6.8-14.7%; ES = 1.34 to 2.82). There were very likely increases in distances covered for striding (%Δ: 23.4-33.2; ES = 2.42 to 4.35) and high intensity running (17.9-21 km/h) (%Δ: 47.3-104; ES = 0.91 to 1.68) for MM compared to NMM irrespective of player number.
CONCLUSION: Man-Marking during soccer SSGs can substantially elevate perceptual load and running distances across a range of speed zones (striding to high intensity running), regardless of player number. While differences between NMM and MM for internal load (HR) were unclear, MM during SSGs maybe an effective rule modification to alter training load.
References: [1] Impellizzeri, FM, Marcora, SM, Castagna, C, Reilly, T, Sassi, A, Iaia, FM, and Rampinini, E. (2006). Physiological and performance effects of generic versus specific aerobic training in soccer players. Int J Sports Med 27(6): 483-492.

BILATERAL KICKING PERFORMANCE IN GAELIC FOOTBALLERS

O'SULLIVAN, M., CROGNALE, D., SUSTA, D.

DUBLIN CITY UNIVERSITY, UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: The ability to proficiently undertake sport specific tasks with each side of the body plays a major role in both sport performance and injury prevention: In elite football (FIFA) players non-dominant leg shows lower strength and different motor strategies while performing two types of kicks were identified (McLean and Tumilty, 1993). One side dominance can increase the risk of injuries in Australian rules, a sport where movements are similar to Gaelic football (Orchard 2001). Accuracy in kicking was defined as 'the ability to kick a ball to a specified area' (Finhoff et al., 2002). Aim of the present study is to assess ambidexterity among female and male GAA players.
METHODS: Twenty-one female senior club and inter-county footballers and fifty-two male senior club and inter-county footballers volunteered to participate in this study (23.3± 6.1 years). Ladies were asked to kick a size 4 ball from 5 different pitch positions from the same distance (15 m to the goalposts) and men were asked to kick a size 5 ball from 5 different pitch positions 25 m from the goalposts.
Every participant had to kick five times with the preferred and five times with the non-preferred foot. Statistical analysis was done SPSS version 17. A one way ANOVA was performed to identify the difference in using the preferred or non-preferred foot on performance in the kicking accuracy task. The level of significance was set at $p<0.05$. The research project was approved by Dublin City University Research Ethics Committee.
RESULTS: Female GAA footballers score of 15.7±2.4 (mean ± SD, range 10/25 to 21/25) points while kicking using their preferred foot was significantly higher ($p=0.004$) than their performance while kicking with their non-preferred foot, 10.1 ± 4.1 points (range 2/25 to 16/25).
Male GAA footballers scored 14.7 ± 3.9 (range 4/25 to 22/25) points with their preferred foot, a significantly higher ($p=0.002$,) number of points compared to 9.3 ± 4.8 (range 0/25 to 19/25) score with their non-preferred foot.
CONCLUSION: Our results show that GAA players can benefit from training bilateral kicking accuracy.

PERFORMANCE CHANGES OF FAST BOWLERS DURING A TWENTY20 FAST BOWLING SIMULATION

VICKERY, W.1, MILNE, E.2, BORGES, N.2

<1> NORTHUMBRIA UNIVERSITY, NEWCASTLE UPON TYNE, UK <2> THE UNIVERSITY OF NEWCASTLE, NEWCASTLE, AUSTRALIA

INTRODUCTION: Due to the limited access to players during a cricket match, it is difficult to provide a detailed analysis of the demands associated with fast bowling. A reliable fast bowling match-simulation was developed to overcome this difficulty (Milne et al., 2018). This study examined the changes in physical, psycho-physiological and technical performance of fast bowlers during a Twenty20 fast bowling simulation (FBS-T20) to further understand the demands of fast bowling whilst competing.
METHODS: The physical (distance covered, bowling approach speed, 10 m sprint time), psycho-physiological (heart rate, RPE) and technical (bowling accuracy) demands of six amateur fast bowlers (age= 23.6 ± 1.4 yr, body mass= 82.3 ± 8.8 kg, height= 185.4 ± 5.3 cm) were measured during three sessions each of the FBS-T20. The distance travelled along with heart rate and RPE were measured throughout entirety of the protocol. The approach speed and bowling accuracy of fast bowlers was measured during each ball of the bowling overs. 10 m sprint time was measured once during each fielding over. One-way ANOVA with Bonferroni post hoc ($p<0.05$) was used to determine differences between measures during the bowling and fielding overs.
RESULTS: Fast bowlers covered 7917 ± 934 m over 78 ± 9 min during the FBS-T20, with a mean and maximum heart rate of 148 ± 8 b.min-1 and 184 ± 11 b.min-1, respectively. No significant difference ($p>0.05$) in the approach speed of fast bowlers or bowling accuracy was reported between the bowling overs. A significant difference was evident between the bowling overs RPE ($F(3,76)= 10.352$; $p<0.00$). RPE (6-20) following overs 18 (13.0 ± 1.8) and 20 (13.3 ± 2.1) were both significantly greater ($p\leq0.03$) than overs 2 (10.4 ± 1.8) and 4 (11.2 ± 2.0). No significant difference ($p>0.05$) in the 10 m sprint speed was reported during the fielding overs. RPE appeared to be lowest during the initial 5 overs of the FBS-T20 (9.0 ± 1.8) when compared to the other fielding blocks (over 6-10= 10.4 ± 2.2, $p\leq0.00$; over 11-15= 10.8 ± 2.2, $p\leq0.00$; over 16-20= 10.9 ± 2.2, $p\leq0.00$).
CONCLUSION: The results suggest that fast bowlers are able to maintain their speed and bowling accuracy throughout the FBS-T20 whilst bowling and fielding. Despite few changes in the physical and skill demands of fast bowlers, their perceptual response increased

throughout the FBS-T20 which may be representative of the increased demands on cricket players towards the end of an innings. By using this simulation cricket coaches may be able to provide a physically and technically specific training environment for fast bowlers.
REFERENCES:
Milne, E., Vickery, W., Dascombe, B. &. Borges, N. (Under Review). Development of a Twenty20 field-based simulation for cricket fast bowlers (FBS-T20). International Journal of Sports Physiology and Performance.

QUANTITATIVE ANALYSIS OF HIGH GOAL POLO: A PILOT STUDY

BEST, R., STANDING, R.

TEESSIDE UNIVERSITY; WAIKATO INSTITUTE OF TECHNOLOGY

INTRODUCTION: Academic literature on Polo players is limited. Polo is a global and professional sport played professionally by males and females, but the dearth of literature remains. We aimed to quantify the characteristics of the winning team of a High Goal Polo tournament, through group and knockout stages (seven games; five wins, two losses).
METHODS: Footage from the 2017 Jaeger le Coultre Gold Cup was viewed via Pololine, a dedicated online platform (www.pololine.tv/fullmatches), and analysed using a customised matrix devised in consultation with recreational and professional Polo players. Two raters (R) performed quantitative analysis for each game. Percentage success rates were calculated for forehand and backhand shots of differing lengths and ride-offs (two players contesting for the right to play a shot). Raw differences for melees (coming together of two or more players from each team), penalties awarded (short and long) and turnovers conceded were recorded. Means and 90% Confidence Intervals are shown.
RESULTS: Intra-rater reliability was large to very large (R1 ICC: 0.69 90% C.I.: 0.52 to 0.89. R2 0.72; 0.52 to 0.89), with inter-rater reliability displaying similar values (0.71; 0.62 to 0.78). In games won, fewer turnovers conceded (-3.00; -5.69 to -0.31) and more penalties were awarded (1.43; -0.32 to 3.18) than the opposition. Long penalty (0.86; 0.02 to 1.69) and short penalty (0.57; -0.13 to 1.28) conversion values suggest penalties present advantageous attacking and goal scoring opportunities. Counterintuitively, more melees were won in games lost (4.00; 3.12 to 4.88) than in games won (-0.57; -3.28 to 2.14). Forehand success rates were similar between wins and losses, as were ride-offs. Backhands demonstrated variability in games won (Middle: -1.71; -10.59 to 7.16 and Long: 0.29; -20.28 to 20.85), but were more unsuccessful in lost games (Middle: -6.00; -12.16 to 0.16 and Long: -17.5; -24.09 to -10.91).
CONCLUSION: We recommend Polo players and teams aim to develop their backhand success rate, whilst conceding fewer penalties than the opposition. The role of melees and ride-offs in the present analysis was unclear. We suggest future research scrutinises these contested actions, especially ride-offs that take place off the ball as these may facilitate attacking play by other team members, much like blocking plays in grid-iron football.

Oral presentations

OP-BN19 Digital health and exercise tools

WEARABLE DEVICES-BASED PHYSICAL ACTIVITY INTERVENTION FOR ELDERLY WOMEN : A RANDOMIZED CONTROLLED TRIAL

PARK, S., LEE, S.

KOREA INSTITUTE OF SPORTS SCIENCE

INTRODUCTION: Physical inactivity as well as prolonged sitting may lead to the adverse health effects including cardiovascular disease and mortality. Wearable devices to promote physical activity (PA) and/or to reduce sedentary time are commercially available. However, PA intervention studies using the devices have been limited to the specific population such as adults and/or adolescents. Thus, the purpose of the study was to investigate the effect of the short-term PA intervention using wearable device on cardiorespiratory fitness and cardiovascular risk factors in elderly women.
METHODS: Community dwelling elderly women (n=39, 69.5± 3.96yrs) participated in the 8-week wearable device-based PA intervention study. They were randomly assigned to one of the following groups; a continuous PA (one 30-minute bouts of walking, n=13), an intermittent PA (three 10-minute bouts of walking, n=12), or a control (Cont, n=15) group. Both PA groups were asked to participate moderate-to-vigorous PA (MVPA, 40-70% of heart rate reserve) self-monitored by a wearable device for their PA time and intensity. The control groups were asked to keep their usual PA. All the participants wore an accelerometer at least for 10 hours per day for baseline and during the 8-week intervention period to confirm any changes of PA. Cardiorespiratory fitness (6-minute walk test) and cardiovascular risk factors including carotid intima-media thickness (c-IMT) and carotid artery stiffness (Ep, AC, D_min, P_min) using ultrasound, the brachial-ankle pulse wave velocity (ba-PWV) and the ankle brachial index (ABI) using an oscillometric vascular profiling device were measured at baseline and after the intervention. Analysis of covariance (ANCOVA) were used with the baseline as covariate and post hoc Bonferronis multiple t test were used for group comparison($p<.05$).
RESULTS: Significant effects were found in MVPA ($p<.001$) and total PA time ($p=.047$), but not in sitting time ($p=.259$). In the continuous PA, MVPA and total PA time were increased compared to the Cont. MVPA was only increased in the intermittent PA compared to the Cont. Sitting time tended to decrease in the intermittent PA. 6-min walk was only improved in continuous PA compared to the Cont ($p=.020$). There were significant differences in carotid artery stiffness (Ep; $p=.033$, AC; $p=.018$, D_min; $p=.016$, P_min; $p=.009$), ba-PWV($p=.036$), and ABI($p=.043$), but no difference in c-IMT. Carotid artery stiffness, ba-PWV, and ABI were improved in the continuous PA compared to the Cont.
CONCLUSION: Wearable device–based physical activity intervention was useful to increase PA in elderly women. This was the first study to show the effectiveness of the wearable device to increase PA in elderly and was effective in cardiorespiratory fitness and other cardiovascular risk factors. Thus, wearable device for elderly needs to be developed for diverse PA program.

THE USE OF A MOBILE APPLICATION TO SUPPORT PHYSICAL ACTIVITY AND LIFESTYLE CHANGES IN PERSONS LIVING WITH HIV: THE SMARTAPP STUDY

BONATO, M., TURRINI, F., VITOBELLO, C., GIORDANI, A., PASSERI, L., MELONI, A., GALLI, L., LA TORRE, A., MERATI, G., PAVEI, G., CINQUE, P.

UNIVERSITÀ DEGLI STUDI DI MILANO

INTRODUCTION: Although physical activity has been shown to improve fitness, metabolic and inflammatory parameters in people living with HIV, adherence to exercise programs is usually low when not strictly supervised. Therefore, the aim of this study was to assess if the use of a mobile application will favor engagement to exercise by providing motivational inputs, and therefore adherence to training. We hypothesized, as a consequence an improvement of physical fitness, and therefore of health status.
METHODS: This pilot study was a two-armed, parallel group, randomized controlled trials in which HIV-infected subjects were enrolled and assigned to either an experimental group (EG), which trained with a smartphone application, or a control group (CG), which trained with a hard copy training program. Physical activity program included an initial coach-supervised period of 4 weeks, followed by 12 weeks where participants were instructed to train independently. The program consisted of walking or jogging three times/week for 60 minutes. At baseline (BL) and after 16-weeks (W16), patients underwent measurement of CRF by peak oxygen consumption (VO2peak), body composition (body mass, body mass index-BMI, waist, hip circumferences, %fat mass and %fat free mass by bioimpedentiometry), and metabolic parameters (total-, HDL-, LDL-cholesterol). Results are given as number (%) or median (IQR) values. Intention-to-treat analysis regarding an improvement of the 15% of VO2peak was performed with a Chi-Square test. Percentage changes between BL and W16 regarding EG and CG were assessed by Wilcoxon matched-pairs signed rank test.
RESULTS: Thirty-seven subjects were screened and 28 were eligible and divided in EG [n=13, age: 52 (36-56) y-o, height: 176 (170-180) cm, BMI: 24.4 (22.1-27.1) kg/m2, CD4+: 648 (439-762)], and CG [n=15, age: 50 (36-56) y-o, height: 172 (170-180) cm, BMI: 24.8 (22.1-27.1) kg/m2, CD4+: 619 (439-762)]. During training we had 1 and 2 drop-outs for EG and CG, respectively. Median training adherence was 100% (IQR 91-100%) during the initial coach supervised period, and 70% (IQR 41-91%) during the independently training period, with 15/28 (54%) who trained for at least 50% of the sessions. Intention-to-treat analysis showed post-intervention improvement in VO2peak (+ 15%, p=0.005), % fat mass (-10%, p=0.014); %fat free mass (+ 8%, p=0.008), total cholesterol (- 6%, p=0.016) between EG and CG were observed.
CONCLUSION: Adherence to training is fundamental, but seems to be low when not strictly supervised in HIV infected patients. The preliminary results from this pilot study showed that patients trained using a smartphone application were more adherent and as consequence improved physical fitness, body composition and metabolic parameters.

STEP COUNT ACCURACY OF SMARTPHONES DURING VARIOUS WALKING CONDITIONS WHEN WORN AT DIFFERENT WEARING POSITIONS

HÖCHSMANN, C.

UNIVERSITY OF BASEL

INTRODUCTION: Activity trackers can increase physical activity among unmotivated inactive individuals. Commercial PA monitors, such as activity wristbands and smartwatches, and especially smartphones with their various applications have increasingly gained popularity in recent years and are most commonly used for PA assessment today . The fact that there are approximately two billion smartphone users worldwide , most of which carry their phones with them throughout the day, make them promising tools for PA assessment in public health, given that they prove to be accurate. Because not all smartphone users wear their smartphones in their pants pocket, the aim of this study was to examine the accuracy of smartphones and different accelerometer apps to detect steps during various walking conditions while assessing the impact of different phone positions on the accuracy of step detection.
METHODS: Participants from two different age groups walked on a treadmill at four pre-defined walking speeds <1.6, 3.2, 4.8, and 6.0 km/h> and completed an outdoor walking course at a self-chosen walking speed while wearing three iPhone SE smartphones , one Samsung Galaxy S6 Edge , one Garmin Vivofit 2 wristband, and two ActiGraph wGTX+ devices . In addition to the built-in accelerometer apps Apple Health and Samsung S Health, all smartphones recorded steps via the apps Runtastic Pedometer, Accupedo, and Pacer. We used video observation as the gold standard and evaluated validity by comparing each device with the gold standard using mean absolute percentage errors .
RESULTS: The MAPE of the iPhone SE, independent of the phone's position, was small <<3> for all treadmill conditions ≥3.2 km/h as well as for free walking during the outdoor walking course. The Samsung Galaxy showed a small MAPE only for treadmill walking at 4.8 and 6.0 km/h and for free walking. The commonly used research-grade accelerometer ActiGraph wGTX+ was inaccurate for walking speeds <4.8 km/h when worn on the hip and entirely inaccurate for all walking conditions when worn on the wrist .
CONCLUSION: The iPhone SE including all used apps is suitable to accurately measure steps in various walking conditions while the phone's position does not impact the accuracy of step detection. This may have important implications for public health as it could increase the applicability of smartphones for PA assessment in various settings.

FOOT TYPE ANALYSIS BY KNOWFOOT APPLICATION FOR MOBILE

YI, L.C., PAZETTI, J.A.T., PEREIRA, G.B., RUMAQUELLA, M.R.1, TESSUTTI, T.U. SOUZA, V.T.O.C., TESSUTTI, V.

FEDERAL UNIVERSITY OF SAO PAULO

INTRODUCTION: Identifying the foot type allows to find out how the foot interacts with the ground or with the footwear during the functional tasks or in a static position. It is necessary to develop methods to evaluate it, in an easy and practical way. The Foot Posture Index (FPI) [1] allows visual assessment of the foot type in three dimension. The Navicular Drop Test [2] is another way of evaluation, considering the vertical height from the navicular bone to the ground, in the sitting and standing positions. Both tools, used in a clinical practice, are easy to apply, validated and accepted in the scientific community. The use of these tools, developed for mobile, would allow more people to use, provide greater accessibility and fast diagnosis. The aim of this study is present a mobile application developed to evaluate foot type.
METHODS: KnowFoot is an easy use application (app) that allows the user to identify their foot type. The application uses two methods to obtain the foot type as follows: neutral, supinated, hyper supinated, pronated and hyper pronated. The first method, Foot Posture Index [1], evaluates through 6 different aspects, in three dimensions, by previously determined photographs, where the user will score the different foot aspects based on a scale that ranges from -2 to +2. The second method, the Navicular Drop [2], identifies the foot type

through the difference between the navicular bone to the ground in the sitting and standing position. After choosing the images and foot scores in method 1 and inserting the vertical measurements in the sitting and standing positions in method 2, the application provides the classification of foot types, based on standard scores for each of the methods. KnowFoot app allows capturing photos of the feet and store information of the evaluated individuals for further analysis. The technologies used for App construction were Ionic 3, Angular, Javascript, HTML, CSS e Firebase and the technologies used in its styling and design were Adobe Photoshop CC 2018, Adobe InDesign CC 2018.
RESULTS: This is the first app created to provide a foot type analysis for mobile. A reliability research are in process. The results will be soon published.
CONCLUSION: knowfoot is an easy use app, developed to evaluate the foot type in a static condition. It can provide the foot type in an easy and fast way, as well as to store evaluated feet pictures and daily life activities information for later analysis, thus providing a database construction.

EVALUATION AND RELIABILITY OF A NEW MOVEMENT QUALITY ASSESSMENT TOOL USED TO GUIDE EXERCISE PRESCRIPTION .

BENNETT, H.

UNIVERSITY OF SOUTH AUSTRALIA

INTRODUCTION: While the assessment of movement quality is commonplace in practice, there is currently no movement assessment tool specifically designed to guide exercise prescription and track training induced changes in movement quality. The purpose of this study was to (1) introduce a new system for assessing movement quality designed to inform exercise prescription practices (MovementSCREEN), (2) evaluate its suitability for this purpose and (3) establish the intra and inter-rater reliability of the tool for both novice and experienced assessors.
METHODS: The tool assesses movement quality across 9 movements (squat, lunge, deadlift, single leg squat, overhead reach, thoracic rotation, four point, push up, active straight leg raise), and was qualitatively appraised across six key domains to identify the rigor in which it was developed, and its applicability to professional practice. Additionally, 30 apparently healthy adults (mean age 27.3 yrs, SD 5.4) were video recorded completing the MovementSCREEN assessment two times, two weeks apart. The recording was scored two times, two weeks apart, by two expert and two novice assessors to establish inter- and intra- rater reliability. Estimates of systematic and random error were computed with paired t-tests, intraclass correlation coefficients (ICCs), standard error of measurement (SEM95), and minimal detectable change (MDC95).
RESULTS: Despite some limitations in developmental rigor, the tool appears to offer an appropriate method of assessing movement quality with the intent to guide exercise prescription practices. It is presented clearly and its applications are outlined with detail. Intra-rater reliability for the component items (Kappa) ranged from 0.619 – 1.000 and 0.233 – 1.000 for expert and novice assessors respectively, while ICC for the movement quality scores ranged from 0.707 – 0.952 and 0.502 – 0.958. SEM95 for the individual movements ranged from 4.39 to 18.85, while MDC95 ranged from 6.21 to 26.66. The MDC95 for the composite movement quality score was 6.1 points, with an ICC 0.901.
CONCLUSION: The MovementSCREEN has been developed to meet the needs of practitioners working within strength and conditioning or general fitness based exercise prescription environments. Results suggest that the tool can reliably assess movement quality on a test-retest basis when used by experienced assessors, although there is some variability in scoring between assessors. The MDC95 for the composite score of movement quality is approximately six points, suggesting a capacity to track training induced changes in movement quality when assessed by the same practitioner.

Oral presentations

OP-BN20 Concussions and other injuries in contact sports

USA UNIVERSITY RUGBY-7S TOURNAMENT PLAYERS INJURY RATES: AN EMERGING U.S. GENDER NEUTRAL SPORT

LOPEZ, V.JR.1,2, MYERS, L.S.D.1, MA, R.1,2,3, WEINSTEIN, M.G.1,4, HUME, P.A.1,2, VICTORIA, C.1,2,4, MARCANO, E.D.1,5, METTRY, M.T.1,6, ALLEN, A.A.1,2,7

1: RRIPG-HSS , 2: AUT/SPRINZ , 3: UNIV. MISSOURI-MOI, 4: NYU , 5: PHLEXPT , 6:CUNY , 7:HSS .

INTRODUCTION: The Olympic sport of Rugby-7s, is played on many U.S. universities. Due to its status as a club sport, data to support the development of prevention protocols is scarce. The aim of this study was to document match injury incidence in USA Rugby sanctioned collegiate 7s tournaments.
METHODS: Prospective epidemiological data were collected using the Rugby Injury Survey & Evaluation (RISE) Report methodology (Lopez et al, 2012), compliant with best practices (Fuller et al., 2007) to capture injury rates. USA Sevens Collegiate Rugby-7s Championship and Rugby Invitational (1,138 athletes) over 2011-2012, 2014-2015 competitive divisions (men and women collegiate and small college championships) match injuries were evaluated.
RESULTS: Injury rates overall (including time-loss and medical attention) were higher among university men (183.9/1000ph, CI:148.8-224.8) compared to women (95.1/1000ph, CI:50.6-162.6; RR: 1.93, p=0.018). Time-loss injury rates were observed higher among men (67.8 /1000ph, CI:47.2-94.2) than women (14.6/1000ph, CI:1.8-52.9, RR:4.63, p=0.012). Mean injury severity was 85.2 mean days absent (men 82.6d, SD:16.6; women 130.0d, SD:40.0). Backs had higher rates (69.6/1000ph, CI:45.5-102.1) of time-loss injuries than forwards (32.1/1000ph, CI:14.7-61.1; RR: 2.17, p=0.039). Mean severity of injuries was higher among forwards (133.4d, SD:122.8) than backs (74.2d, SD:84.5, p=0.117). Most injuries (overall 69.4%) occurred during the first two matches of the tournaments. Injuries overall were acute, among combined genders at 82.4% and occurred during the tackle (63.0%) and running/open play (12.1% overall; from 12.5% in 2012 to 21.1% in 2014). Among all players, 57.4% were injured during a shoulder tackle, which was more prevalent than other tackle types (p<0.001). Recurrent injuries were observed at 34.9% of all injuries (56.6/1000ph, CI:39.9-78.1). Most common injuries were concussions (11.2%, 18.4/1000ph), shoulder dislocations (11.2%, 18.4/1000ph) and ankle sprains (9.4%, 15.3/1000ph). Concussions were frequently observed among men (12.7% of all injuries among males; 23.2/1000ph, CI:12.0-40.6).
CONCLUSION: Increasing risk of head/neck injuries, is a concern with the expansion of collegiate U.S. Rugby-7s over 2011 and 2012, 2012 and 2014, 2012 and 2015 (RR: 2.17, 4.7, 3.3, respectively). Head/neck injury rates in the current study were found to be higher than inter-

national elite males Rugby-7s (5%) (Fuller et al., 2010) and U-20 international Rugby-15s (12%) (Fuller et al, 2011). Largest injury increase was seen in running/open play, possibly due to the variability of training regimens among programs. Developing institutional support as other U.S. collegiate sanctioned sports can help reduce injuries.
References: Lopez V, Jr., et al (2012) Am J Sports Med, 40(1), 179-84.
Fuller CW, et al. (2007) Clin J Sport Med, 17(3), 177-81.
Fuller CW, et al. (2010) Clin J Sport Med, 20(3), 179-84.
Fuller CW, et al. (2011) Clin J Sport Med, 21(4):356-8
drvictorlopezjr@gmail.com

NON-CONTACT INJURY INCIDENCE AMONG U.S. WOMENS RUGBY-7S

VICTORIA, C.1,2, LOPEZ, V.2,3, MA, R.2,3,4, WEINSTEIN, M.G.1,2, HUME, P.A.2,3, HALEEM, S.Y.2,5, DELALLO, J.F.2,6, ALLEN, A.A.2,3,7

1:NEW YORK UNIVERSITY , 2:RRIPG-HSS , 3:AUT/SPRINZ , 4: UNIV. MISSOURI-MOI, 5:CUNY , 6:TULANE SCHOOL OF MED. , 7:HSS

INTRODUCTION: Rugby-7s, is growing in popularity, with a lack of injury data among women. Aims were to report non-contact risk factors in U.S. women's Rugby-7s.
METHODS: Injury incidence (per 1000 player-match hour (ph)) and non-contact factors were cataloged with the Rugby Injury Survey & Evaluation (RISE) Report methodology (Lopez et al., 2012). Injury data were collected from 10,328 U19 to elite U.S. women players (age: 8-50 years) on 852 teams involving 1,895 matches in 80 USA Rugby sanctioned tournaments (2010-2015). Medical attention injuries were injuries with no absence from play and time-loss injuries were where players were unable to return to play the same day. Injury severity was defined as days absent before return to training/competition. Non-contact injuries were defined as no contact with an opposing player or collision-type mechanism, and further subdivided into classic-non-contact (CNC) (ie: cutting, accelerating); or other non-contact (ONC), influenced by another factor (Marshall, 2010).
RESULTS: Non-contact causes of injury occurred frequently (29%; n=167) over the study period (CNC=92%, n=153; ONC=8%, n=14; P<0.001). Non-contact injuries overall (including time-loss and medical attention) were found at similar rates among backs (58%, 23.9/1000ph, CI:19.1-29.6) and forwards (42%, 19.3/1000ph, CI:14.4-25.3; RR:1.04, p=0.816). CNC time-loss injuries were observed at similar rates among positions (backs 6.1/1000ph; forwards 5.9/1000ph, RR:1.03, p=0.933). Non-contact injuries resulted in 58.4 mean days absent (CNC 58d; ONC 60d). Injuries overall were acute (90%) and occurred during attempted tackling (35%) and running/open play (32%). Most injuries (70%) occurred during the first two matches of the tournaments. Recurrent injuries were observed at 40% of all injuries (10.0/1000ph, CI:7.7-12.8). Most common time-loss injuries were ankle sprains (18%). Knees were most commonly injured (23%, 5.9/1000ph, CI:4.1-8.1) followed by ankles (17%, 4.3/1000ph, CI:2.8-6.3). Non-contact injuries were higher on artificial playing surfaces (36.6/1000ph) as compared to grass (24.7/1000ph, RR:1.48, p=0.044).
CONCLUSION: The incidence of head/neck injuries among U.S. women is of concern, reemphasizing the need for more focus on attempted tackling techniques, among women and non-contact factors (Ma et al., 2016). The current study's increase in injury with running/open play phases supports the need for training and conditioning necessary to meet Rugby-7s demands (Portillo et al., 2014). To avoid overtraining, a balance must be between pre-season, competition conditioning and tournament demands, since a single Rugby-7s tournament reduces neuromuscular function and players may not be fully recovered by the start of the second competition (West et al., 2014). Injury reduction of non-contact soft tissue and ligamentous injuries to the lower extremity may be achieved by increasing muscular load tolerance and proprioception during training to include open field maneuvers (Hrysomallis 2007).

CHANGES IN COGNITIVE PERFORMANCE AND CEREBRAL OXYGENATION IN YOUNG RUGBY UNION PLAYERS OVER ONE SEASON

TERBLANCHE, E., CLARKE, A.

STELLENBOSCH UNIVERSITY

INTRODUCTION: Changes in functional brain connectivity, as well as impaired cerebral haematological function and neurocognitive function have been reported in contact sport players, even in the absence of a diagnosed concussion. Specifically, studies described compromised executive cognitive function in both active and retired rugby union players Shuttleworth-Edwards et al, 2008; Hume et al, 2017). The aim of this study was to determine whether a fifteen-week high-level competitive season elicits changes in the cognitive function and cerebral oxygenation of young rugby players.
METHODS: Twenty-nine athletes (16 rugby players and 13 non-contact sport athletes) were assessed before and after the 2017 Varsity Cup rugby competition, held in South Africa. None of the participants experienced, or were diagnosed with concussion over the 15 weeks. Each participant completed the CNS Vital Signs® Core testing battery, during which continuous measurements of cerebral oxyhaemoglobin (COX) were made using near-infrared spectroscopy. The cognitive testing battery consisted of seven tests that assessed eleven cognitive domains. Training and match time were noted for each individual on a weekly basis. Cohen's effect sizes and 95% confidence intervals (CI) were calculated to compare the magnitude of differences in cognitive function and COX between the groups.
RESULTS: There was no difference in training and competition time in the two groups over 15 weeks (P>0.05). Rugby players performed better in the domains of information processing speed (ES=0.4, 95% CI -0.44, 1.03) and psychomotor speed (ES=0.47, 95%CI -0.5, 0.99), but worse in the 'higher' domains of executive function (ES=0.77, 95%CI -1.4, 0.1) than the non-contact players. COX during cognitive testing was higher in the rugby players than in the non-contact players at the end of the season (ES = 0. 57, 95%CI -0.23, 1.34).
CONCLUSION: The findings of this study are inconclusive whether repetitive subconcussive events, as experienced during rugby training and matches over one season, negatively affect the cognitive performance of young rugby players. It is possible that 15 weeks were too short to measure changes in brain health, or that the actual subconcussive events were minimal. However, this does not exclude the possibility that exposure to contact over multiple seasons may not cause neural impairments to the extent that cognitive function, and health, are affected later in life.
References: Hume et al (2017). Sports Med, 47:1209-1220
Shuttleworth-Edwards et al (2008). J Clin Exp Neuropsych, 30:870-884

RECOVERY OF VESTIBULAR AND OCULOMOTOR IMPAIRMENTS IN AMATEUR ATHLETES FOLLOWING SPORT-RELATED CONCUSSION; A PROSPECTIVE STUDY.

BÜTTNER, F., HOWELL, D., DOHERTY, C., RYAN, J., BLAKE, C., DELAHUNT, E.

UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: Vestibular and oculomotor symptoms are frequently self-reported by athletes following sport-related concussion. However, clinical assessment strategies, that longitudinally identify the presence of vestibular and oculomotor impairments, remain elusive in the absence of a baseline assessment. Few longitudinal studies exist that clinically evaluate the natural history of vestibular and oculomotor impairments following sport-related concussion.
METHODS: Objective: To prospectively and longitudinally describe the recovery of vestibular and oculomotor impairments in amateur athletes following sport-related concussion.
Design: Prospective, longitudinal study.
Setting: Clinical evaluation at a university biomechanics laboratory.
22 amateur athletes diagnosed with sport-related concussion by an emergency medicine physician, and 22 sex-, age-, and activity-matched control participants, were assessed on 3 separate occasions: within 7 days following sport-related concussion, prior to return-to-activity [range (days)= 6 - 24], and 2 weeks after return-to-activity. Control participants were assessed at matched time-points.
At each assessment, a Chartered Physiotherapist administered the Vestibular/Oculo-Motor Screening (VOMS) to study participants. The VOMS assesses smooth pursuits, saccades, convergence, vestibular-ocular reflex, and visual motion sensitivity via a 7-item symptom provocation tool. Following each test item, participants self-report their symptom provocation of headache, dizziness, nausea, and fogginess.
A mixed-methods analysis of variance was performed to evaluate participants symptom response to vestibular and oculomotor test items. The independent variables were group and time. The dependent variable comprised the Percentage of Potential Change (PoPC) in total symptoms, a valid measure of symptom change that accounts for the burden of reported pre-test symptoms. The PoPC was calculated using participants self-reported symptoms at baseline (directly prior to the administration of the VOMS) and subsequent symptom reporting following each test item.
RESULTS: A significant time*group interaction was observed ($F(1.5, 64.4) = 7.6$; $p = 0.003$; $N2p = 0.15$). Concussed participants reported significantly greater percentage of potential symptom exacerbation at time-point 1 (mean PoPC = 9.1%; 95% CI = 5.9 - 12.3) compared to control participants (mean PoPC = 2.0%; 95% CI = -1.2 - 5.2). No between-group differences in PoPC were observed at time-point 2 (mean diff. = 0.9%; 95% CI = -1.8 - 3.6) or at time-point 3 (mean diff. = 1.5%; 95% CI = -1.4 - 4.5).
CONCLUSION: Amateur athletes demonstrated, on average, a greater percentage of potential symptom exacerbation within one-week following sport-related concussion compared to matched non-concussed athletes. Between-group differences were no longer present prior to, and following, return-to-activity, suggesting full recovery of concussion-induced vestibular and ocular symptoms by the time amateur athletes resumed physical activity.

LOW RISK OF CONCUSSIONS IN TOP-LEVEL KARATE COMPETITION

ARRIAZA, R., CIERNA, D., ROMAN, F., AGRASAR-CRUZ, C., SAAVEDRA-GARCIA, M.

UNIVERSITY OF A CORUÑA

INTRODUCTION: Although it is well known that injuries take place in combat sports, the true incidence of concussions is not clearly defined in the literature for karate competition
METHODS: Injuries in a total of 4,625 fights (2,916 in the male category and 1,709 in the female category), in four consecutive World Karate Championships (from 2008 to 2014) were prospectively registered. Concussions were identified and analyzed separately for frequency (rate per fight) and injury risk
RESULTS: A total of four concussions were diagnosed by the attending physicians after carrying on the athletes examination. Globally, there was 1 concussion in every 1,156 fights, or 0.43/1,000 AE. In male athletes, the rate of concussion was 1/5,832 minutes of fighting, and in female athletes, it was 1/6,836 minutes. Odd Ratio is 0.57 (95% CI: 0.06-5.47; z=0.489; p=0.6249) and Risk Ratio is RR 1.478 (95%CI 0.271-8.072), p=0.528, representing a higher risk of definite concussions in males than in females, but not statistically significant. Neither in men nor in women there is a significantly higher risk of injury in team competition (no weight-limit) when compared to individual competition (held with strict weight limits for each category)
CONCLUSION: The risk of concussions in top level karate competition is low, with a tendency for an increased risk for males and for competition without weight limits, not statistically significant with respect to females or individual competition

Invited symposia

IS-SH08 Sport for All? Inclusion of Female Refugees in European Sports

PHYSICAL ACTIVITY AND SPORT FOR GIRLS AND WOMEN: A POSSIBILITY OF INTEGRATION INTO GERMAN SOCIETY?

HOFMANN, A.

LUDWIGSBURG UNIVERSITY OF EDUCATION

In 2015 almost half a million persons applied for asylum in Germany. Sport, physical activity and exercise are often used as means to raise awareness for social problems and it is generally thought that they can support integration. This can be seen in the fact that state governments often act as partners of sport federations by giving financial support to set up sport and physical activity offers for refugees. Women with migration background participate to a much lesser extend participate in these programs than males. Several reasons account for this: Not only are there fewer female refugees, but also, due to their religious background women and girls are much more drawn to the private sphere and to family life. This means they often do not participate in public sport or exercise activities to the same extend. In addition, many refugee women and girls were to a lesser extent than men, involved in sports and physical exercise in their home countries. This paper will examine and compare chosen examples how to include refugee women within German sports and show the difficulties and barriers in doing so.

OUTDOORS, SPORT AND INTEGRATION – A SCANDINAVIAN PERSPECTIVE

RADMANN, A., HEDENBORG, S.
MALMÖ UNIVERSITY

During the last five years the number of people who have applied for asylum in Sweden and Norway has increased dramatically as a result of the severe draughts in the Middle East and the war in Syria. Governments have set aside special means for working with the newly arrived and a strategy has been to work with integration using "Friluftsliv" (Outdoors) and sports. The Norwegian White Paper No. 18 (Stortingsmelding 18 (2015-16) "Outdoors – nature as a source of health and overall life quality" declare that it is a strong political commitment to involve refugees in the Norwegian tradition of Outdoors/Friluftsliv since Friluftsliv is considered to be an important arena for inclusion and integration. As a means for integration the Swedish government decided to set aside 32 and later 64 million Swedish Crowns per year for work directed to the Swedish Sport Confederation's integration projects. The aim of this presentation is to critically analyse the perceptions of "friluftsliv" and "sport" in relation to integration/inclusion. Why these activities are seen as important in the process of integration as well as in what ways the use of these concepts reveals ideas of what it is to be a "typical" Norwegian or Swede will be discussed using an intersectional perspective and a critical analysis of how good intentions of integration/inclusion simultaneously include and exclude groups (cf Popkewitz 2008).
Popkewitz, T, Cosmopolitanism and The Age of Reform (2008).

˝TRAIN THE TRAINERS˝: GENDER AND INTERCULTURAL COMPETENCES IN COURSES FOR COACHES FOR TRAUMATIZED FEMALE REFUGEES

DIKETMÜLLER, R., LEY, C.
UNIVERSITY OF VIENNA

Knowing that refugees show a particularly high prevalence of psychosomatic and psychosocial disorders and that exercise and sport gain somatic and psychosocial health benefits, this lecture focuses on the relevance of gender and intercultural competencies of ongoing coaches for traumatized women. Previous studies (e.g. Ley et al., 2016) indicate that these benefits are very relevant for traumatized refugees, torture and war survivors. Nevertheless, especially for migrant (muslim) women the person who offers physical activity and sport is crucial. Till now, competencies of coaches for traumatized female refugees are currently scarcely researched and curricula on this issue are still missing. The research analyses how gender, cultural, religious and health-status issues are addressed within a program for coaches who wanted to work with traumatized female refugees. It got clear that intersectional approaches were needed in order to contribute to the understanding of the specific needs of the target group and to the development of a target-group oriented program. This lecture focuses on the results regarding the program-development, the experiences of the coaches in offering physical activity and sport and finally discusses the role of gender and intercultural issues in the framework of trauma work with female refugees.
Ley C. (2016). Sport and exercise therapy with people forced to cross borders. In ECSS Vienna 2016 Book of Abstracts, p.159.

Oral presentations

OP-PM78 Cycling

THE EFFECT OF PHYSIOLOGICAL AND ANTROPOLOGICAL PARAMETERS ON SCORING RESULTS OF SLOVENIAN CYCLISTS IN THREE AGE CATHEGORIES

JUROV, I., MILIC, R., RAUTER, S.
FACULTY OF SPORT, UNIVERSITY OF LJUBLJANA

INTRODUCTION: Physiological markers in cycling that are typically used in assessing performance are VO2max, peak power, power per unit of body mass, lactate values and heart rate. Cycling is an athletic discipline favouring leanness and body mass is a known anthropological factor contributing to athlete's performance. However, some parameters like peak power are more dependent on fat free mass as opposed to body mass. Markers like peak power per unit of fat free mass (W/kg FFM) have been proposed for assessing and comparing values of power measurements. All these markers are known to influence performance. We have conducted a research on Slovenian cyclist in three age categories (U17, U19 and U23) to find a correlation with their overall result in cycling in that year.
METHODS: The aim of the study was to find correlations between cyclist's overall yearly results and physiological parameters obtained on the cycle ergometer in the laboratory. The study involved 110 cyclists, 43 in the U17 category (age 16 ± 0 years, BM = 67,7 ± 6,6 kg, BH = 179,8 ± 7,0 cm, % fat = 9,1 % ± 2,7 %), 42 cyclist in the U19 category (18 ± 0 years, BM = 68,3 ± 6,1 kg, BH = 179,4 ± 6,3 cm, % fat = 9,9 ± 3,1 %) and 25 cyclists in the U23 category (20,4 ± 0,5 years, BM = 71,2 ± 6,0 kg, BH = 181,8 ± 4,3 cm, % fat = 9,5 ± 2,1 %) who performed incremental cycle exercise test (100W + 20W/min). We used their results in the Slovenian cycling cup and in the international level and compared them to their VO2max, peak power, power per kg, power per kg FFM, BM, body fat percentage and efficiency. Binary regression model was used.
RESULTS: Results showed that there were significant correlations between VO2max (r=0,394, p=0,005), W(max) (r=0,547, p=0,000), W/kg BM (r=0,631 p= 0,000), W/kg FFM (r=0,594, p=0,000) and scoring results in the U17 group. In the U19 category, VO2max (r=0,399, p=0,004), W(max) (r=0,371, p=0,008), W/kg BM (r=0,460 p= 0,001), W/kg FFM (r=0,447, p=0,002) also significantly correlated with the overall result. In the older U23 group, no correlations were found.
CONCLUSION: VO2max, W(max), W/kg BM and W/kg FFM were positively correlated with overall scoring in the U17 and U19 group. However, in the U23 group no correlations were found. In the younger cyclists physical abilities appear to be more relevant, whereas in the older group other factors contribute greatly to the overall result.

FUNCTIONAL OVERREACHING IN PROFESSIONAL FEMALE CYCLISTS; IMPLICATIONS FOR MONITORING AND PRESCRIBING TRAINING

LAMBERTS, R.P.1,2, DECROIX, L.3, MEEUSEN, R.3

1: STELLENBOSCH UNIVERSITY, RSA; 2: STELLENBOSCH UNIVERSITY, RSA; 3: VRIJE UNIVERSITEIT BRUSSEL, BEL

INTRODUCTION: The Lamberts and Lambert Submaximal Cycle Test (LSCT) has shown to be promising tool to monitor and prescribe training in cyclists [1]. However, it has not yet been well documented if and how the LSCT is able to reflect a state of functional overreaching [1-3]. Therefore, the aim of this study was to monitor a team of professional female cyclists during an 8-d training camp and 3 recovery days.
METHODS: Six professional female cyclists performed an LSCT on days 1, 5, and 8 of the training camp
and 3 d after the training camp. During each stage of the LSCT, physiological parameters as power, cadence and hear rate were captured, while a rating of perceived exertion (RPE) at the end of each stage was also given. Upon completing the last stage, heart rate recovery was
were also measured. In addition to the LSCT, cyclists also completed a Profile of Mood States (POMS) and indicated their level of fatigue on a visual analogue scale.
RESULTS: In addition to traditional statistics, magnitude-based inferences (MBI) were used interpret the LSCT data. Power output within the LSCT increased throughout the training camp reaching higher values in stage 2 on day 8 ($p = 0.009$) increased RPE levels in stage 2 on day 5 and 8 ($p < 0.05$). MBI indicated that power during stage 2 and 3 were 'likely' and 'very likely' higher on day 5 and 8, respectively, while RPE's were 'likely' to 'most likely' higher on days 5 and 8. HRR was likely to be faster on day 5, while HRR could not be accurately used on day 8 due to cyclist not being able to elicit their predetermined target heart rates. The different LSCT parameters returned to baseline after 3 days of recovery.
CONCLUSION: The LSCT reflects a state of overreaching in elite professional female cyclists by increased power output levels in combination with higher RPE levels and a faster HRR. The power and HRR response are counter intuitive and without the RPE data, might be interpreted as a positive training adaptation rather than a state of functional overreaching. Therefor a multi-variate approach is needed to correctly monitor and fine-tune training prescription in athletes.
[1] Lamberts R.P. (2014) Int J Sports Physiol Perform 9: 610-614
[2] Meeusen R. et al. (2013) Med Sci Sports Exerc 45:186-205
[3] Decroix L.et al. (2018) Int J Sports Physiol Perform 13: 23-28

THE DIFFERENCE IN INTENSITY AND LOAD CHARACTERISTICS BETWEEN MEN'S AND WOMEN'S PROFESSIONAL CYCLING RACES

SANDERS, D., VAN ERP, T., DE KONING, J.J.

UNIVERSITY OF STIRLING

INTRODUCTION: There is little known about the differences between men's and women's professional cycling races in terms of exercise intensity and load demands. Knowledge of possible differences is relevant for coaches and practitioners with respect to preparation strategies for competition. This study aims to provide an in-depth analysis of a large competition database describing the intensity and load demands of professional road cycling races, highlighting the differences between men's and women's races.
METHODS: Twenty male and ten female highly trained professional cyclists, part of a current World Tour professional cycling team, participated in this study. During 4 consecutive years, whenever possible, heart rate (HR) and power output (PO) data was collected during competitions for both the males and females within the team. Intensity distribution as time spent in five predetermined HR zones was quantified. Load was calculated using different metrics including Training Stress Score (TSS) and Training Impulse (TRIMP). Magnitude based inferences was used to evaluate differences in load and intensity between men and women. Standardized effect size is reported as Cohen's d.
RESULTS: A total of 667 women's and 3024 men's races were analysed. Higher values ($d = 1.36 – 2.86$, large to very large) were observed for distance, duration, total work (kJ) and mean PO in men's races. Mean HR and mean HR as % of maximal HR ($d = 1.60 – 1.80$, large) was higher in women's races as well as time spent in high intensity HR zones (i.e. zone 4 and zone 5) ($d = 1.38 – 1.55$, large) compared to men's races ($42 \pm 11\%$ and $21 \pm 16\%$ versus $24 \pm 12\%$ and $6 \pm 6\%$). Higher absolute loads were observed in men's races quantified using TSS ($d = 0.53$, small) and TRIMP ($d = 0.23$, small). However, relative load (per km) was higher in women's races for TSS·km-1 ($d = 1.50$, large) and TRIMP·km-1 ($d = 2.31$, very large).
CONCLUSION: This study highlights substantial differences in intensity and load characteristics between men's and women's cycling races. Although men's cycling races are longer with a higher total load, the intensity of women's races is substantially higher compared to men's races. This is highlighted by the longer time spent in higher intensity zones and the higher relative load in women's races. Differences in pacing strategies as well as a higher variability in performance level in women's cycling most likely contributes to these results. Coaches should consider these differences in race demands in the preparation of professional cyclists. These results may indicate that preparation strategies between men's and women's races cannot be used interchangeably.

INFLUENCE OF CHRONOTYPE ON PERFORMANCE AND PACING IN A SIMULATED CYCLING TIME TRIALS

SCHWINDLING, S.1, SKORSKI, S.1, SPIEß, F.1, KLÜTSCH, A.1, ABBISS, C.2, MEYER, T.1

1 SAARLAND UNIVERSITY , 2 EDITH COWAN UNIVERSITY

INTRODUCTION: Circadian rhythms regulate key physiological processes involved in athletic performance, e. g. core temperature and serum cortisol. As such, the Chronotype (CT) is defined as an individual's circadian predisposition towards morningness (M) and eveningness (E). It is discussed that CT might influence endurance performance as M-types seem to perform better in the morning and E-types in the evening. However, current results are equivocal (Vitale et al. 2017) as research using sport-specific performance tests is still lacking. Therefore, the aim of this study was to determine the influence of CT on pacing and performance in self-paced cycling time trials.
METHODS: 76 competitive male cyclists and triathletes completed the Morningness-Eveningness Questionnaire to differentiate between CTs (Home et al. 1976). Participants categorized as "definite" M- (n=10) and E-types (n=7) were included in the study. In a randomised order and separated by 2 to 7 days participants performed 4 self-paced 20 km cycling time trails (TT) with a standardised warm-up on an electromagnetically braked cycle ergometer at 4 different times of the day (6 am, 12 pm, 6 pm, 10 pm). Rating of perceived exertion (RPE)

was collected every 10 % and power output (PO) averaged every 10 % of each trial. Perceived mental performance (MP), sleepiness (S) and motivation (M) were collected via visual analogue scales before each trial.
RESULTS: Overall time of day had no significant effect on mean power output (POmean; p=0.12). No significant differences between CT were observed in Pmean (p>0.05) and/or total time (p>0.05) at any time of the day. Furthermore, neither daytime nor CT had a significant effect on pacing (p>0.05) and/or RPE (p>0.05). However, MP of E-type was significantly lower 6 am, compared to 6 (p=0.02) and 10 pm (p=0.01). S and M did not significantly differ between the CT and daytime (p>0.05).
CONCLUSION: Previously published findings observed differences in endurance performance throughout a day as well as between CT. However, in the current study neither time of day nor the individual CT seem to affect cycling performance and/or pacing. This might be explained by the inclusion of a standardised warm-up as it is speculated that this might increase core body temperature, and thus blind potential circadian influences. Additionally, behavioural factors, such as habitual training time might have further influenced the results, as participants regularly train in the afternoon/evening. Interestingly, E-types subjectively rated their MP to be worse before the morning test, however this did not affect their performance.
REFERENCES:
Home JA, Ostbert O. A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. Int J Chronobiol. 1976;4:97-111.
Vitale JA, Weydahl A. Chronotype, physical activity, and sports performance: A systematic review. Sports Med. 2017;47:1859-1868.

DECEPTION OF CYCLING DISTANCE ON PACING STRATEGIES, PERCEPTUAL RESPONSES AND NEURAL ACTIVITY

WINGFIELD, G.
CHARLES STURT UNIVERSITY

INTRODUCTION: The aim of this study was to examine the effect of deception of cycling distance on pacing, cerebral oxy (O2Hb) and deoxy (HHb) haemoglobin concentrations and alpha (α) brain wave activity.
METHODS: 10 well-trained male cyclists completed three cycling time trials (TT) on a stationary air-braked cycle ergometer and were informed the study was to examine the reliability of 3 x 30 km time trials (TT). However, participants unknowingly completed three distances (24, 30 and 36 km) in a randomised order. Performance (power output; PO), physiological (heart rate; HR), perceptual (rating of perceived exertion; RPE) and hemo-neurological (O2Hb, HHb and α activity) measures were recorded at rest and throughout each TT. Data were converted to a percentage relative to the total distance covered.
RESULTS: At 100% completion, HR and PO was lower during the 36 km compared to the 30 km trial (P=0.01). Further during the 36 km compared to the 24 km trial, α waves were reduced at 100% (P=0.02), while O2Hb was greater at 70% of completion (P=0.03). RPE was also higher for 36 km compared to 30 km trial at 80% and the 24 km trial at 10% and 40 – 100% of completion (P=0.00-0.02).
CONCLUSION: We conclude that the increase in O2Hb and RPE during the 36 km trial while a reduction in HR and PO is present, may indicate that the pre-frontal cortex could influence the regulation of exercise performance when deceived of the duration end-point by increasing perception of effort to reduce premature onset of physiological strain

CARBOHYDRATE FEEDING STRATEGIES TYPICAL OF PRO-TOUR CYCLING IMPROVE EXERCISE CAPACITY IN TRAINED CYCLISTS IN A DOSE-DEPENDENT MANNER.

FELL, J.M.1, ELLIS, D.G.1, MORAN, J.1, HEARRIS, M.1, STRAUSS, J.1, COCKS, M.1, LOUIS, J.1, SHEPHERD, S.O.1, MORTON, J.P.1
1LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: It is well accepted that carbohydrate (CHO) feeding during exercise improves exercise performance and/or capacity. Nonetheless, the optimal dose of CHO to exert ergogenic effects is not yet established in those instances where exercise duration is > 3 hours. Previous dose-response studies (Newell et al., 2015; Smith et al., 2013) have also administered CHO drinks per se as opposed to feeding strategies typical of elite cyclists whereby a mixture of drinks, solids and gels are typically consumed. Accordingly, the aim of the present study was to test the hypothesis that CHO feeding as comprised from a mix of CHO sources improves exercise capacity in a dose-dependent manner.
METHODS: In a repeated measures crossover design and after a 36 h CHO loading protocol (12 g/kg body mass) and pre-exercise meal (2 g/kg body mass), eight male trained cyclists (VO2max 61 ± 5 mL.kg-1.min-1) completed three experimental trials comprising of 3 h steady state (SS) cycling at lactate threshold (208 ± 11 W). Subjects consumed CHO during exercise at a rate of 0, 45 or 90 g/h as achieved via a mixture of fluids, solids and gels with fluid being matched within each trial. Muscle biopsies were obtained from the vastus lateralis muscle immediately before and after completion of the 3 h SS protocol after which point, subjects then completed an exercise capacity test at 150% lactate threshold (312 ± 18 W). Venous blood samples and expired gas were also collected throughout exercise.
RESULTS: Exercise capacity was different between trials (P=0.01) where 90 g/h was longer (233 ± 133 s) than both 45 (156 ± 66 s; P = 0.06) and 0 g/h (108 ± 48 s; P = 0.013). Additionally, exercise capacity was greater in 45 g/h compared with 0 g/h (P=0.029). During the final hour of SS exercise, total CHO oxidation rates were greater in the 90 g/h (1.87 ± 0.27 g/min; P=0.07) and 45 g/h (1.74 ± 0.13 g/min; P=0.05) compared with the 0 g/h trial (1.36 ± 0.18 g/min). Accordingly, fat oxidation rates were lower in the 90 g/h (0.81 ± 0.08 g/min) compared with the 0 g/h (0.98 ± 0.06 g/min; P = 0.073) trial but were not different from the 45 g/h (0.87 + 0.05 g/min) compared to the 0 g/h (P = 0.14) trial. Muscle fibre type-specific glycogen and intramuscular triglyceride utilisation during exercise is currently being assessed using immunohistochemistry.
CONCLUSION: Data demonstrates that CHO feeding improves exercise capacity in trained male cyclists in a dose-dependent manner. Given the higher rates of CHO oxidation observed in the CHO feeding trials, such data are likely due to maintenance of plasma glucose availability and/or muscle and liver glycogen sparing.
Newell, M.L. et al. (2015). International Journal of Sport Nutrition and Exercise Metabolism, 25, 285 - 292.
Smith, J. W. et al. (2013). Medicine and Science in Sports and Exercise, 45, 336-341.

Oral presentations

OP-PM82 Training and testing: mixed

ELECTROMYOGRAPHY ANALYSIS OF FRONT CRAWL SWIMMING, PULL UP AND BENCH PRESS EXERCISES

CROWLEY, E., HICKEY, S., QUILTER, C., HARRISON, A.J., LYONS, M.

UNIVERSITY OF LIMERICK, IRELAND

INTRODUCTION: Resistance training is intended to increase maximal force output and therefore improve swimming performance. Resistance training exercises for specialised preparation and development refer to the improvement in human performance with regards to specific performance movements. Therefore, the transfer of resistance training to swimming performance is imperative. Specificity is an underlining concept that aids in the positive transfer of resistance training exercises to human performance due to the improved coordination of the musculoskeletal system. Therefore, an analysis of the neuromuscular system through the investigation of electromyography (EMG) on both resistance training exercises and swimming performance is required.
METHODS: Fourteen male national and international level swimmers (18.2 ± 2.5 years) were recruited. EMG and 2D kinematic data were collected whilst swimming and performing the barbell bench press and prone pull ups in a randomised order. A standardised race warm up was conducted at the start of each testing session. The participants then swam 3 x 35 m front crawl swimming repetitions, with 5 minutes' passive rest between repetitions. The first set was conducted at approximately 70% of the swimmer's maximal effort with sets two and three at maximal exertion. A standardised resistance training warm up was conducted before performing bench press and pull ups at 70% of their 5 RM with set two and three conducted at their 5 RM. EMG data were filtered using a 4th order Butterworth filter. The data were normalised to peak EMG values for each muscle only during the propulsive phase of front crawl swimming and the concentric phase of the bench press and pull up exercises. Technical parameters (stroke length, stroke rate and maximal swimming velocity) were extracted from the 2D kinematic data collected and Pearson correlations were conducted.
RESULTS: The muscle activation data were presented using a 50% threshold of peak EMG values of each muscle during front crawl swimming, bench press and pull up. The onset and offset EMG data displayed overlapping muscle activation patterns between the propulsive phase of front crawl swimming performance and bench press or pull up exercises. 2D kinematic data found moderate to strong Pearson correlations between stroke rate, stroke length and maximal swimming velocity.
CONCLUSION: The results of this study show similarities between muscle activation patterns between the propulsive phase of front crawl swimming performance and pull up or bench press exercises. Further investigation is required to compare the linear envelopes of the pull up and bench press exercises to front crawl swimming performance to support these findings. Methods such as functional data analysis and statistical parametric mapping are two such methods that could provide a further indication of the specificity of these resistance training exercises to swimming performance.

THE EFFECT OF POST-EXERCISE APPLICATION OF EITHER GRADUATED OR UNIFORM COMPRESSION SOCKS ON THE MITIGATION OF DELAYED ONSET MUSCLE SORENESS.

MCDONNELL, A.C., COOPER, D., MLINAR, T., MEKJAVIC, I.B.

INSTITUTE JOZEF STEFAN

INTRODUCTION: A series of studies were conducted to test the hypothesis that compression socks worn following an exercise comprised of eccentric contraction of the calf muscles mitigate exercise induced delayed onset muscle soreness (DOMS). Secondly to compare the effects of compression strategy, whether uniform or graded compression is better suited to mitigate the perception of DOMS.
METHODS: A total of 59 (39 male and 20 female) participants took part in three exercise protocols, anticipated to induce a detectable degree of muscle soreness. Participants wore either ankle height socks with no compression (NoCo), knee height socks with uniform (UNI) or graduated compression (GRAD) for 8hrs/day following exercise. Before, immediately after and at regular intervals during the recovery period, we measured muscle strength, flexibility and the perception of DOMS. The three exercise protocols were: 1) Hike trial (Low pain): A 10-km treadmill hike with a 1000m mountain ascent and descent phases, assessed the effects of GRAD socks in mitigating DOMS, by comparing the results to those of the NoCo socks. 2) Trail Run trial (Moderate pain): compared the effect of GRAD and UNI socks in mitigating DOMS following a 14km trail run with 250m ascent and descent. 3) Calf exercise trial (moderate to severe pain): compared the effect of GRAD and UNI socks in mitigating DOMS following a predominately eccentric calf exercise.
RESULTS: GRAD socks significantly mitigated subjective perception of muscle pain in the calf on day 2 compared to NoCo (Hike Trial). The UNI socks were superior to the GRAD socks in mitigating the perception of pain during the recovery period in the Trail Run. No statistical difference noted in the perception of pain between the UNI and GRAD socks after the Calf exercise trial.
CONCLUSION: Properly sized compression socks mitigated the perception of DOMS induced by eccentric contractions of calf muscles (Hike trial), with UNI compression socks providing more benefit compared to GRAD socks (Trail Run trial) following a trail run. No differences between the effects of UNI and GRAD socks were observed when eccentric contractions of the calf muscles were severe (Calf exercise trial). Compression socks aid in the perception of recovery following low to moderate pain from DOMS.
ACKNOWLEDGEMENTS:
This study was funded in part by Intersocks d.o.o. (Kočevje, Slovenia), who also provided the socks for the participants.
Keywords: Compression socks, Uniform compression profile, Graduated Compression profile, Recovery, DOMS

VALIDITY AND REPRODUCIBILITY OF THE FUNCTIONAL THRESHOLD POWER TEST

MC GRATH, E., DONNE, B., FLEMING, N., MAHONY, N.

TRINITY COLLEGE DUBLIN

INTRODUCTION: Coggan and Allen have sold 100,000 copies of their cycling manual "Training and racing with a power meter". This textbook introduces the "Functional Threshold Power" (FTP) test and the commensurate FTP measurement. FTP purportedly reflects sustainable power output in a "quasi-steady state" for approximately 60-min without fatiguing. However, the test has not been validated nor proven reliable. The juxtaposition of an invalidated "scientific test" being embraced by a large number of cyclists creates a chasm between sport science and sport in-vivo. Models for power using a hyperbolic model to predict a "fatigueless power" as the asymptote of a curvature constant have stressed that duration is actually limited to about 30-min (Poole et al. 2016). The purpose of this investigation was

initially to determine the repeatability of the FTP test. Thereafter, to assess validity of computed FTP (cFTP) against estimates of lactate threshold and the assertion that cFTP could be maintained for 60-min in a quasi-steady state (60min TT).
METHODS: Participant were highly trained male and female cyclists and triathletes (n=13). Four non-randomised exercise tests were completed on a Wattbike across successive weeks. Test one comprised a 3-min incremental test to volitional exhaustion to compute Dmax (Cheng et al. 1992), and TLac using a double linear regression model (Beaver et al. 1986). Sequentially, two 20-min FTP tests were completed and FTP calculated (cFTP1 and cFTP2, respectively). Lastly, participants were tasked with sustaining their cFTP2 power for 60-min.
RESULTS: The 95% limits of agreement (LoA) between cFTP1 and cFTP2 test were deemed acceptable (+15 to -20 W, mean bias 2 W, ICC=0.98 and %TEM of 2.4%). The 95% LoA between load at Dmax and TLac with cFTP1 extrapolated to +46 to -10 W, mean bias 18 W, ICC = 0.85 and %TEM of 6.5% and +78 to -46 W, mean bias 16 W, ICC = 0.74 and %TEM of 9.2%, respectively. These disparities were considered unacceptable, despite ANOVA failing to detect significance ($P > 0.05$) between variables. The 60min TT was successfully completed by 12 of 13 participants assessed at a load equivalent to their cFTP.
CONCLUSION: Comparing cFTP1 with the Dmax and TLac would intimate that cFTP may be a proxy substitute. However, the effectiveness of Dmax or TLac to predict 60minTT should be questioned. We suggest that in highly trained athletes cFTP is a superior predictor for 60mTT than either Dmax or TLac. However, based on physiological measures recorded during testing, cFTP should not be used as a stand-alone pivot for exercise prescription.

PRACTICE EFFECTS OF SYNCHRONOUS AND ASYNCHRONOUS SUBMAXIMAL HANDCYCLING

KRAAIJENBRINK, C., VEGTER, R., HENSEN, A., WAGNER, H., VAN DER WOUDE, L.

UNIVERSITIES OF GRONINGEN AND MUENSTER

INTRODUCTION: The handcycle crank system is based on bicycle technology and was initially asynchronous. Although a shift from asynchronous to synchronous crank mode took place in the eighties, an asynchronous crank mode is still seen, especially in non-western countries (Mukherjee et al. 2001). It is suggested that asynchronous is more strenuous than synchronous handcycling, due to trunk stabilization (Bafghi et al. 2008). Our aim is to compare asynchronous (ASYN) and synchronous (SYN) low intensity handcycling (15 W) and study effects of practice on cardio-respiratory variables. We hypothesize that asynchronous handcycling is more straining than synchronous handcycling. Over time, trunk instability is controlled and energy expenditure, oxygen uptake, ventilation and heart rate reduce in both modes.
METHODS: Twelve able-bodied men performed a pre-test, 3 practice units (see Kraaijenbrink et al. 2017) and a post-test in an add-on handcycle on a treadmill at 1.94 m/s and was repeated for SYN and ASYN. Pre and post-tests consisted of 3x4-minute exercise at 15 W with 60 rpm with 2-minute rest in-between. Oxygen uptake (VO2, ml/min), ventilation (VE, L/min) and heart rate (HR, bpm) were continuously measured. Energy expenditure (EE, W) was calculated according to Garby & Astrup (1987). Values were averaged over the last minute of each block to ensure steady state. Effects were analyzed with a repeated measures ANOVA ($P<0.05$) with crank mode (SYN-ASYN), test (pre-post) and time (4th, 8th and 12th minute) as within-subject factors.
RESULTS: EE is significantly higher ($P=0.004$) in ASYN (416 W) than SYN (386 W). No test, time or interaction effects are found. VO2 is significantly higher ($P=0.015$) in ASYN (813 mL/min) than SYN (741 mL/min), and decreases significantly after training ($P=0.008$) and over time ($P<0.001$). An interaction effect between crank mode and time exists ($P=0.021$). VE is significantly lower ($P=0.018$) in the post-test (20 L/min) than in the pre-test (22 L/min) and has an interaction effect of crank mode and time ($P=0.006$). The HR in the SYN mode increases significantly over time ($P=0.042$).
CONCLUSION: The difference between SYN and ASYN reduces over time for EE, VO2, VE and HR values. Asynchronous handcycling is a difficult motor task, but even after short practice, the cardio-respiratory variables reduce supported by a motor learning effect, as represented by an interaction effect in VO2 and VE.
REFERENCES:
Bafghi, AH et al., 2008. IJSM, 29(8), 630–638.
Garby, L & Astrup, A, 1987. Acta Physiol Scand, 129(3), 443–444.
Kraaijenbrink, C et al., 2017. PLoS ONE, 12(8)
Mukherjee, G et al., 2001. Clin Rehabil, 15(2), 125–132.

OXYGEN UPTAKES SLOW COMPONENT AND EFFICIENCY OF HALF-SQUAT EXERCISE

GARNACHO-CASTAÑO, M.V.1, PALAU, G.1, SERRA-PAYÁ, N.1, GOMIS, M.1, SAMATIER, B.1, GUIRAO, L.1, PLEGUEZUELOS, L.1, VILCHES-SÁEZ, S.1, MATÉ-MUÑOZ, J.L.2

TECNOCAMPUS-POMPEU FABRA UNIVERSITY

INTRODUCTION: While several studies have focused on evaluating the oxygen uptakes slow component (VO2sc) in endurance exercises, the VO2sc phenomenon and gross mechanical efficiency (GME) in resistance exercises has not been studied. This study aimed to assess VO2sc and GME in half-squat (HS) exercise during constant-load test at lactate threshold (LT) intensity.
METHODS: Twelve healthy young men completed 3 HS exercise tests separated by 48-hour rest periods: one-repetition maximum (1RM) HS test to determine the % loads to be used in the incremental test, incremental-load HS test to establish the %1RM corresponding to the LT, and constant-load HS test at the LT. During the last test, VO2, lactate and mechanical responses were monitored. GME was calculated as the ratio of work accomplished per minute (ie, W in kcal · min-1) to energy consumed per minute (ie, in kcal · min-1). Fatigue in the lower limbs was assessed before and after the constant-load tests using a counter movement jump test.
RESULTS: A slight and sustained increase of the VO2sc was observed. In blood lactate, no significant differences were observed between set 3 to set 21 ($P > 0.05$). Significant inverse correlations were observed between VO2 and GME ($r = -0.91$, $P < 0.001$). Significant losses were observed in jump height ability and in mean power output ($P < 0.001$) in response to the constant-load HS test.
CONCLUSION: VO2sc tended to rise slowly during constant-load HS exercise testing at LT intensity. We postulated that the VO2sc phenomenon might be explained, at least in part, by the change in GME, which estimates the effects of blood alkalinization on the gradual loss of muscle efficiency (Gaesser and Poole, 1996). Effectively, an inverse relationship between GME and ΔVO2 was observed during the constant-load test, which means that VO2 was slightly increasing and GME was decreasing as the time of the test or sets was extended. It has been reported that a decrease in efficiency coincides with significant increases in VO2 during repeated submaximal exercise (Passfield and Doust, 2000). Thus, a lowering in maximal voluntary force- and power-production is induced in muscle ability (Lucía et al., 2002). This was corroborated by the mechanical fatigue detected after constant load test.

This comprehension would allow to elucidate the underlying fatigue mechanisms produced by resistance exercises in a predominantly aerobic metabolism.
REFERENCES: Gaesser GA, Poole DC. (1996). Exerc Sport Sci Rev, 24, 35-70
Lucia A, Hoyos J, Perez M, Santalla A, Chicharro JL. (2002). Med Sci Sports Exerc, 34, 2079-2084.
Passfield L, Doust JH. (2000). Med Sci Sports Exerc, 32, 1935-41.

Oral presentations

OP-PM47 Microbiota

PROBIOTIC SUPPLEMENTATION INCREASES CHO OXIDATION IN TRAINED MALE CYCLISTS: A RANDOMIZED, DOUBLE-BLIND, PLACEBO-CONTROLLED CROSS-OVER TRIAL

PUGH, J., WAGENMAKERS, A.J.M., MORTON, J.P., CLOSE, G.L.
LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: In vitro and animal studies suggest probiotic supplementation can enhance glucose absorption and subsequent oxidation. This study aimed to investigate the effects of a multi-strain probiotic supplementation on substrate utilization, markers of gastrointestinal damage, permeability, subjective symptoms of discomfort and performance during endurance cycling.
METHODS: Methods - Nine male cyclists were randomized to two periods of daily supplementation with a probiotics capsule (25 billion CFU of Lactobacillus acidophilus (CUL60 and CUL21), Bifidobacterium bifidum (CUL20), Bifidobacterium animalis subs p. Lactis (CUL34), Proven Probiotics) or placebo for four weeks, separated by a 14-day washout period (double-blind cross-over trial). After each supplementation period, cyclists consumed a 10% maltodextrin solution (initial 8 ml.kg-1 bolus at commencement of exercise and 2 ml.kg-1 every subsequent 15 min) while exercising for 120 minutes at 55% Wmax followed immediately by a time trial performance test (100 kJ of work). Markers of GI permeability, damage and GI discomfort were assessed as well as substrate utilization via venous blood and breath samples. Magnitude-based inferences were employed to determine differences in substrate utilization between trials.
RESULTS: Results - Probiotic supplementation resulted in a likely large increase in the proportion of total carbohydrate oxidation (ES = 5.7; ±7.2) and a likely large decrease in the proportion of total energy contributed by fat oxidation (ES = 5.7; ±7.2). No difference was observed in overall energy expenditure (5747 ± 555 vs 5821 ± 451 kJ) between probiotic or placebo supplementation. Comparing probiotic to placebo, there was no change in LR (0.047 ± 0.028 vs. 0.045 ± 0.019), or I-FABP (298 ± 171 vs. 317 ± 95 pg.ml-1). Performance during the time trial was not different in probiotic (301 ± 74s) or placebo trial (308 ± 69s).
CONCLUSION: Conclusion - Probiotic supplementation enhances carbohydrate oxidation while simultaneously attenuating fat oxidation during moderate intensity cycling. However, probiotic supplementation was not associated with improved symptoms of GI symptoms, damage, permeability or performance.

GUT MICROBIOTA VARIABILITY IN MALE BODYBUILDERS DURING COMPETITION PREPARATION

MITCHELL, L., LUK, A., OCONNOR, H., HOLMES, A.
UNIVERSITY OF SYDNEY

INTRODUCTION: Diet can exert profound effects on human physiology that are exploited by athletes to modify physique and improve performance. However, a limiting factor is that the effect of diet varies between individuals. This variable response to diet has been demonstrated to arise through mechanisms that are influenced by the gut microbiota. During competition preparation bodybuilders typically undergo a progressive series of diet modifications aimed to achieve reductions in fat mass. Since this process involves change to the macronutrient profile and total energy intake it is possible that the effectiveness will be influenced by inter-individual differences in the gut microbiota. The purpose of this study was to describe the association between the gut microbiota and dietary intake of males spanning a period of body composition modification, and identify factors which may determine these.
METHODS: Five competitive bodybuilders (28.0±11.9 yrs, 77.7±6.7 kg, 177.0±2.8 cm) were followed over 12 weeks with stool samples collected at 8 and 1 week before, and 4 weeks after, competition. Weighed food record (7 days), body composition, resting metabolic rate (RMR), and serum hormones were measured. QIIME was used for microbial analysis, to cluster operational taxonomic unit at 97% sequence identity, and measure alpha- and beta-diversity. Linear discriminant analysis effect size was used to identify differences in microbial taxa and dietary factors between time points and participants. Repeated measures ANOVA was used to assess change in diet composition, body composition and serum variables.
RESULTS: Carbohydrate and starch provided a significantly greater, and protein a significantly lesser, proportion of dietary energy post-competition than pre-competition ($p<0.05$). Fat mass, lean mass, and IGF-1 were significantly increased in the four weeks after competition ($p<0.05$), with no change in RMR, testosterone, insulin, cortisol or leptin ($p>0.05$). The gut microbial diversity of all participants was typical of healthy humans, with diversity indices for each sample showing no significant differences across the dataset ($p>0.05$). Analysis of patterns of beta-diversity (difference between samples) indicated that although the diet shifts induced changes in the microbial abundance distribution over time, each participant maintained distinct differences to other participants. A consistent effect was a post-competition increase in Bacteroides (LDA score=4.91) that corresponded with increased dietary starch (LDA score=4.47).
CONCLUSION: The dietary strategies of bodybuilders impact their microbiota as well as host physiology and metabolism. Despite similar dietary alterations at the level of macronutrient composition and energy intake, the microbial composition varied markedly between individuals. Hence, individual starting microbial compositions and specific food choices also need to be considered to predict the effects of dietary strategies used during competitions.

INTRA-INDIVIDUAL VARIABILITY IN NITRATE REDUCING FACULTATIVE COMMENSAL BACTERIA IN THE ORAL CAVITY

LIDDLE, L.1, BURLEIGH, M.1, MONAGHAN, C.1, MUGGERIDGE, D.J.2, SCULTHORPE, N.1, BUTCHER, J.1, HENRIQUEZ, F.L.1, EASTON, C.1
1 UNIVERSITY OF THE WEST OF SCOTLAND, 2 UNIVERSITY OF STRATHCLYDE

INTRODUCTION: The ingestion of nitrate (NO3-) rich beetroot juice (BRJ) increases the bioavailability of nitric oxide (NO) and, in some cases, has been shown to improve exercise performance. Crucial to this process is the reduction of NO3- in saliva to nitrite (NO2-) by NO3-

reducing bacteria in the oral cavity, of which there are fourteen known species. However, the extent to which the abundances of these bacteria vary over time is unknown. The aim of the study was to determine the intra-individual variability (CoVi) in the abundance of known NO3- reducing bacteria in the oral cavity and to assess whether this influences the variance in salivary and plasma [NO2-].
METHODS: Nine healthy male participants (age 25 ± 5 years, stature 177 ± 5 cm, and body mass 81 ± 11 kg) completed three identical trials. At the beginning of each visit, a bacterial scrape was taken from the posterior section of the dorsal surface of the tongue for 16s rRNA next-generation sequencing. During each visit, the collection of blood and saliva were obtained at baseline and 2.5 h after the ingestion of BRJ, for later analysis of [NO2-]. Taxonomic classification and bacterial abundance were quantified using Qiime software and clustered based on 97% identity and taxonomy using RDP classifier trained to the GreenGenes database (October 2013 release).
RESULTS: The CoVi for the sum of the NO3- reducing bacteria during the study was 20 %. At the species level, the CoVi for the NO3- reducing bacteria detected in these analyses were: Prevotella Melaninogenica (27 %), Veillonella Dispar (31 %), Rothia Mucilaginosa (41 %), Veillonella Parvula (44 %), Neisseria Subflava (58 %), Haemophilus Parainfluenzae (91 %), and Rothia Dentocariosa (118 %). Salivary (Δ768 ± 193 μM) and plasma (Δ154 ± 38 nM) NO2- were all significantly elevated 2.5 h after the ingestion of BRJ in each of the three experimental trials (all $P < 0.01$). The CoVi for salivary and plasma NO2- following BRJ were 19 and 24%, respectively. The variance in the abundance of NO3- reducing bacteria (sum of all species) was not associated with the variance in salivary (baseline, $r = -0.34$, $P = 0.08$; 2.5 h, $r = -0.18$, $P = 0.37$) or plasma (baseline, $r = -0.11$, $P = 0.59$; 2.5 h, $r = 0.08$, $P = 0.71$) [NO2-].
CONCLUSION: These data demonstrate that the abundance of NO3- reducing bacteria on the tongue can vary profoundly from week to week. However, such variation in the abundance of these bacteria does not appear to account for the CoVi in plasma and salivary NO markers. Further work is required to determine whether it can influence the physiological and performance responses to BRJ.

GUT MICROBIOTA DYSBIOSIS INDUCED BY ANTIBIOTICS AND RESEEDING : FUNCTIONAL AND METABOLIC IMPACTS ON SKELETAL MUSCLE

NAY, K., JOLLET, M., GOUSTARD, B., BAATI, N., VERNUS, B., BONNIEU, A., OLLENDORFF, V., DERBRÉ, F., RAMONATXO, C.
INRA, UMR866 DYNAMIQUE MUSCULAIRE ET MÉTABOLIQUE, MONTPELLIER, FRANCE

INTRODUCTION: Gut microbiota cross-talks metabolically with many organs, such as brain, lung and liver. Recently, the hypothesis of a dialogue between microbiota and skeletal muscle has emerged, however no study has thoroughly explored this functional link with potentially significant scientific and implications in the athlete performance.
METHODS: We determined in C57BL/6 mice the effects of a broad-spectrum antibiotic mixture on both running endurance performance and fatigability using ex-vivo assessments of muscle contractility. These results were compared to those obtained in animals sacrificed 11 days after the end of antibiotic treatment to observe the potential recovery on muscle performance after reseeding. Muscle structure and typology, as well as cellular mechanisms involved in skeletal muscle atrophy, mitochondrial biogenesis and substrate bioavailability were also explored;
RESULTS: Antibiotic-treated mice exhibited a significant decrease of running time limit, and an increased ex-vivo fatigability of skeletal muscle. However, maximal aerobic speed (MAS) and maximal ex-vivo strength remained unaffected. These deleterious effects on endurance performance were rapidly corrected after a period of reseeding, supporting a direct link between gut microbiota and skeletal muscle function. No major changes were evidenced for muscle mass, mitochondrial biogenesis, proteosynthesis/proteolysis or muscle fiber typology. Interestingly, promising analyses suggest that muscle glycogen content could play a role in alterations of muscle endurance related to antibiotic treatment-induced dysbiosis.
CONCLUSION: Our data suggest the existence of a functional crosstalk between microbiota and skeletal muscle. These results, beyond gut dysbiosis, questions on altered endurance performance observed in athletes treated with antiobiotics, and thus highlight the need of further studies on potential beneficial effects of correcting dysbiosis in athletes.

GUT MICROFLORA DIVERSITY IS INDUCED BY RESISTANCE TRAINING IN AGED MICE, BUT ITS ACQUIRED DIVERSITY MIGHT NOT BE CONTRIBUTED WITH THE HIGH PHYSICAL PERFORMANCE

YANO, H., HORII, N., KREMENIK, M.J., AOKI, T., UCHIDA, M., IEMITSU, M., OYANAGI, E.
KAWASAKI UNIVERSITY OF MEDICAL WELFARE

INTRODUCTION: It has been reported that aging-dependent changes in gut microbiota might induce physical and psychological aging. To clarify whether or not the anti-aging by exercise is regulated by changes in the gut microbiota, we investigated the effect of the fecal microbiota transplantation (FMT) from exercised aging mice on the phenotype of each recipient mouse.
METHODS: Male SAMP1 mice (38 weeks old) were divided into SAMP 1 - Ex (resistance training for 12 weeks, n=8) and SAMP 1 - Ctrl (sedentary condition, n=6). Feces were collected from each group, and then meta-genome analysis of gut microbiota was carried out. Moreover, cecal contents were collected and transplanted into recipient mice (C57BL/6 mice). In the control group, the cecal content from the same age- and strain- recipient mouse was used. Analysis of gut microbiota of donor mice and the evaluation of physical activity and anxiety behavior of recipient mice seven weeks after FMT were carried out.
RESULTS: The alpha-diversity (phylogenetic diversity whole tree, Chao1 and observed species) of gut microbiota in SAMP1-Ex mice was significantly higher than that in SAMP1 Ctrl. Additionally, the difference of the microbiome communities between the 2 groups could be observed using traditional PCoA. Especially, the abundance of Akkermansia muciniphila in SAMP1-Ex was significantly lower than that in SAMP1-Ctrl. Although, in the recipient mice, the muscle strength was reduced by FMT from the SAMP1 groups, there was no big difference by FMT from between SAMP1-Ex and -Ctrl groups. Also, the FMT did not affect the physical activity in the recipient mice.
We found that resistance training induced high-diversity of gut microbiota in senescence accelerated mouse SAMP1. Since it is known that A. muciniphila increases in Parkinsons disease or multiple sclerosis patients, resistance training might have a preventive effect on those diseases via gut microbiota alteration. However, at least this FMT experiment showed that high muscular strength and muscle hypertrophy of resistance trained mice did not transmit to recipient mice via gut microbiota.
CONCLUSION: These results suggest that resistance training in senescence accelerated mice might induce changes in the gut microbiota.

Oral presentations

OP-PM30 Molecular biology and biochemistry

THE EFFECTS OF HIGH-INTENSITY INTERVAL TRAINING VERSUS MODERATE-INTENSITY CONTINUOUS TRAINING ON PRO/ANTIOXIDANT STATUS IN MALE ZUCKER RATS ARE TISSUE SPECIFIC.

GROUSSARD, C.1, MAILLARD, F.2,3, VAZEILLE, E.3,5, BARNICH, N.3, SIRVENT, P.2, OTERO, Y.2, COMBARET, L.4, MADEUF, E., SOURDRILLE, A., DELCROS, G., ETIENNE, M., TEIXEIRA, A., SAUVANET, P., PIALOUX, V.

1-LABORATORY MOVMENT SPORT AND HEALTH; 2- AME2P LABORATORY; 3- UMR 1071 INSERM; 4- INRA, UNH, UMR 1019; 5- CHU CLERMONT-FERRAND; 6-CRNH AUVERGNE; 7- LIBM EA 7424.

INTRODUCTION: Physical activity is known as an effective strategy for prevention and treatment of obesity. For years, the moderate-intensity continuous training (MICT) has been the most widely popular type of exercise advised to improve body composition, cardiorespiratory fitness, lipid profile and to decrease obesity-induced oxidative stress. However, recent studies demonstrated that high-intensity interval training (HIIT) was more efficient than MICT to decrease visceral fat mass. Moreover, the long-term adherence to HIIT would be likely increased compared to MICT since the subjects perceive HIIT as less monotonous and more enjoyable. Thus, the aim of this study was to compare the effects of a traditional MICT with a HIIT on pro/antioxidant status in obese rats in different tissues.
METHODS: Male Zucker rats (fa/fa, n = 36) aged of 8 weeks were subdivided into MICT, HIIT or control (CON) group. Trained animals ran on a treadmill (0° slope), 5 days/week during 10 weeks (MICT group: 51 min at 12m.min-1; HIIT group: 6 x [3 min at 10m.min-1 followed by 4 min at 18m.min-1]). Tissues (muscle [gastrocnemius], adipose tissue [epididymal and subcutaneous]) and plasma were collected to measure markers of pro/antioxidant status (oxidative stress markers [AOPP, oxLDL], antioxidant system [FRAP, SOD, CAT, GPx], prooxidant enzymes [NADPHox and XO activities, MPO content]).
RESULTS: In muscle, MICT induced beneficial effects by increasing antioxidant system (SOD activity) without effects on oxidative stress markers (AOPP) whereas HIIT was able to increase both SOD and GPX activities leading to a reduced AOPP level compared with CON. In addition, HIIT had greater effect than MICT with higher GPX activity and lower AOPP. On the contrary, in adipose tissue (epididymal), only MICT exerted beneficial effects by increasing GPX and SOD activities and FRAP level. In subcutaneous adipose tissue, HIIT had negative effects by increasing AOPP level. Finally, in plasma both training programs were equally effective to reduce MPO content.
CONCLUSION: Both HIIT and MICT are efficient to improve pro/antioxidant status but training responses are tissue-specific. HIIT was more helpful than MICT to improve pro/antioxidant status in muscle, ie. the tissue where reactive oxygen species are mainly produced.

EXERCISE TRANING MODULATES TOTAL ANTIOXIDANT CAPACITY AND GENE EXPRESSION IN RAT CARDIAC AND SKELETAL MUSCLE

FUSI, J., FEDERIGHI, G., CERRI, E., BANDUCCI, R., PETROCCHI, A., SANTINI, V., SCURI, R., FRANZONI, F., GALETTA, F.

VAT N. IT00286820501 UNIVERSITY OF PISA

INTRODUCTION: Regular exercise play an important role in the prevention of cardiovascular and muscular diseases. Such effects seem to be mediated by changes in anti-oxidative status, but limited information is available on the nature of molecular pathways supporting the antioxidant effects of exercise in the cardiac and skeletal muscle.
METHODS: In this study 3-5-month-old male Wistar albino rats were subjected to three times/week moderate intensity exercise on a rodent treadmill for a period of 6 weeks. The tissue antioxidant activity towards various reactive oxygen species (ROS) was determined in the cardiac and gastrocnemius muscle. In addition, to identify the molecular pathways that may be involved in ROS metabolism, the expression of sirtuins (SIRT1 and SIRT3) were measured.
RESULTS: Our results showed a higher anti-hydroxyl and anti-peroxynitrite antioxidant activity in both the cardiac and gastrocnemius muscle of physically trained rats compared to sedentary controls. Furthermore, exercise induced an up-regulation of SIRT1, possibly related to an improved redox balance in the cardiac tissue.
CONCLUSION: These results suggest that physical exercise might prevent age-induced oxidative damage in the cardiac and skeletal muscle.

IMPAIRED AUTOPHAGY IN THE LIVER, BUT NOT SKELETAL MUSCLE OF MICE FOLLOWING A HIGH FAT, HIGH SUCROSE DIET

MORALES-SCHOLZ, M.G., SWINTON, C., HOWLETT, K.F., MURPHY, R.M., KOWALSKI, G.M., BRUCE, C.R., SHAW, C.S.

DEAKIN UNIVERSITY

INTRODUCTION: Autophagy is a cell nutrient sensitive degradation process promoting homeostasis by recycling dysfunctional components. Insulin resistance (IR) and ectopic tissue lipid deposition have been recently associated with autophagy impairments. Autophagy responses to acute glucose administration were examined in mouse skeletal muscle and liver following a chronic, high fat, high sucrose diet intervention.
METHODS: Forty 8-week-old, male C57BL/6J mice were randomly divided into 2 groups (n=20 each) and were fed either a high-fat, high-sucrose (HFSD) or standard chow control (CON) diet for 16 weeks. At the end of the diet intervention each group was further divided into 2 subgroups, either receiving water (sham) or glucose (50 mg) via oral gavage after a 5 h fast. Quadriceps and liver samples were collected from each subgroup and tissue lipid accumulation was assessed. Furthermore, markers of autophagy activity, lysosome and lipid-droplet associated protein content, as well as upstream signalling events were measured by immunoblotting and gene expression analyses.
RESULTS: Both the liver and muscle from HFSD groups displayed higher lipid content compared to CON ($P<0.05$). In the liver, the levels of lipidated LC3B and GABARAP, as well as p62, were increased in the HFSD group compared to CON (all $P<0.05$) without any changes in gene expression. HFSD also resulted in upregulation of the lipid-droplet associated proteins PLIN2 and PLIN3 ($P<0.05$). HFSD liver displayed features of IR such as reductions in pAkt (Thr308) post glucose gavage, as well as increases in pmTOR (Ser2448) and pULK-1 (Ser758) compared to CON (all $P<0.05$). In skeletal muscle, there were no differences in autophagy markers (LC3B, GABARAP or p62) between groups, despite a tendency for a reduction in pAkt (Thr308) levels in HFSD ($P=0.07$). LAMP1 protein levels were increased in HFSD

compared to CON (P<0.05), without significant changes in gene expression. Furthermore, there were no changes in any autophagy markers in liver or muscle following acute glucose administration.
CONCLUSION: Taken together, a high-fat, high-sucrose diet intervention induces tissue-specific autophagy impairments. In muscle, no differences in autophagy activity were found after a HFSD intervention. Whereas in the liver, increases in p62 and the lipidated LC3B and GABARAP in the HFSD group indicate autophagosome accumulation, potentially due to a failure of lysosomal autophagosome clearance. These autophagy impairments may contribute to hepatic lipid accumulation and metabolic dysfunction following HFSD.

THE EFFECT OF RAT HIND-LIMB FNDC5 OVEREXPRESSION UPON SKELETAL MUSCLE METABOLISM, IN VIVO

FARRASH, W.1,3, BROOK, M.1, BASS, J.J.1, CROSSLAND, H.1, PHILLIPS, B.E.1,2, CEGIELSKI, J.1, WILKINSON, D.J.1,2, SMITH, K.1,2, CLEASBY, M.3, ATHERTON, P.J.1,2

THE UNIVERSITY OF NOTTINGHAM

INTRODUCTION: Fndc5, a type I transmembrane protein, is up-regulated in skeletal muscle via the transcriptional co-activator PGC-1α after exercise training. Fndc5 is cleaved and its product, Irisin, is secreted and purported to elevate energy expenditure, via causing increased mitochondrial biogenesis/futile cycling through non-shivering thermogenesis - leading to loss of body fat. Moreover, recently, Irisin was purported to regulate skeletal muscle hypertrophy. Similar adaptions occur in skeletal muscle in response to exercise, albeit where Fndc5's/Irisin regulatory pathways are unestablished, and where myokines, such as Irisin, are thought to exert physiological effects on skeletal muscle in an autocrine/paracrine fashion. In this study, we aimed to investigate the mechanistic role of Fndc5/Irisin upregulation in skeletal muscle.
METHODS: Overexpression (OE) of Fndc5 in rat hind-limb muscle was achieved by in vivo electro-transfer techniques i.e. bilateral injections of Fndc5 harbouring vectors for OE rat (n=8) and empty vector for controls (n=8). Seven days later, D2O (7.2mls/kg) was administered via oral gavage for muscle protein synthesis (MPS) analysis. After an overnight fast on day 9, 2-deoxyglucose (2-DG 6mg/kg) was provided during an intraperitoneal glucose tolerance test (IPGTT, 2g/kg) with regular blood sampling. Animals were euthanized and muscles harvested. Metabolic changes in transfected skeletal muscles (tibialis cranialis (TC)) were evaluated.
RESULTS: Gene expression of Fndc5 mRNA in OE TC muscles was increased ~2-fold to that of control values (P=0.001), with concomitant increases in protein expression to 1.4-fold of control animals (P=0.036). In addition, plasma Irisin concentrations were elevated from 1.5 ng/ml in Ctrl, to 3.5 ng/ml in OE animals (P=0.097). As a result, glycogen content and its regulatory gene GYS1, was elevated in Fndc5 OE (P=O.O4 and 0.02, respectively). However, no changes in whole-body glucose disposal were evident with Fndc5 OE i.e. AUC of IPGTT (P=0.75). Similarly, no changes in plasma membrane Glut4 (P=0.15) or its mRNA (P=0.61) were observed. Fndc5 OE had no major effect on muscle mitochondria, as no changes were detected in gene/protein markers of mitochondrial biogenesis. Similarly, anabolic processes relating to muscle growth genes were unaffected by muscle Fndc5 overexpression. Finally, systemic Irisin elevation accompanying Fndc5 OE had no effect on thermogenesis markers, PGC-1α, uncoupling Protein 1 (UCP-1), or cell death activator (CIDEA) in sub-cutaneous fat.
CONCLUSION: Fndc5 overexpression yields limited metabolic impacts in muscle in terms of anabolic and mitochondrial biogenesis processes, and extra-muscular endocrine effects. Nonetheless, increases in glycogen accumulation in Fndc5 OE TC muscle point to a local harnessing of tissue glucose uptake that cannot be discerned on a whole-body level. This study casts further doubt over claims of Fndc5 as a hypertrophic or thermogenic gene product.

PROTECTION OF THE SKELETAL MUSCLE INSULIN SIGNALING PATHWAY IN FEMALES WITH TYPE 2 DIABETES

GORRES-MARTENS, B., SCHMIDT, E., FIELD, T., MUNGER, K.

AUGUSTANA UNIVERSITY

INTRODUCTION: Previous studies suggest that oestrogen loss increase one's risk for type 2 diabetes , and combining oestrogen loss with a high-fat diet poses an even greater risk. The extent to which exercise can ameliorate the deleterious effects of oestrogen loss combined with a HFD and the molecular mechanisms accounting for the whole body changes remains unknown. Therefore, this study analyses the whole body changes and the skeletal muscle insulin signalling pathway in female rats fed a HFD in the presence and absence of oestrogens and examines the extent to which exercise can ameliorate the deleterious effects.
METHODS: Female Wistar rats were fed a standard diet or a HFD for 10 weeks. The rats fed the HFD were either ovariectomised or their ovaries remained intact. A subset of the HFD/OVX rats also underwent exercise training on a motor-driven treadmill. Throughout the study, body weight and food consumption was measured weekly. After 9 weeks, a glucose tolerance test was performed, and blood glucose and insulin levels were measured. After 10 weeks, anaesthetised rats were injected with insulin, and the soleus and extensor digitorum longus muscles were removed and frozen in liquid nitrogen. The amount of abdominal white adipose tissue was removed and weighed. Western blot analyses determined activation of the skeletal muscle insulin signalling pathway via measuring .
RESULTS: Even when combining the HFD/OVX state, exercise significantly decreased the total body weight gain, WAT, hyperglycaemia, and hyperinsulinaemia. However, no significant changes were observed in the skeletal muscle insulin signalling pathway. These results suggest that the skeletal muscle insulin signalling pathway is not responsible for the whole body change seen in this study and is not involved in exercise's ability to combat the whole body changes.
CONCLUSION: Maintenance of the skeletal muscle insulin signalling pathway shown in this study is markedly different from male rodents fed a HFD who show reductions in the insulin signalling pathway and glucose uptake . In human females, increased whole body insulin sensitivity can be explained by greater skeletal muscle glucose uptake . Thus, the insulin signalling pathway in female skeletal muscle may be better suited to respond to insulin and may also possess resilience against defects in the signalling pathway, although more studies are needed to confirm this hypothesis. Furthermore, this study demonstrates the ability of exercise to act as a prophylactic treatment for T2D even when combining two challenging physiological states.

Oral presentations

OP-SH13 Depression, stress and exercise

EXERCISE EFFECTS ON DEPRESSION IN CHILDREN AND ADOLESCENTS: A SYSTEMATIC REVIEW OF META-ANALYSES

BUDDE, H., KAULITZKY, A., AMATRIAIN, S., WEGNER, M., MURILLO-RODRIGUEZ, E.

MEDICAL SCHOOL HAMBURG, UNIVERSIDAD ANÁHUAC MAYAB

INTRODUCTION: Depression is a common threat for children and adolescents in terms of affecting their psychosocial development and increases the risk of suicide. Apart from conventional treatments of depression such as psychotherapy and pharmacotherapy, physical exercise has become a promising alternative. This paper aims at systematically reviewing the extant meta-analyses that focus on the impact of physical exercise on depressive outcomes in children and adolescents.
METHODS: All used meta-analyses were found on PubMed, PsycINFO, PsycARTICLES or hand-searched. The literature research was limited to a period of publication between 1985 till February 28th, 2017. Study eligibility criteria were whether the papers presented mean effect sizes for the impact of physical exercise on dependent variables, the use of randomized controlled trials and other study designs such as quasi-experimental, prospective and cross-sectional observational designs. The overall mean effect was calculated according to Wegner et al., <2014>.
RESULTS: Nine meta-analyses were included that investigated over 50 single studies with over 16,416 participants. The overall mean effect of physical exercise on depression was medium .
CONCLUSION: This study provides a summary of all published results of the effect of exercise on depressive disorders in children and adolescents. Effective exercise programs should be implemented over a longer period of time and, ideally, should integrate an educational dimension. Physical exercise seems to be especially helpful for young patients suffering from either depression or physical health problems with comorbid depression.
References: Wegner, M., Helmich, I., Machado, S., Nardi, A. E., Arias-Carrion, O., & Budde, H. <2014>. Effects of exercise on anxiety and depression disorders: review of meta- analyses and neurobiological mechanisms. CNS & Neurological Disorders Drug Targets, 13<6>, 1002–1014.

DEPRESSION SCORES PREDICTION WITH AEROBIC FITNESS, BODY FATNESS, PHYSICAL ACTIVITY, AND VAGAL INDICES IN FEMALE WORKERS

BOULLOSA, D., TONELLO, L., OLIVEIRA-SILVA, I., MEDEIROS, A.R., DONATO, A.

UNIVERSIDADE CATÓLICA DE BRASÍLIA

INTRODUCTION: The aetiology of depression is multifactorial, with women being most affected than men (WHO, 2017). Previous studies demonstrated an inverse moderate relationship between depression scores and aerobic fitness, appearing stronger in men than in women (Papasavvas et al., 2016). In addition, other factors as body fatness, physical activity (PA) levels, and vagal indices (heart rate [HR] variability [HRV], and HR recovery [HRR]) have been independently demonstrated to be related to depression scores in women. Thus, the aim of the current study was to investigate the relationships between depression scores and all those factors in women; and subsequently elaborate on the best predictive model of depression scores.
METHODS: Thirty-five female workers at two universities (age: 34.5±0.9 yrs; VO2max: 25.2±0.9 ml/kg/min; 29.2±1.1% body fatness; Beck Depression Inventory (BDI) scores: 12.3±1.2) volunteered for participation. In the first day of evaluations, they were evaluated for: aerobic fitness with an incremental cycling test; body fatness with the sum of 7 skinfolds; and depression scores with the BDI. In the second day, HRV was evaluated at rest (sitting and standing), and HRR after a submaximal cycling exercise. PA levels were recorded with an accelerometer over 5 consecutive days. Multicollinearity was defined with correlations >0.7 between independent variables. A stepwise regression and various linear multiple regression models were tested to find the better predictive model of BDI scores.
RESULTS: Only VO2max (r=-0.446, p=0.007) and the sum of skinfolds (r=0.435, p=0.009) were significantly and independently correlated to BDI scores. A stepwise regression analysis showed that only VO2max could significantly predict (R=0.446) BDI scores. Multiple linear regression analyses revealed a slightly better model (R=0.586) when adding the sum of skinfolds, moderate PA, and standing HRV to VO2max.
CONCLUSION: It is concluded that VO2max, an index of aerobic fitness, is the main factor influencing depression scores in overweight female workers, with other health related parameters (body fatness, moderate PA and resting HRV) maybe contributing for depression scores prediction. Further studies should elaborate on these relationships in both sexes, while controlling other potentially confounding factors, for a better understanding the aetiology of depression.

SUPERIOR EFFECTS OF SPRINT INTERVAL TRAINING VS. CONTINUOUS AEROBIC EXERCISE TRAINING ON SYMPTOMATOLOGY IN DEPRESSIVE DISORDER

DONATH, L.1, MINGHETTI, A.2, FAUDE, O.2, ZAHNER, L.2, HANSSEN, H.2

<1> GERMAN SPORT UNIVERSITY, <2> UNIVERSITY OF BASEL

INTRODUCTION: Psychiatric disorders are associated with a higher prevalence of cardiovascular disease and mortality. Regular exercise has been shown to reduce depressive symptoms and improve arterial stiffness as a biomarker of cardiovascular risk. We aimed to investigate the effects of different exercise modalities on depression severity index and arterial stiffness in patients suffering from unipolar depression
METHODS: 34 patients suffering from unipolar depression [female: 25, male: 9, age: 37.8, Beck-Depression-Inventory-II (BDI-II) score: 31.0] were enrolled in this two-armed randomized controlled trial. Central hemodynamics, augmentation index at heart rate 75/min (AIx@75) and aortic pulse wave velocity (PWV) were obtained by an oscillometric monitoring device. Maximal bicycle ergometer exercise testing yielded maximal fitness parameters. Patients were assigned to either high-intensity low volume (HILV) or moderate continuous aerobic training (MCT). Both intervention groups trained three times a week during a 4-week intervention period. BDI-II were filled out by the patients before and after the intervention period.
RESULTS: We found moderate interaction effects on depression severity reduction (η2p=0.10). HILV showed a 85% beneficial effect in lowering BDI-II scores compared to MCT (HILV: pre: 28.8 (9.5), post: 15.5 (8.5), SMD = 1.48), MCT: (pre: 33.8 (8.5), post: 22.6 (7.5), SMD =

1.40). Reduction of AIx@75 was more pronounced after MCT (SMD = 0.61) compared to HILV (SMD = 0.08), showing 37% possibly beneficial effects of MCT over HILV. PWV remained unchanged in both training groups.
CONCLUSION: Both training regimes showed large effects on the reduction of depressive symptoms. While HILV was more effective in lowering depression severity, MCT was more effective in additionally lowering peripheral arterial stiffness. Exercise should be considered an important strategy for preventive as well as rehabilitative treatment in depression

PREVALENCE OF DEPRESSIVE SYMPTOMS IN RETIRED JOCKEYS

KING, L., CULLEN, S.J., LOSTY, C., WARRINGTON, G.

WATERFORD INSTITUTE OF TECHNOLOGY

Introduction: Retiring from sport has many difficulties associated with it which may have implications on mental health (Martin et al., 2014). Limited research is available investigating the prevalence of depression in retired athletes and given the demanding and challenging lifestyle of jockeys (Wilson et al., 2014), this study aimed to investigate the incidence of depression in retired jockeys.
Methods: 36 ex-jockeys (age=41.1±12.85) completed a self-report measurement tool, the Center for Epidemiological Studies Depression Scale (CES-D) (Radloff, 1977), to assess prevalence of depressive symptoms. Demographic information including age, license type, years retired, number of winners, race involvement, making weight difficulties and concussion history was also collected. Information was gathered through distribution of an anonymous online survey.
Results: Mean score for depression in retired jockeys was 15.17±12.19 (range: 1-49), which was below the threshold indicative of depression (<16). Despite this, 44.2% of the retired jockeys met the caseness (criteria) for depression. Using a pearsons correlation, there was a negative weak but significant association between symptoms of depression and years holding a license (r2=-.335;p=.046). Mean scores of depression were higher for jockeys who had been retired for less than ten years (<10 years 19.31±14.57 vs >10 years 11.85±8.95; p>0.05) and those who retired through pressure of the job (24.75±10.5) and injury (18.55±11).
Conclusion
Results of this study suggest that while the group of retired jockeys did not meet the criteria for depression, nearly one in two retired jockeys display symptoms of depression. This indicates a higher prevalence of depression amongst retired jockeys in comparison to retired rugby union and football players (Gouttebarge et al., 2015; 2016). Further research is needed to understand the predictors and causal mechanisms behind these figures.
References: Gouttebarge, V., Kerkhoffs, G., & Lambert, M. (2016). Prevalence and determinants of symptoms of common mental disorders in retired professional Rugby Union players. European Journal of Sport Science, 16(5), 595-602.
Gouttebarge, V., Kerkhoffs, G. (2016). Prevalence and determinants of symptoms related to mental disorders in retired male professional footballers. Journal of Sports Medicine & Physical Fitness, 56(5), 648-654.
Martin, L. A., Fogarty, G. J., & Albion, M. J. (2014). Changes in athletic identity and life satisfaction of elite athletes as a function of retirement status. Journal of Applied Sport Psychology, 26(1), 96-110.
Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. Applied Psychological Measurement, 1(3), 385-401.
Wilson, G., Drust, B., Morton, J. P., & Close, G. L. (2014). Weight-making strategies in professional jockeys: implications for physical and mental health and well-being. Sports Medicine, 44(6), 785-796.

ASSOCIATIONS BETWEEN SELF-REPORTED PHYSICAL ACTIVITY AND CHRONIC STRESS IN EMPLOYEES OF STATIONARY NURSING HOMES

BISCHOFF, L.L., OTTO, A.K., LAUBENSTEIN, H., WOLLESEN, B.

INSTITUTE OF HUMAN MOVEMENT SCIENCE

Introduction: Shortages in the labor market and higher percentages of old people in need of care result in work intensification and high stress levels among the nursing personnel in stationary nursing homes [1]. Earlier studies report a positive association between physical activity (PA) and perceived stress levels [2]. Yet, there are no studies examining this association in employees of stationary nursing homes. Thus, the purpose of this study was to examine the effect of PA on chronic stress levels among employees of nursing homes.
Methods: An extensive questionnaire was distributed to N=120 employees in three stationary nursing homes in Northern Germany. The survey included the German versions of the Copenhagen Psychosocial Questionnaire, Screening Scale of the Trier Inventory for the Assessment of Chronic Stress (TICS-SSCS) and the WHO Global Physical Activity Questionnaire. A total of N = 44 employees (9 men, 32 women) completed the questionnaire. n=5 were excluded.
Results: 66.7% of the participants had "above average" stress values (TICS-SSCS > 12). The mean SSCS value was 15.7±9.1. The WHO criteria of 600 MET minutes of activity per week were met by 85.3% of the participants. 76.5% met the German national recommendation for PA during leisure time of at least 150 min activity of moderate intensity per week. No significant correlations were found between PA and chronic stress or other work related outcomes. The only significant differences were identified with regard to transportation activities: participants who walked or cycled regularly felt significantly lower demands for hiding emotions (p=0.026).
Discussion: Since working in the providence of health care is physically demanding, it is not surprising that the majority of the nursing personnel met the WHO's MET criteria. However, the majority of respondents also met national recommendations of leisure time PA. Surprisingly, there were no associations between PA and chronic stress in employees of stationary nursing homes. These findings differ from previous studies in other professions, e.g. teachers [3] and might be a result of the specific stressors in stationary nursing homes. Nevertheless, in view of the relatively small sample size at this stage, these associations will be reevaluated in this ongoing survey study.
References: 1. Pêlissier, C., Vohito, M., Fort, E., Sellier, B., Agard, J. P., Fontana, L., & Charbotel, B. (2015). Journal of occupational health, 57(3), 285–296.
2. Gerber, M. & Pühse, U. (2009). Scandinavian Journal of Public Health, 37, 801–819.
3. Bogaert, I., De Martelaer, K., Deforche, B., Clarys, P. & Zinzen, E. (2014). BMC Public Health, 14, 534.
Contact: laura.bischoff@uni-hamburg.de

IMPLEMENTING PHYSICAL ACTIVITY INTERVENTIONS FOR ELDERLY CARE NURSES WITH HIGH STRESS LEVELS

HOLD, C., WOLLESEN, B.

UNIVERSITY OF HAMBURG, INSTITUTE OF HUMAN MOVEMENT SCIENCE

Introduction: Elderly care nurses are exposed to high workloads, which can lead to chronic stress (Gandoy-Crego et al., 2009). Physical activity can affect employee well-being (Brown et al., 2011), but little is known about appropriate interventions for this occupational group. To implement workplace health promotion interventions for elderly care nurses, the aims of this study were to examine how work-related behavior affects chronic stress and what kind of physical activity interventions will be suitable for this sample.
Methods: Data was collected by using questionnaires in a sample of elderly care nurses (N=78) from small and medium-sized facilities of residential aged care. The Screening Scale (SSCS) of the Trier Inventory for Chronic Stress (TICS) was used to assess chronic stress. The Occupational Stress and Coping Inventory (AVEM) assigned the respondents into four different work-related behavioral and experiential patterns. Furthermore intervention requirements were collected. Statistical analysis included Chi²-tests and ANOVA.
Results: The lowest stress levels were found in subjects classified in the healthy patterns G - "Health" (13,06±7,64) and S - "Protection" (14,45±8,55). Higher levels were found in risk pattern A - "Typ A behavior" (23,57±7,92) and risk pattern B - "Burnout" (25,42±9,99). The ANOVA showed significant differences between the assignment to the work-related behavioral patterns and perceived stress (F (3,69)=8,787; p=.000; N=73). Bonferroni-adjusted post-hoc analysis revealed a significant difference ($p<.05$) in perceived stress between all patterns except between risk patterns A and B and between patterns G and S. Back exercises (19,8%), relaxation exercises (17,9%), strength training (15,1%) and endurance training (9,4%) were the most requested physical activity interventions. There was no significant relationship between work-related behavioral patterns and intervention requirements (N=48, $\chi^2=23.87$, p=.878).
Conclusion
Work-related coping behavior plays an important role in stress experience among elderly care nurses and should be considered when conducting interventions. Exercise interventions were demanded by elderly care nurses in this study. Especially the request for relaxation exercises matches the complaints. Since no relationship was found between work-related behavioral patterns and intervention requirements further research needs to address the specific requirements for an effective intervention of the high risk patterns (A and B). Implementation of the interventions has not taken place yet.
References: Brown H E, Gilson N D, Burton N W, Brown W J (2011). Sports Medicine, 41 (3), 249-262.
Gandoy-Crego M, Clemente M, Mayan-Santos J, Espinosa P (2009). Archives of Gerontology and Geriatrics, 48, 246-249.
Contact: carolin.hold@uni-hamburg.de

Oral presentations

OP-SH12 Applications of sport psychology to performance

EVALUATION OF A BRIEF MINDFULNESS BASED INTERVENTION ON PUTTING PERFORMANCE IN AMATEUR GOLFERS

O DONOGHUE, C., CAMPBELL, M.J., TOTH, A.

UNIVERSITY OF LIMERICK IRELAND

Introduction: There has been an increasing trend for mindfulness to be viewed as a trainable psychological skill for performance enhancement. Published practitioner protocols and a growing evidence base have allowed for more systematic study, with early evidence for effectiveness across a range of performance and surrogate measures such as attention, emotional regulation and flow states (Sappington & Longshore, 2015). This study evaluated impacts on putting performance of a four-day mindfulness based intervention (MBI) programme on amateur golfers and assessed changes in dispositional mindfulness and underlying facets, while exploring related cognitive skills.
Methods: A non-randomised controlled trial evaluated an adapted Mindful Sports Performance Enhancement (MSPE) protocol (Kaufman et al., 2017) (n = 9 intervention, n= 7 wait-list control). Informed consent and demographic information was gathered at baseline. At baseline and post-test all participants completed a computerised Five Facet Mindfulness Questionnaire (FFMQ) (Baer et al., 2003), computerised Stroop test (Stroop, 1935) and a putting task measured manually and with SAM PuttLab motion analysis technology (www.scienceandmotion.com).
Results: ANOVA pairwise comparisons of putting performance revealed only the MBI group improved significantly from baseline to post-test ($F(1,15) = 11.228$, $p = .005$). One tailed independent samples t-test found a significant difference in the mean difference score improvements for MBI group vs control ($t(15) = -1.995$, $p = .033$).
ANOVA pairwise comparison for overall FFMQ scores revealed significance only in the MBI group ($F(1,14) = 13.597$, $p = .002$). Significant improvements in the underlying facets of 'Observing' ($F(1,14) = 15.209$, $p = .002$), 'Describing' ($F(1,14) = 19.53$, $p = .001$), 'Acting with Awareness' ($F(1,14) = 4.983$, $p = 0.42$) and 'Non-Judging Ineer Experience, ($F(1, 14) = 9.223$, $p = .009$) were found only for MBI group.
Stroop score analysis revealed significance in MBI group improvements for total ($F(1,14) = 18.276$, p=.001), congruent ($F(1,14) = 19.393$, $p = .001$), incongruent ($F(1,14) = 9.985$, $p = .007$) and control conditions ($F(1,14) = 18.537$, $p = .001$). Controls significantly improved only in the control condition ($F(1,14) = 4.712$, $p = .048$).
Conclusion
This study provides supportive evidence that brief MSPE interventions are effective in increasing dispositional mindfulness and can confer meaningful sports enhancing effects. Further research is required to corroborate these finding, assessing further performance parameters and examining further the effect mechanisms involved.
References: Baer RA, Smith GT, Hopkins J, Krietemeyer J, Toney L. (2006). Assessment, 13, 27-45.
Kaufman KA, Glass CR, Pineau T R. (2017). MSPE. Washington DC, United States: APA Books.
SAM Puttlab (V. 2010) [Computer software] www.scienceandmotion.com.
Sappington, R., & Longshore, K. (2015). J Clin Sport Psych, 9(3), 232-262.
Stroop JR. (1935). J Exp Psych, 18(6), 643-662.

MENTAL TOUGHNESS IN RUGBY

POWELL, A.J., MYERS, T.D.

NEWMAN UNIVERSITY BIRMINGHAM

MENTAL TOUGHNESS IN RUGBY UNION
Powell, A. 1, Myers, T., D. 1
1: NUB (Newman University, Birmingham)
Mental toughness (MT) is important for performance, goal progress, and thriving despite stress, and can vary across contexts. Whilst the importance of MT has been established, the dimensionality of MT needs further investigation; qualitative studies highlighting its multidimensionality, yet recent quantitative studies suggesting MT is unidimensional (Guccardi et al., 2015). The aim of the study was to investigate MT, its development and dimensionality in Rugby Union by exploring the perceptions and experiences of rugby players across performance levels and contexts.
Methods: A purposive sample of rugby players (n=468) across performance levels were recruited to complete a repertory grid online. Participants were asked to rate fixed qualities across fixed contexts in a grid produced from idiographic analysis of interviews with elite rugby players and coaches. Participants rated various qualities of MT from 1-10 (irrelevant-essential) including: motivated by self-development; focus in pain; perceiving challenge positively; effective decision making under pressure; and responsibility to the team. Participants had to consider how important these qualities were in: training; a match; dealing with pressure; adversity; injury; defeat; and being dropped from the team. Descriptive statistics were calculated, cluster analysis conducted to determine groupings of contexts, and Bayesian regression used to examine differences of ratings across playing levels.
Results: The highest mean rating of constructs across contexts was for playing a match (mean=8.39, SD=0.59); the lowest for dealing with injury (mean=7.58, SD=1.43). The highest rated individual construct was being motivated by continuing development (9.35) when dealing with being dropped from the team. The lowest rating was for staying focused in pain (5.79) when dealing with defeat. Cluster analysis suggested contexts formed two distinct groupings. Differences were found between playing levels, the largest difference in the responsibility for team success when dealing with an injury: Premiership (8.51) compared to international (4.50) with a high probability of a difference (p=0.99).
Discussion: The results suggest different qualities of MT are required for dealing with different contexts. The MT qualities required to deal with being dropped, coping with defeat and dealing with injury form one group, and the qualities for playing a match, dealing with pressure, and dealing with adversity, form a second group. The differences in the ratings of Premiership and international players may be explained by different cohesion levels resulting from the seasonal disparity in the time playing and training together as a team.
References: Gucciardi DF, Hanton, S, Gordon S, Mallett, CJ, & Temby P (2015). The concept of MT: Tests of dimensionality, nomological network and traitness. J Pers 83, 26-44.

PREPARING FOR A DUAL CAREER IN THE AFL DRAFT YEAR – REFLECTIONS OF SUCCESSFUL PLAYERS

SAUNDERS, J., PINK, M.

AUSTRALIAN CATHOLIC UNIVERSITY

Introduction: In Australian football players become eligible for the draft in the year they turn 18. This presents an issue in the process of developing a dual career because of the conflict with the final year of schooling, when results obtained in the school leaving certificate will influence access into future careers, particularly those requiring competitive grades. A previous report (Saunders and Pink, 2017) examined the experience of role strain by young men seeking to be drafted at the end of 2015, pursuing the notion of developmental mismatch previously found by de Bruyn (2005) to be negatively associated academic achievement. This study found that those who reported experiencing lower levels of overload between their football and their other roles including that of student were 5.81 times more likely to be drafted. Likewise, those who experienced less overload in their school role were 2.99 times more likely to be drafted. These findings were interpreted as demonstrating that players were already discounting their academic and alternative career aspirations as a means of coping with the pressures of trying to reconcile the demands of forging dual careers.
Methods: This study sought to supplement the earlier findings of how potential draftees were experiencing their draft year with the reflections of successful draftees on how their experiences had impacted on both their ongoing development as footballers and their ongoing personal and alternative vocational development. Data comprised semi-structured interviews with eighteen players recruited from three clubs. Interviews were transcribed and imported into the NVivo 10 qualitative analysis software before being subjected to a deductive-inductive content analysis. The players' attitudes, abilities and beliefs about their football, school and alternative career plans were reviewed within the environmental influences provided by their schools, their families and their football clubs.
Findings
A common theme amongst all participants was the passion they held for their football and the priority placed on achieving the goal of being drafted. There was however some variety in the nature of the alternative career plans nurtured and in the ways in which the environmental influences of the educational, family and football club contexts interacted to support the players as they strove to fulfil their ambitions. Some of this variety and richness is captured in the anecdotes and stories provided
Discussion: On the issue of whether the draft age should be raised to reduce the conflict between academic and football milestones, there was no clear consensus. However, the benefit of supportive personal and educational environments emerged as important in the ability to achieve any kind of academic success in parallel with football success. For those who are successful in entering into the AFL environment with its well-developed player support system and programs there is the opportunity for future success in developing alternative career and personal development outcomes. For those who are unsuccessful, the impact of the draft process on their alternative career prospects appears to be more problematic.
References: De Bruyn, E. H. (2005) Role strain, engagement and academic achievement in early adolescence, Educational Studies. 31: 1, 15-27
Saunders, J and Pink, M. (2017) Young Australian Footballers experience of role strain in their draft year. 22nd Annual Congress of the ECSS 5-8 July

YOUTH TALENT DEVELOPMENT ENVIRONMENT OF WORLD-CLASS CARIBBEAN TRACK AND FIELD ATHLETES

THOMAS, C.E., CHAMBERS, T.P., MAIN, L.C., GASTIN, P.B.

DEAKIN UNIVERSITY

Candice E Thomas1, Timothy P Chambers2, Luana C Main1, Paul B Gastin1

1School of Exercise and Nutrition Sciences, Deakin University, Melbourne, Australia
2School of Psychological Sciences, Australian College of Applied Psychology, Melbourne, Australia
Presenter: Candice Thomas
Aim: This qualitative investigation sought to explore the youth training and competition experiences of world-class Caribbean track and field athletes and the influence of psychosocial factors on their decision to invest in high-performance sport. Design: The study was underpinned by the developmental model of sport participation (Côté, Baker, & Abernethy, 2007) and informed by ontological relativist and epistemological constructionist perspectives. Method: Sixteen world-class track and field athletes (8 males and 8 females; M age = 29, SD = 5 years) from 6 English-speaking Caribbean islands took part in semi-structured interviews. An inductive thematic analysis (Braun & Clarke, 2006) was performed on the transcribed data. Findings: Four major themes were identified: (1) functional support network, (2) sporting culture, (3) reasons for success and (4) challenges. Findings revealed that world-class Caribbean athletes perceived themselves to be significantly influenced by the motivationally-relevant behaviors of the extended family, coaches and peers at the sampling, specializing and investment stages of development. Additionally, the youth sporting culture revealed a generally ad hoc approach to sport at the sampling level and a more structured and goal-oriented approach at the specializing/investment levels. The complex, interactive and multifaceted motivational atmosphere and support experienced at the youth stage encouraged participant athletes to remain engaged and progress to international success. Conclusions: The findings of this study provide insight into the youth sporting environment of world-class track and field athletes and the motivational climate experienced within a Caribbean socio-cultural context.

QUALIFICATION PATTERNS OF OLYMPIC AND IAAF WORLD CHAMPIONSHIP MIDDLE DISTANCE RUNNERS

HETTINGA, F.J., HANLEY, B.

UNIVERSITY OF ESSEX

INTRODUCTION: Introduction: The 800 m and 1500 m are the two middle distance events contested at the Olympic Games and other major championships. On most occasions, athletes must negotiate two qualifying rounds to reach the final. The theoretically optimal method of competing in these rounds is to obtain an automatic qualifying position in the slowest possible finishing time; however, elite athletes are often ego oriented and this might have led them to try to win all races. The aim of this study was to identify whether elite athletes adopted these theoretically optimal tactics, or whether the will to win overrode them.
Methods: Finishing positions and times of the eventual finalists in the men's and women's 800 m and 1500 m competitions at Olympic Games and IAAF World Championships between 1999 and 2017 were analysed. The performances of 606 athletes were analysed (800 m men: 122; 800 m women: 120; 1500 m men: 183; 1500 women: 181). The finalists' finishing positions and times, as well as their overall ranking in the heats and semi-finals, were also obtained. Athletes were allocated to groups based on finishing position in the final: medallists (800 m and 1500 m), non-medallists finishing in the top eight ('Top 8': 800 m and 1500 m), and those athletes finishing outside the top eight ('Top 12': 1500 m only). One-way repeated measures ANOVA was conducted on the heat, semi-final and final finishing times. In addition, one-way ANOVA were conducted with Tukey's post-hoc tests to compare finishing times between groups. Statistical significance was accepted as $P < .05$. Kendall's tau-b (τb) correlations determined the relationships between finishing position in the final with qualifying round positional, rank and finishing time data.
Results: Across the four events, 70% of the 57 gold medallists won both qualifying rounds, whereas 36% of the silver medallists and 19% of the bronze medallists achieved the same positions. Nineteen gold medallists set a season's best or personal best time in the final. In each event, finishing position in the final was correlated with finishing position in the heats and semi-finals ($P \leq 0.002$), but not with finishing time in those rounds. In the 800 m, medallists were faster than non-medallists in the final only ($P < 0.001$); in the 1500 m, medallists and Top 8 finishers were faster than Top 12 finishers in the final only ($P < 0.001$).
Discussion: Most World and Olympic champions won both their heat and semi-final, even though this was unnecessary, but managed to do so with slower times than in the final. These tactics showed a long-term pacing strategy that optimised overall competition success. In addition, the gold medallists did so in most cases in times slower than their best that year. Head-to-head elite championships, where winning is more important than time recorded, encourage a performance climate for both men and women athletes where ego orientation is more likely to occur.

METHODS: RESULTS: CONCLUSION: APPLIED SPORT PSYCHOLOGY IN SOUTH AFRICA: REFLECTIONS OF AN EDUCATIONAL PSYCHOLOGIST

LEWIS, A.

UNIVERSITY OF THE WESTERN CAPE

Applied Sport Psychology is in its infancy in South Africa. Given the popularity of sport and physical activity participation in this country, one would expect an abundance of Sport Psychology practitioners applying their knowledge and skills at all levels. This however is not the case with past discriminatory practices and having no formal association and registration category as being a few reasons for this phenomenon. Another reality is that applied knowledge and training within this context are not freely available. The aim of this paper is to reflect on practising this applied science from the framework of a registered Educational Psychologist in a specific context in South Africa as an initial step so that this practice can be understood, practised and expanded on. As a registered Educational Psychologist, by means of a reflexive, qualitative approach, I would like to contribute towards this body of knowledge and field of practice. It is also hoped that this will stimulate debate within this field so that it can lead to knowledge creation, practise and an even greater professionalization of this applied field.

17:30 - 19:00

Invited symposia

IS-PM02 Muscle injury: acute injury cellular responses to contemporaneous rehabilitation strategies

CELLULAR RESPONSES TO MUSCLE INJURY

MACKEY, A.

UNIVERSITY OF COPENHAGEN AND BISPEBJERG HOSPITAL

INTRODUCTION: The presence of resident stem cells in skeletal muscle affords a potential to regenerate fully after injury and yet the incidence of injury recurrence suggests that muscle repair is often complete.
METHODS: Also it is known that ageing is associated with a decline the satellite cell content of muscle together with an increase in resistance to activation. A better understanding of the activity of different cell types involved in muscle repair following injury, or muscle growth with exercise training, could contribute to the development of interventions capable of improving repair after injury, not to mention the adaptive response to heavy resistance training.
RESULTS: The focus of this presentation will be on the regeneration of young and old human skeletal, with particular focus on the distribution and activity of satellite cells, macrophages and fibroblasts in relation to regenerating muscle fibres.
CONCLUSION: It is believed this topic will be of interest to people concerned with sarcopenia, muscle regeneration and hypertrophy adaptation to resistance exercise training.

MAXIMIZING HEALING OF MUSCLE INJURY USING MECHANICAL LOADING: A CLINICAL PERSPECTIVE

GLASGOW, P.

ULSTER UNIVERSITY

Rehabilitation is a dynamic continuum during which the nature and difficulty of exercises are progressed in response to tissue healing and the functional abilities of the athlete. Pain is the most commonly used clinical outcome measure to progress rehabilitation. The level of discomfort tolerated during rehabilitation should be guided by the rationale for the specific exercise. For example, where the primary goal of the exercise is tissue loading some discomfort may be acceptable. In contrast, where the focus is on restoring movement quality it is more appropriate that for exercises to be painfree.
A number of key questions assist in optimising load during rehabilitation. What is happening at a tissue level? What outcomes are you trying to achieve? And, what is the specific adaptation associated with different exercise types?
Muscle tissue is highly sensitive and adaptable to mechanical loading. Following injury, muscle undergoes a number of changes in architecture and function as a direct consequence of tissue insult and as an indirect consequence of reduced loading and recruitment. Architectural characteristics of muscle are related to a range of performance variables. Muscle force is proportional to PSCA, while muscle velocity is proportional to muscle fibre length. Following injury there are reductions in fascicle length and physiological cross-sectional area (PSCA) as well as alterations in neuromuscular activation). Rehabilitation should therefore focus on restoring muscle structure.
Key goals during the acute stage are to limit the size of the haematoma and scar formation as well as facilitating re-capillarisation and neuronal resprouting. Early loading should be viewed as a way of enhancing stimulus for regeneration. There is good evidence from animal studies that progressive early loading of muscle results in enhanced histological and mechanical outcomes.
Eccentric exercise has become the primary mechanism by which these adaptations are achieved. Low-level, controlled eccentric exercises performed early in rehabilitation have the potential to reduce pain inhibition and facilitate tissue adaptation. These should then be progressed in line with healing and adaptation.
Restoration of neuromuscular deficits is also important. Prolonged deficits in NMC following muscle injury may have a role to play in recurrence. Reduced activation of previously injured muscle may further compound architecture components as well as limit function. Early inclusion of simple dynamic recruitment of muscles throughout range during functional movements often help to restore pain free range of motion and normalise pain. Sport-specific function is further developed through progressive neuromuscular rehabilitation aimed at improving the central nervous system's ability to fine tune muscle coordination and improve the skill execution.

HOW CAN WE AVOID RECURRENT MUSCLE INJURY?

WITVROUW E.

GHENT UNIVERSITY

The recurrence rate of muscle injuries is about 25%, with an extended rehabilitation period as a result. This rate is unacceptably high and needs reflection. At first it can be stated that the average time to return to sports (RTS) is at 2-3 weeks, when insufficient maturation of the scar tissue is present. A recent study identified that 25% of the re-injuries happen in the first week after RTS, and that all these injuries were situated at exactly the same location as the previous injury. This reinforces the idea that time should also be taken into account as a criteria for RTS.
In addition, the content of the rehabilitation program should be modified according to the latest research. Stretching as a treatment modality should still be included in the rehab approach, but the aim should be to improve the elasticity of the connective tissue, and not to improve the muscle range of motion. Consequently, different techniques should be used. Concerning strengthening, new research identified that the injured muscle is the victim, but very frequently not the cause of the muscle injury. As a consequence, other muscles than the injured muscle must be targeted during the rehab and prevention. Considering the very high incidence of muscle injuries and re-injuries in different sports the physiotherapies should know these new treatment approaches in order to reduce the amount of (re)injuries by composing evidence based and state of the art prevention and rehabilitation programs.

Invited symposia

IS-PM04 Proteome dynamics: new insights into the effects of exercise, diet and ageing on the turnover of human muscle proteins

DYNAMIC PROTEOMIC PROFILING: A NEW TOOL FOR STUDYING THE TURNOVER OF HUMAN MUSCLE PROTEINS

BURNISTON, J.

LIVERPOOL JOHN MOORES UNIVERSITY

The functional characteristics of muscle are determined by its protein composition and changes to the abundance or post-translational modification of proteins are well-acknowledged mechanisms that can alter characteristics, including muscle force production and substrate utilisation. In addition, the rate of turnover of proteins is also an important and modifiable feature that can influence muscle function, but this aspect of adaptation has been less widely studied due to a lack of suitable analytical methods. Recently, deuterium oxide (D2O; 'heavy water') has reemerged as a popular stable isotope for metabolic labelling studies of protein turnover because it can be delivered via the drinking water so the burden on the participant is less and the scope for investigating the long-term effects of diet and exercise is broadened compared to amino acid tracers that require intravenous infusion. D2O-labelled proteins are also more amenable to analysis using proteomic techniques, and I will give an introduction to the measurement of protein turnover using liquid chromatography and peptide mass spectrometry, termed dynamic proteomic profiling. This technique brings new opportunities to interrogate protein-specific changes in turnover rate associated with exercise and diet interventions. I will present a selection of proteomic data from D2O metabolic labelling experiments conducted in muscle cell cultures, laboratory animal models and human participants. The data illustrate the broad range of turnover rates across abundant proteins within myotubes or rodent and human skeletal muscle. I will also provide examples where the average rate of turnover of mixed proteins is indistinguishable between experimental groups but significant differences can be uncovered when turnover is investigated at a protein-specific level, offering new insight to the mechanisms of muscle adaptation.

PROTEOSTASIS AND SLOWED AGING: IDENTIFYING CONTRIBUTIONS OF THE SELECTIVELY TRANSLATED PROTEOME AND CELL PROLIFERATION IN MODELS OF SLOWED AGING

HAMILTON, K.L., DRAKE, J.C., ZHANG, Q., PEELOR, F.F., WOLFF, C.A., MUSCI, R.V., REID, J.J., LAWRENCE, M.L., PRICE, J.C., MILLER, B.F.

COLORADO STATE UNIVERSITY

Maintaining protein homeostasis, or proteostasis, is among the mechanisms that likely contribute to slowed aging and increased healthspan. Analyses in multiple tissues from growth-restricted slowed aging models suggest that slowed aging is consistently characterized by a greater ratio of protein synthesis rates:DNA synthesis rates in multiple protein fractions. This greater ratio is accompanied by two observations. First, slowed aging models are characterized by selective synthesis of proteins that include mitochondrial and other proteins that are likely important for maintaining cellular energetics and resistance to stresses encountered during aging. Second, tissues from slowed aging models have slower rates of DNA synthesis-indicative of slower cell proliferation-compared to controls. These consistent findings suggest that proteostatic mechanisms are maintained in growth-restricted slowed aging models, with more of the newly synthesized proteins allocated toward replacing damaged and degraded proteins in existing cells and less toward proliferation. These findings are consistent with theories of slowed aging in which limited energetic resources are directed toward somatic maintenance rather than growth. This session will include a discussion of the critical information that could result from identification of the selectively translated proteome, and the contribution of changes in cell proliferation rates to proteostasis in models of slowed aging and increased healthspan.

IDENTIFYING EXERCISE-DIET INTERACTIONS ON HUMAN MUSCLE PROTEIN RESPONSES.

HAWLEY, J.

MARY MACKILLOP INSTITUTE FOR HEALTH RESEARCH

A high-fat diet (HFAT) reduces rates of muscle protein synthesis, but resistance exercise (REX) may attenuate or rescue this diet-induced impairment. Using Dynamic Proteomic Profiling (DPP), we determined the contributions of synthesis and degradation to changes in the abundance of individual proteins in response to HFAT and REX. Two groups (n=8) of age-matched, overweight, untrained males consumed a HFAT (65% Fat, 20% CHO, 15% Protein) while ingesting deuterium oxide (200 mL/d) for 9-d. Participants were assigned to control (HFAT) or REX, who performed REX on days 1, 4 and 7. Blood and muscle samples were analyzed to determine precursor enrichment and the rate of incorporation of deuterium in to newly synthesised proteins. Synthesis of mixed sarcoplasmic proteins was similar in control and REX. In the myofibrillar fraction, the rate of synthesis was 45% higher in REX (1.6 vs. 1.1 %/day; $P<0.05$). DPP found 24 proteins differed in either their synthesis rate or abundance after REX ($P<0.05$). These findings provide empirical evidence that the contribution in rates of synthesis and degradation to changes in the REX-induced increase in protein abundance differ on a protein-by-protein basis. Determining how exercise-nutrient interactions impact on individual protein responses in skeletal muscle is the first step to delaying the age-related decline in muscle mass observed with ageing and could provide an entry point for personalized exercise-diet prescription.

Oral presentations

OP-PM31 Fatigue

THE EFFECT OF PRE-EXERCISE COOLING ON PERFORMANCE CHARACTERISTICS: A SYSTEMATIC REVIEW AND META-ANALYSIS

CLIJSEN, R.1,2,3, HOHENAUER, E.1,2,3, STOOP, R.1, CLARYS, P.3, DELIENS, T.3, TAEYMANS, J.3,4

1: SUPSI , 2: THIM , 3: VUB , 4: BFH

INTRODUCTION: Exercising in high environmental temperatures may cause precocious hyperthermia induced fatigue resulting in a decreased athletes performance output. This systematic review with meta-analysis investigated the possible effects of pre-exercise cooling on performance output.
METHODS: This study was performed according to the PRISMA guidelines and the PICO model was used to establish the research question. The Cochrane Risk of Bias Tool was applied to assess the validity of the included studies. Study eligibility was given when the studies compared the effects between any kind of pre-cooling and non-cooling strategies prior to exercise on performance output.
RESULTS: Twenty-nine studies met the inclusion criteria for quantitative analysis. Risk of bias was high or unclear but the performance bias was low. The estimated standardized mean difference revealed that external pre-cooling <21 studies> enhanced performance , with the main effect observed in endurance cycling or running. Internal <7 studies> and mixed-method <5 studies> pre-cooling failed to significantly affect performance parameters. However, the main output parameter, evaluated in these studies, was peak power output. Subgroup analysis for different outcome measures was not possible because meaningful grouping was not plausible. Limitations of this meta-analysis were the high or unclear risk of bias and the comparability of the included studies.
CONCLUSION: Based on the results of this meta-analysis, it can be concluded that there is some evidence in favour of external pre-cooling to avoid precocious hyperthermia induced fatigue in endurance athletes exercising in hot environments.
Keywords: Performance cooling, precooling, core temperature, exercise, meta-analysis
Contact: ron.clijsen@supsi.ch

THE EFFECT OF ISOLATED LOCOMOTOR MUSCLE FATIGUE ON PACING REGULATION WITH AND WITHOUT AN OPPONENT

KONINGS, M.J., HETTINGA, F.J.

UNIVERSITY OF ESSEX

INTRODUCTION: Exercisers are required to decide continuously about how and when to invest their limited available energy resources, a process that is also known as pacing (Smits et al. 2014). This study will further explore the importance of locomotor muscle fatigue onto this decision-making process involved in pacing during competition. This will be done by manipulating the level of induced locomotor muscle fatigue (internal bodily state) and the presence of an opponent (external stimulus). It is hypothesised that the induction of isolated locomotor muscle fatigue via an eccentric fatiguing protocol results in a reduced average pace (De Morree & Marcora, 2013). However, the faster initial pace and enhanced performance evoked by the opponent's presence in unfatigued conditions (Konings et al. 2017) is expected still to be present when isolated muscle fatigue is induced via an eccentric fatiguing protocol. This would indicate that the pacing response to an opponent is not related to the level of isolated locomotor muscle fatigue.
METHODS: Ten trained cyclists performed four experimental, self-paced 4-km time trial conditions on a VeloTron cycle ergometer in randomised, counterbalanced order. In the time trials participants had to ride alone (NO) or against a virtual opponent (OP). In addition, prior to the time trials participants had to complete an eccentric fatiguing protocol (80 drop jumps; DJ) or a control resting condition (CO). As such the experimental conditions were 1) CO-NO, 2) CO-OP, 3) DJ-NO and 4) DJ-OP. Differences in pacing, performance and perceived exertion were examined using repeated-measures ANOVA ($p<0.05$).
RESULTS: A faster initial pace was adopted during CO-OP (341±56W) versus CO-NO (324±50W; $p=0.029$), and during DJ-OP (327±81W) versus DJ-NO (304±58W; $p=0.009$). Moreover, participants showed a lower mean power output in CO-NO compared to CO-OP ($p=0.023$), DJ-NO compared to CO-NO ($p=0.007$), DJ-OP compared to CO-OP ($p=0.034$), DJ-NO compared to CO-OP ($p=0.005$), and DJ-NO and DJ-OP ($p=0.010$). No differences in mean power output were found between CO-NO and DJ-OP ($p=0.297$). RPE did not differ between experimental conditions at any point during or after the time trials (all $p>0.05$).
CONCLUSION: Trained cyclists adopted a slower average pace after an eccentric fatiguing protocol in advance of their time trial. However, the evoked response by the opponent to adopt a faster initial pace remains present when isolated locomotor muscle fatigue was induced via an eccentric fatiguing protocol. These findings illustrate that the behavioural response to an opponent is not directly related to the level of locomotor muscle fatigue, and highlight the importance of perceived exertion and the complex interplay between external stimuli and internal bodily state in the pacing decision-making process.
References: Smits, Pepping, Hettinga (2014) Sports Med, 44(6): 763-75
De Morree, Marcora (2013) EJAP, 113(9): 2371-80
Konings, Parkinson, Zijdewind, Hettinga (2017) IJSPP. DOI:10.1123/ijspp.2017-0220

DIFFERENCES IN NEUROMUSCULAR FATIGUE BETWEEN PREPUBERTAL CHILDREN, UNTRAINED ADULTS AND WELL-TRAINED ADULT ENDURANCE ATHLETES.

PIPONNIER, E., BONTEMPS, B., CHALCHAT, E., JULIAN, V., BOCOCK, O., DUCLOS, M., MARTIN, V., RATEL, S.

UNIVERSITY OF CLERMONT-AUVERGNE

INTRODUCTION: It is now well acknowledged that prepubertal children have a greater net contribution of energy derived from aerobic metabolism in exercising muscle and reduced susceptibility to muscular fatigue than untrained adults. However, children and well-trained adult endurance athletes could have a comparable oxidative metabolic profile and thus similar muscular fatigue rates during high-intensity exercise (Ratel and Blazevich, 2017). To check this hypothesis, we aimed at comparing the development and etiology of neuromuscular fatigue during repeated maximal voluntary contractions (MVC) of the knee extensor (KE) muscles between prepubertal children, untrained adults and well-trained adult endurance athletes.

METHODS: Eighteen 9-to-11-year-old boys (B), nineteen 18-to-30-year-old untrained men (UT) and thirteen 21-to-45-year-old well-trained endurance male athletes (WT) performed a fatigue protocol consisting in a repetition of 5-s isometric KE MVCs interspersed with 5-s recovery periods until MVC reached 60% of its initial value. Single magnetic stimulations were delivered to the femoral nerve every five MVC to quantify the time course of potentiated twitch amplitude (twpot), i.e. the peripheral fatigue. M-wave amplitudes of vastus lateralis and rectus femoris were determined to quantify sarcolemmal excitability. The maximal voluntary activation level (VA) was determined every five MVC using the twitch interpolation technique to quantify the central fatigue.
RESULTS: The number of MVC was significantly lower in UT (15.9 ± 3.9) than B (40.4 ± 19.7, p<0.001) and WT (51.7 ± 19.6, p<0.001). However, this difference was reduced between WT and B (p<0.05). The relative decrement in twpot was significantly greater in UT (-51.6 ± 14.8%) than B (-18.8 ± 19.5%, p<0.001) and WT (-8.3 ± 14.6%, p<0.001) but similar in B and WT. M-waves remained unchanged whatever the groups considered. Finally, VA decreased significantly more in B (-38.4 ± 22.5%) than UT (-4.6 ± 5.5%, p<0.001) and WT (-20.3 ±10.1%, p<0.001) but this difference was reduced between B and WT (p<0.01).
CONCLUSION: Our results confirm that children experience less peripheral and more central fatigue during high-intensity exercise than untrained adults. However, they point out reduced differences in central fatigue and similar peripheral fatigue between children and well-trained adult endurance athletes. Therefore, children could be metabolically comparable to well-trained adult endurance athletes.
Ratel, S., Blazevich, A.J. Are Prepubertal Children Metabolically Comparable to Well-Trained Adult Endurance Athletes? Sports Med. 47, 1477-1485, 2017.

IMPACT OF A PAIN STIMULUS OF REPEATED SPRINT EXERCISE

JAKEMAN, J., LEANEY, S.

OXFORD BROOKES UNIVERSITY

INTRODUCTION: Several studies have shown that exercise training can increase pain tolerance, which can lead to improvements in subsequent exercise performance. However, during exercise, pain may alter neural drive and reduce performance, although the extent to which exposure to pain can acutely influence subsequent exercise performance is less well established.
METHODS: Fourteen physically active males (21.4 ± 1.6yr, 1.87 ± 0.08m, 86.8 ± 13.8kg) were recruited for the study, and completed two sessions of four, thirty second maximal cycle sprints (with a four minute recovery) on an electronically braked cycle ergometer, separated by a minimum of one week. In a randomised counterbalanced order, participants were exposed to an ischemic pain stimulus, which progressively increased pain severity until pain tolerance was reached, or had no pain exposure, five-minutes before completing cycle sprint exercise. Measures of power output, fatigue index and energy expenditure were recorded during each sprint.
RESULTS: Data analysis showed that there were significant differences between the pain and no pain conditions on mean power output (722.7 ± 124.8W v 736.1 ± 124.8W, η2p 0.31), minimum power output (484.0 ± 152.2W v 514.3 ± 142.5W, η2p 0.43) and energy expenditure (21.7 ± 3.7kJ v 22.08 ± 3.7kJ, η2p 0.31), with the pain stimulus causing reductions in performance and energy expenditure. There were no significant differences in fatigue index (53.2 ± 13.6% v 50.4 ± 10.9%, η2p 0.17) or peak power output (1046.3 ± 203.4W v 1034.5 ± 177.9W, η2p 0.017) for pain and no pain groups respectively (data presented as mean ± SD).
CONCLUSION: While peak power was statistically unaffected by the pain stimulus, mean power output was negatively influenced. These data indicate that while maximum force generation was unaffected, the ability to sustain force production was negatively influenced, which may be related to alterations in neural drive associated with changes in afferent fibre activity. As this pain stimulus reduces some exercise performance indicators if experienced immediately before sprint interval training, it may have implications for the intensity and type of pre-exercise preparation undertaken by individuals in high intensity competition.
Contact: jjakeman@brookes.ac.uk

MAXIMAL RATE OF HEART RATE INCREASE TRACKS FATIGUE-INDUCED CHANGES IN ANAEROBIC EXERCISE PERFORMANCE

DUNIENVILLE, N.M., NELSON, M., BLAKE, H., BELLENGER, C., BUCKLEY, J.

UNIVERSITY OF SOUTH AUSTRALIA

INTRODUCTION: The maximal rate of heart rate (HR) increase (rHRI) reflects the maximal acceleration of HR at exercise onset, and has been shown to track fatigue-induced changes in endurance exercise performance. Recent evidence suggests that rHRI may be modulated by efferent signals arising from fatigued muscle, raising the possibility that rHRI might track performance changes for exercise modalities other than endurance activities. The purpose of this study was to determine whether rHRI tracked fatigue-induced changes in maximal anaerobic cycling performance.
METHODS: Nineteen (13 M, 6 F) recreational strength and power athletes had rHRI and maximal anaerobic cycle performance (peak power during 6 sec maximal effort [PP6] and work done during 30 sec maximal effort [W30]) assessed prior to (baseline), and one and three hours after, an acute fatigue-inducing sprint-cycling intervention. rHRI was assessed during 3-min of cycling at 100W (F) or 120 W (M).
RESULTS: rHRI and PP6 were unchanged across test sessions (P>0.05). Compared with baseline W30 was very likely decreased at 1-hr (-5.8±2.1%; ES±90% CI=-0.38±0.14; P=0.002) and 3-hr (-3.8±2.4; -0.25±0.16; P=0.048) post-fatigue. There was no significant within-subject correlation between rHRI and PP6 across test points (P>0.05), but there was a large positive correlation between rHRI and W30 (r=0.50; p<0.01).
CONCLUSION: rHRI appears to track fatigue-induced reductions in maximal exercise performance not only for endurance activities but also for anaerobic activities. rHRI might be a useful submaximal method for monitoring readiness to perform in athletes to guide training and competition schedules.

MUSCLE METABOLIC RATE AND MUSCLE TORQUE COMPLEXITY ARE INVERSELY CORRELATED DURING FATIGUING INTERMITTENT ISOMETRIC CONTRACTIONS

PETHICK, J., WINTER, S.L., BURNLEY, M.

UNIVERSITY OF KENT

INTRODUCTION: Muscle torque output is characterised by inherent fluctuations, which possess an irregular temporal structure, or complexity. This complexity reflects the ability to adapt motor output rapidly and accurately in response to task demands, with changes in muscle torque complexity having important functional implications. It has been suggested that a system's complexity is inversely related

to its metabolic rate (Seely and Macklem, 2012), but this hypothesis has yet to be tested. Fatiguing muscle contractions represent the ideal model with which to test this hypothesis, as it has been repeatedly demonstrated that neuromuscular fatigue reduces the complexity of muscle torque output. We hypothesised that muscle torque complexity would be closely related to muscle metabolic rate, and would only change under conditions in which muscle metabolic rate changed.
METHODS: Twelve healthy participants performed intermittent isometric contractions of the knee extensors to task failure at a high-intensity (40% MVC), where a progressive increase in muscle metabolic rate would be expected, and for 30 minutes or until task failure (whichever occurred sooner) at a low-intensity (20% MVC), where a change beyond the initial transient would not be expected. The duty factor for the contractions was 60%, i.e. 6 seconds contraction, 4 seconds rest. Torque and surface EMG were sampled continuously. Muscle metabolic rate ($\dot{m}O_2$) was determined using near-infrared spectroscopy and arterial occlusion, while whole-body metabolic rate ($\dot{w}b\dot{O}_2$) was determined on a breath-by-breath basis using respiratory gas analysis. Complexity and fractal scaling of torque were quantified using approximate entropy (ApEn) and the detrended fluctuation analysis (DFA) α scaling exponent. Global, central and peripheral fatigue were quantified using MVCs with femoral nerve stimulation.
RESULTS: Results are presented as means ± SEM. At 40% MVC, task failure occurred after 11.8 ± 1.6 minutes, while all participants were able to continue for 30 minutes at 20% MVC. Complexity decreased significantly during the contractions at 40% MVC (ApEn, 0.54 ± 0.06 to 0.15 ± 0.03, $P < 0.001$; DFA α, 1.36 ± 0.02 to 1.60 ± 0.03, $P < 0.001$), but did not change at 20% MVC. Similarly, $\dot{m}O_2$ increased significantly at 40% MVC (2.66 ± 0.44 to 3.99 ± 0.037%·s-1, $P < 0.001$), but did not change at 20% MVC. The rates of change of complexity and $\dot{m}O_2$ at 40% MVC were negatively correlated (ApEn, $r_s = -0.555$, $P = 0.03$; DFA α, $r_s = 0.559$, $P = 0.027$).
CONCLUSION: These results provide the first experimental evidence for the hypothesised inverse relationship between a system's complexity and prevailing metabolic rate.
REFERENCES:
Seely, A.J, Macklem, P. (2012). Chaos, 22, 013108.

Oral presentations

OP-PM32 Hormonal Biology

A 10+-YEAR FOLLOW-UP STUDY OF KNOWLEDGE, ATTITUDES, AND PRACTICE BEHAVIORS USED BY COLLEGE COACHES AND ATHLETIC TRAINER'S IN THE U.S. FOR THE FEMALE ATHLETE TRIAD.

MORAN, P.D., PANTANO, K.J., LOWERY, M.C.
CLEVELAND STATE UNIVERSITY

INTRODUCTION: The female athlete triad or relative energy deficiency in sport, is a condition that involves an imbalance between energy intake and energy expenditure. This deficiency can lead to serious health consequences, such as menstrual dysfunction, low bone mineral density, cardiovascular disease, and comprised bone health. Given potential outcomes, it is important that coaches and athletic trainers understand the condition and how it can be treated and prevented. Despite greater exposure, it is not known whether gaps in knowledge about the triad among U.S. coaches and trainers continue to exist. The aim of this research was to conduct a follow-up study on the knowledge and practice behaviors in U.S. college coaches and athletic trainers regarding the female athlete triad and compare results to a similar study conducted 10 years ago.
METHODS: A survey instrument was designed to assess knowledge and practice behaviors used by U.S. college coaches and athletic trainers for recognizing, treating and preventing the female athlete triad (RED-S). Databases of U.S. college coaches and certified athletic trainers practicing were purchased and randomly selected from approximately 1,000 surveys administered through an online survey tool, Qualtrics. Descriptive statistics summarized demographic and practice information about the survey participants and the most commonly used methods of treatment and prevention for the triad.
RESULTS: Fifty-seven college coaches and 48 athletic trainers responded to the survey; the majority were women between the ages of 25-55 who practiced 16 years or more. While 98% of the survey participants reportedly noticed disordered eating in female athletes, less than 40% could identify that "energy deficiency" was a component of the triad. Twenty-six percent of coaches and 35% of trainers still thought that irregular or absent menstruation is a normal consequence of exercise. The most frequently reported modes of treatment for both professions included contacting the athlete's physician, consulting with a dietitian and sports psychologist, and addressing the issue with the athlete. Nutritional counseling and pre-participation exams (PPE) were the most frequently reported means of prevention.
CONCLUSION: Promoting optimal health for all athletes is a desired goal for coaches and athletic trainers. This goal requires having adequate knowledge and awareness of potential deleterious conditions involved in sport participation, such as the female athlete triad or RED-S. The current study shows that while knowledge of the female athlete triad or RED-S has improved and practice behaviors have positively changed in the last 10 years, some concepts about the condition are still misunderstood. A limitation of this study is the generalizability of the results.

HEART RATE VARIABILITY CHANGES DURING THE MENSTRUAL CYCLE PHASES OF ATHLETIC WOMEN

DOYLE-BAKER, P.K., KOKTS-PORIETIS, R., MINICHIELLO, N.
UNIVERSITY OF CALGARY

INTRODUCTION: The menstrual cycle (MC) remains a major barrier to the inclusion of women in sport and health research. This limits the depth of knowledge pertaining to how the MC interacts and effects homeostasis in sport performance. Regulation of homeostasis is largely impacted by the autonomic nervous system (ANS) and its two divisions, the sympathetic and parasympathetic systems. Heart rate variability (HRV) has evolved as a measurement tool to assess ANS function and overall health. The objectives of this study, exploratory and descriptive in nature, were to determine how daily measures of HRV shift over the course of the MC and whether the menstrual phases (Follicular; FP or Luteal, LP) affect the range in measures of HRV in an athletic population of women.
METHODS: Eumenorrheic women without oral contraception between the ages of 18-45 yrs., and cycling greater than 3 hour/week (self-reported) were included through a rolling recruitment. Oral basal body temperature (BBT) was measured upon waking using a low-reading digital thermometer (Geratherm) and self-reported menstruation was used to align subject's MCs at ovulation. HRV was assessed by the time (SDNN, RMSSD) and variance in high and low frequency (HF and LF) domain analysis using a smartphone application (HRV4Training) with measurements recorded upon waking for one minute in the supine position. Descriptive statistics were employed to

characterize shifts in daily measures of HRV: 1) across the MC and between the phases using the mean difference of consecutive days. Seven women (mean, standard deviation (±); age 28.57 ± 8.36 yr.; height 167.0 ± 6.3cm; weight 66.41 ± 7.89kg; %BF 21.1 ± 4.93%) completed the study with regular MCs (28.4 ± 2.3 days; ovulation day 14.57 ± 0.98 day).
RESULTS: Time and frequency domain decreased across the MC, however the LF decreased before ovulation and increased following it. The mean difference in SDNN between consecutive days decreased around ovulation and showed a -32.76 ms shift four days before the end of the MC. The HF band displayed a 0.078 increase followed by a -0.053 difference at the beginning of the MC. Approaching ovulation the mean difference in consecutive days of HF showed only slight change while after ovulation an oscillatory pattern emerged with greater magnitude. The mean difference between consecutive days in the LF band began with a sudden decrease followed by a large increase before shifting to smaller magnitude changes leading to ovulation. After ovulation, larger magnitude fluctuations occurred for the duration of the MC.
CONCLUSION: The mean difference between consecutive days demonstrated a negative trend with less fluctuation in RMSSD and HF, primarily around ovulation. Along with the increase in the range of mean difference of consecutive days in the LP compared to the FP, suggests MC phase may impact HRV in athletic women. A larger sample size is still needed to capture and confirm the HRV variation of MC and the phases.

DIFFERENTIAL RESPONSES IN CIRCULATING ADRENAL STEROID LEVELS IN RESPONSE TO EXTREME PHYSICAL, BUT NOT TO EXTREME MENTAL STRESS IN MALE ATHLETES

CSÖNDÖR, É., KARVALY, G., LIGETVÁRI, R., VÁSÁRHELYI, B., KOMKA, Z., FARKAS, I., VÉGH, J., SZILÁGYI, G., TÓTH, M.V., TÓTH, M., STROMÁJER-RÁCZ, T., BETLEHEM, J., OLÁH, A., ÁCS, P.

FACULTY OF HEALTH SCIENCES, UNIVERSITY OF PÉCS, SEMMELWEIS UNIVERSITY, EÖTVÖS LÓRÁND UNIVERSITY, UNIVERSITY OF PHYSICAL EDUCATION, INTERNATIONAL TRAINING CENTRE, BUDAPEST,HUNGARY

INTRODUCTION: Adrenal steroid molecules play a significant role in the regulation of cardiovascular, metabolic and other functions in response to acute stress situations.
METHODS: We investigated the effects of stress on the steroid homeostasis in male athletes (n=44) using a combined model of extreme acute physical (vita maxima treadmill test) and mental stress (simulated military combat situation). The levels of 16 adrenal and gonadal steroid substances were evaluated in serum using ultra performance liquid chromatography-tandem mass spectrometry (UPLC-MS/MS). Heart rate (HR) and blood pressure (BP) values were monitored in both models in addition to metabolic (lactate) and gas-exchange (VO2 maximum) parameters which were evaluated in the physical stress experiments. All values were measured at baseline, at maximum stress situation and thirty minutes into the restitution phase.
RESULTS: BP and HR were elevated in both stress models. No significant changes could be observed in the serum concentrations of steroids as a result of mental stress, while dehydroepiandrosterone (DHEA, baseline: 3.46±2.44 ng/mL, peak: 4.30±3.13 ng/mL, restitution phase: 6.72±4.14 ng/mL), corticosterone (CORT, baseline: 4.58±4.78 ng/mL, peak: 4.75±4.32 ng/mL, restitution phase: 9.87±4.94ng/mL) and cortisol (CL, baseline: 143.14±44.39 ng/mL, peak: 138.38±43.63 ng/mL, restitution phase: 180.45±41.66 ng/mL) levels showed significant ($p<0.05$) elevation in the restitution phase in the physical stress model.
CONCLUSION: Both stress models induced similar responses in the cardiovascular system. The cardiovascular and steroid effects have a different time frame showing maximum levels of BP and HR at the peak of the stress, while steroid levels are elevated thirty minutes later, and only in the physical stress model. The three elevated steroid molecules originate from three structurally different parts of the adrenal gland pointing to the fact that mineralocorticoid, glucocorticoid and androgenic lines are all involved. The interaction of the cardiovascular system and the adrenal gland with such mediators as steroids, catecholamines and possibly peptides, (i.e. adrenomedullin) needs further systematic investigations.

ASSESSING BASAL INFLAMMATORY MARKERS AND SYNTHETIC OVARIAN HORMONE USE IN FEMALE AUSTRALIAN ATHLETES SELECTED FOR THE RIO OLYMPIC GAMES

LARSEN, B., COX, A.J., COLBEY, C., DREW, M.K., MCGUIRE, H.M., FAZEKAS DE ST GROTH, B., HUGHES, D., VLAHOVICH, N., WADDINGTON, G., BURKE, L., LUNDY, B., WEST, N.P., MINAHAN, C.

GRIFFITH UNIVERSITY - GOLD COAST CAMPUS

INTRODUCTION: Athletes have enhanced susceptibility to illness and infection during periods of intense training and competition (1), which may be compounded in an Olympic environment. Data from the London 2012 Olympic Games found that female athletes were 60% more likely to fall ill than male athletes, and one in five illnesses was expected to result in absence from training and/or competition (2). This absence is associated with decreased sports performance outcomes (3). Thus, factors that contribute to an increased risk of infection or illness in elite female athletes must be further examined. This study measured C-reactive protein (CRP) and other inflammatory markers in Australian elite female athletes three months before the 2016 Rio Summer Olympic Games. We sought to determine the association between synthetic ovarian hormone use (i.e., the oral contraceptive (OC) pill) and basal CRP, peripheral blood immune cell subsets, and circulating pro- and anti-inflammatory cytokine concentrations.
METHODS: Elite female athletes (n = 53) selected in Rio 2016 Summer Olympic squads participated in this study. Of the 53 participants, 25 were taking the OC pill (AthletesOC) and 28 were not taking the OC pill and were considered naturally hormonally cycling (AthletesNC). Venous blood samples were collected at rest for the determination of sex hormones, cortisol, CRP, peripheral blood mononuclear memory and naïve CD4+ T-cells, CD8+ T-cells and natural killer cells, as well as pro- and anti-inflammatory cytokine concentrations.
RESULTS: C-reactive protein concentrations were elevated ($p < 0.001$) in AthletesOC (median = 2.02, IQR = 3.15) compared to AthletesNC (median = 0.57, IQR = 1.07). Conversely, no differences were reported for cortisol, serum cytokines, or PBMC immune cell subsets, although there was a trend ($p = 0.062$) for higher IL-6 concentrations in AthletesNC.
CONCLUSION: This study is the first to investigate the effect of OC use on acute phase hormonal and systemic inflammatory parameters in elite female athletes prior to the Olympic Games. Elite female athletes had substantially higher levels of CRP, a marker of inflammation and tissue damage, in the months before the 2016 Rio Olympic Games if they used the OC pill. Thus, future research should further examine the relationship between OC use and immune function, and the potential consequences for performance and recovery, in elite female athletes.
1. Gleeson M. Immune function in sport and exercise. J Appl Physiol 2007;103(2):693-99.
2. Engebretsen L, Soligard T, Steffen K, et al. Sports injuries and illnesses during the London Summer Olympic Games 2012. Br J Sports Med 2013;47(7):407-14.

3. Drew MK, Raysmith BP, Charlton PC. Injuries impair the chance of successful performance by sportspeople: a systematic review. Br J Sports Med 2017;51:1209-1214.

PHYSICAL PERFORMANCE IN RELATION TO MENOPAUSAL STATUS AND PHYSICAL ACTIVITY

BONDAREV, D., LAAKKONEN, E.K., FINNI, T., KOKKO, K., KUJALA, U.M., AUKEE, P., KOVANEN, V., SIPILÄ, S.
UNIVERSITY OF JYVÄSKYLÄ

INTRODUCTION: Low muscle strength and decline in the power are associated with low walking speed (Rantanen et al, 1999) and with mobility limitations, disabilities and falls among older populations (Sipilä et al, 2006). The menopausal sequelae may influence later years by contributing to functional limitations among women. The aim of this study was to examine differences in physical performance across menopausal stages and potential contribution of physical activity to modify the impact of the menopausal transition on physical performance.
METHODS: This cross-sectional study is a part of the ERMA study. Women aged 47 to 55 were randomly selected from the Finnish National Registry and categorized as premenopausal (n=233), perimenopausal (n=381) or postmenopausal (n=299) based on serum concentrations of follicle stimulating hormone and bleeding diary. Physical performance was measured by knee extension force, hand grip force, vertical jumping height, maximal walking speed and six-minute walking distance. Physical activity (PA) level was assessed by self-report and categorized as low, moderate or high. Multivariate linear regression modeling and marginal means differences were used for data analysis.
RESULTS: After including fat mass, height, PA and education in the model, the postmenopausal women were 12.0 N weaker ($p<0.001$) in hand grip force and performed 1.1 cm worse ($p<0.001$) in vertical jumping height than the premenopausal women. There was no significant interaction between menopausal stage and PA on physical performance. However, the peri- and postmenopausal women with high PA performed better in the maximal knee extension strength and 6-min walking test, and lower body muscle power than those with low PA.
CONCLUSION: Menopausal status is associated with muscle strength and power, whereas the association between menopausal status and mobility/walking is clearly weaker. A high PA level provides more capacity to counteract the potential negative influence of menopausal factors on muscle function.
References: Rantanen T, Guralnik JM, Foley D, et al. Midlife hand grip strength as a predictor of old age disability. JAMA. 1999;281(6):558-560.
Sipilä S, Heikkinen E, Cheng S, et al. Endogenous Hormones, Muscle Strength, and Risk of Fall-Related Fractures in Older Women. J Gerontol Ser A. 2006;61(1):92-96.

Invited symposia

IS-BN07 Gait stability and adaptability among older adults: implications for falls prevention

THEORY-DRIVEN INTERVENTION FOR IMPROVING REACTIVE BALANCE CONTROL IN THE ELDERLY

ARAMPATZIS, A.
HUMBOLDT-UNIVERSITY BERLIN

One important factor which contribute to increased risk of fall in the elderly population is deficient reactive balance responses after sudden, unexpected perturbations. Therefore, exercise interventions aiming to improve the reactive balance control in older people may progressively reduce the risk of falling. It is widely accepted that resistance training aiming to improve muscle strength within the lower extremities is a successful therapeutic modality for increasing stability performance. Although muscle strengthening has the potential to improve balance recovery, the direct transfer of improvements in strength in the motor control of responses to sudden unexpected gait perturbations and/or the handling of control errors initiated from deficits in the perception and processing of sensory information within the motor system is limited. First we provided evidence that predictive and reactive adaptation, remains highly effective in the elderly, showing only minor, not statistically significant age-related deficits. In a second step we designed a generic exercise intervention including mechanisms of dynamic stability and we applied this intervention for 14 weeks to elderly adults. We found an average improvement in the ability of the old adults to regain balance during simulated forward falls (35%) and unexpected gait perturbation (20%) without any improvements in muscle strength after the intervention. A training intervention of mechanisms of dynamic stability that also improves muscle strength akin to a conventional resistance exercise intervention is likely to improve the efficiency of the training. Currently we developed a perturbation-based intervention for old adults, exercising mechanisms to control dynamic stability (i.e. increase of BoS and counter-rotation of segments around the CoM) on unstable conditions to expose the participants to repeated and variable disturbances. Our strategy in the perturbation-based intervention aimed to increase the amount of muscle activation in the lower extremity muscles during training and, thus, muscle strength over time, and to increase the need of the nervous system to perceive sensory signals and to generate appropriate motor commands. We found improvements in muscle strength of the plantar flexors and in the ability to regain balance after sudden forward falls at the same level as a conventional muscle strength intervention. Further, the perturbation-based training was the only one that introduced improvements in standing balance ability as assessed by measuring the approach of the CoM to the anterior limits of stability. We conclude that a perturbation-based training program focusing on exercising mechanisms of dynamic stability on unstable conditions has the potential to enhance muscle strength as well as sensory information processing within the motor system during sudden and static balance tasks and, as a consequence, reduce the risk of falls in old adults.

PERTURBATION-BASED GAIT ASSESSMENT USING VARIOUS PERTURBATION TYPES IN YOUNG AND OLDER ADULTS

PIJNAPPELS, M.
VU UNIVERSITY AMSTERDAM

The ability to resist or recover from a gait perturbation has been shown to be associated with mobility problems and fall risk in older adults. However, knowledge on which perturbation type is most suitable to quantify gait stability is lacking. We therefore developed a protocol containing ipsi- and contra-lateral sway, belt acceleration and deceleration, visual and auditory perturbations and tested it on

healthy young and older adults. Gait stability was most affected by contra-lateral sway and deceleration perturbations hence these perturbation types may be appropriate for fall risk assessment in the elderly. The results of this protocol will be discussed.

GAIT STABILITY AND ADAPTABILITY ACROSS THE ADULT LIFESPAN: THE IMPACT OF MUSCLE AND VESTIBULAR FUNCTION

KARAMANIDIS, K.

LONDON SOUTH BANK UNIVERSITY

The ability to respond to expected and unexpected environmental changes during ongoing gait is important for preventing a fall. In a series of studies, we investigated how gait stability and adaptability during perturbed walking are affected by age, muscle strength and vestibular function in order to better understand the underlying mechanisms of the decline in locomotor function across the adult lifespan. We found that the ability to control dynamic stability in response to a single perturbation during walking has already begun to deteriorate in middle age, but that even in old age the ability to adapt gait and improve stability following repeated perturbations is preserved, although the rate of adaptation may be diminished. Lower limb muscle weakness partly limits gait stability during novel perturbations, as stronger older adults require fewer recovery steps to regain gait stability after a sudden perturbation. However, the potential for adaptive improvement after repeated perturbations during walking seems not to be related to muscle strength in older adults. This adaptation potential is, however, negatively affected in patients with vestibulopathy, indicating a potential role of the vestibular apparatus in gait adaptability. Currently, we are investigating whether muscular changes over medium- or long-term periods (muscle strengthening interventions over months or years) impact gait stability and adaptability and whether older adults are able to retain gait stability improvements over 1.5 years.

Invited symposia

IS-MI01 Sedentary behaviour and physical activity – is there a best bet for public health in young people?

PHYSICAL ACTIVITY AND SEDENTARY TIME, ADIPOSITY AND CARDIO-METABOLIC HEALTH – CAUSAL ASSOCIATIONS?

EKELUND, U.

NORWEGIAN SCHOLL OF SPORT SCIENCES

Physical activity guidelines for young people were first published in 1994. Based on the available evidence these guidelines proposed that young people should be physically active daily or almost every day and engage in at least three sessions per week of at least 20 minutes of more vigorous exercise. An expert panel conducted an update of the scientific evidence in 1998, which concluded that young people should engage in at least 60 minutes of moderate intensity activity daily and preferably more vigorous activities three times per week. Since then the available evidence about the importance of physical activity for health in young people has increased exponentially, largely explained by the development and application of objective monitoring methods. These methods are currently the primary option when assessing physical activity in young people. More recently, prolonged sedentary time has also been suggested to influence on health. However, most data in young people suggest that sedentary time is unrelated to adiposity and cardio-metabolic health when moderate and vigorous intensity physical activity is taken into account. In contrast, self-reported TV-viewing (and other screen-based behaviors) may be detrimentally associated with these health outcomes possibly mediated by other unhealthy behaviors associated with prolonged screen time. This talk will discuss whether the magnitude of associations between physical activity and health outcomes is intensity dependent; the role of substituting sedentary time with light, moderate and vigorous intensity in relation to health outcomes; and the issue of reverse causality for the associations between sedentary time, physical activity and metabolic health outcomes in young people.

SEDENTARY BEHAVIOUR IN YOUTH: IS SITTING FATTENING?

BIDDLE, S.

UNIVERSITY OF SOUTHERN QUEENSLAND

INTRODUCTION: Introduction. Changes to lifestyles for young people over the past decades include ubiquitous access to screens, including TV and computers. The use of such devices usually involves sitting for long periods. Over 30 years ago it was suggested that young people were being 'fattened' at the TV set, and subsequent research on TV viewing, screen time and wider use of sedentary behaviours has provided debate on this issue.
Methods. Synthesis of review-level evidence, appraisal of causality, and commentary.
Results. While some have suggested that the link between sedentary behaviour and adiposity is strong, others have taken a more cautious view. This may depend on what exposure and outcome variables are being assessed, and how. For example, the link between sedentary behaviour and adiposity seems stronger and more consistent for the exposure of TV viewing than it does for device-measured 'total sedentary time'. Important issues include co-existing behaviours (e.g. diet and MVPA) and measurement (e.g., recall by self-report). An assessment suggests that it cannot be claimed that a causal association exists between sedentary behaviour and adiposity in young people.
Conclusions. The association between sedentary behaviour and adiposity in youth is complex but current evidence is not supportive of a causal association.

METHODS: RESULTS: CONCLUSION: THE ACTIVITY INTENSITY DEBATE: IMPLICATIONS FOR GUIDELINES AND INTERVENTION

VAN SLUIJS, E.

MRC EPIDEMIOLOGY UNIT

The high burden of inactivity and (childhood) obesity worldwide makes the promotion of physical activity and/or reduction of sedentary behaviour key public health targets. One crucial question is how to translate these epidemiological findings into public health guidelines

that are believable, understandable and achievable. An understanding of how people interpret the guidelines and how they might act upon them is thereby critical. Physical activity and sedentary behaviour are complex behaviours, consisting of multiple behaviours across the day and week, performed in different locations and with differing levels of control to change. This complexity needs to be considered when communicating guidelines and targeting change in these behaviours. This talk will discuss the implications of the emerging evidence base for public health guidelines and how they are translated to behaviour change interventions.

Oral presentations

OP-BN22 Injury prevention

PREVENTION OF MUSCULOSKELETAL INJURIES IN VOLLEYBAL AND FIELD HOCKEY: DEVELOPMENT AND FEASIBILITY OF TWO INTERVENTIONS

GOUTTEBARGE, V.1, VERHAGEN, E.2, ZWERVER, J.3

1: DUTCH CONSUMER SAFETY INSTITUTE , 2: AMC/VUMC IOC RESEARCH CENTER , 3: UNIVERSITY MEDICAL CENTER GRONINGEN

INTRODUCTION: Volleyball and field hockey are very popular sports, especially in The Netherlands. Both sports are associated with a risk for musculoskeletal injuries, incidence reaching 10.7 and 90.9 injuries per 1000 playing hours in volleyball and field hockey, respectively (Barboza et al., 2018; Kilic et al., 2017). Therefore, a research program started in order to (i) develop an injury prevention intervention in volleyball and in field hockey and (ii) assess their feasibility.
METHODS: The injury prevention interventions were developed in accordance to scientific frameworks (Intervention Mapping and Knowledge Transfer Scheme) based on (i) needs assessment within volleyball and field hockey, (ii) scientific literature, and (iii) experts in injury prevention and either volleyball or field hockey. Subsequently, two quasi-experimental studies based on a one-group pre-post-test design (survey and interviews) were conducted during 4-8 weeks in order to explore the feasibility (knowledge/skills, relevancy, suitability, usability) of both interventions.
RESULTS: The needs assessment revealed that an intervention in both sports was needed, ideally embedded within the warm-up, delivered by trainers/coaches, and available digitally. Therefore, 'VolleyVeilig' and 'Warming-up hockey' were developed as warm-up programme, involving more than 50 distinct exercises, lasting around 15 minutes and being available as application for smartphone/tablet (Gouttebarge et al., 2017a; Gouttebarge et al., 2017b). Calculated effect size (d=0,23-0,34) showed a moderate positive effect on level of knowledge/skills of coaches. All exercises within 'VolleyVeilig' and 'Warming-up hockey' were positively assessed with regard to their relevancy, suitability and usability.
CONCLUSION: Being available as application for smartphone/tablet, the warm-up programmes 'VolleyVeilig' and 'Warming-up hockey' were developed in order to prevent or reduce the occurrence of musculoskeletal injuries in volleyball and field hockey. Both were found feasible in terms relevancy, suitability and usability, leading to more knowledge/skills among coaches. Similar warm-up programmes were developed across different sports such as rugby and football, reaching up to 50-60% injury reduction (Bizzini and Dvorak, 2015; Sewry et al., 2017). If similar injury reduction rates are reached with 'VolleyVeilig' and 'Warming-up hockey', their nationwide implementation will be legitimate and thus facilitated.
References: Barboza SD, Joseph C, Nauta J, van Mechelen W, Verhagen E. (2018). Sports Med,Jan 3. doi: 10.1007/s40279-017-0839-3.
Bizzini M, Dvorak J. (2015). Br J Sports Med, 49, 577-579.
Gouttebarge V, van Sluis M, Verhagen E, Zwerver J. (2017a). Inj Epidemiol, 4, 25.
Gouttebarge V, Zuidema V. (2017b). Br J Sports Med, 51, 323.
Kilic O, Maas M, Verhagen E, Zwerver J, Gouttebarge V. (2017). Eur J Sport Sci, 17, 765-793.
Sewry N, Verhagen E, Lambert M, van Mechelen W, Brown J. (2017). Inj Prev, 23, 428.

MUSCULOSKELETAL PREDICTORS OF NON-CONTACT INJURY IN CRICKETERS – FEW AND FAR BETWEEN? A LONGITUDINAL COHORT STUDY

OLIVIER, B., GRAY, J.

UNIVERSITY OF THE WITWATERSRAND

INTRODUCTION: The determination of predictors of injury in cricketers is a building block towards developing effective injury prevention strategies. The objective of this study was to determine the musculoskeletal predictors of injury amongst professional, domestic cricket players.
METHODS: Professional, domestic cricket players completed a pre-participatory musculoskeletal screening battery consisting of 21 tests including flexibility, neural tension, stability, strength, balance and pain provocation tests at the start of the cricket season. Non-contact, low back and lower limb injuries were monitored throughout the season. Binary logistic regression and receiver operating curves were used to determine predictive value of each test.
RESULTS: During the course of the cricket season, 38 of the 97 <39.2%> cricketers sustained a non-contact low back and/or lower limb injury. Increased hip internal rotation ROM on the dominant side, no symptoms on active slump dominant side, decreased combined elevation, increased shoulder internal rotation ROM on the non-dominant side and increased GIRD predicted in-season non-contact lower quarter injuries. Although statistically significant, none of these variables were strong predictors of injury as shown by the logistic regression models, the area under the curve of the receiver operating characteristic curves and the cut-off scores which revealed high sensitivity, but low specificity.
CONCLUSION: Amongst the many tests included in the battery, only a few showed predictive validity. Investigations into the predictors of injury within the specific roles of cricket e.g. fast bowler or wicket keeper may reveal more appropriate answers to our search for risk factors for non-contact injury.

THE INFLUENCE OF COMPLIANCE ON THE EFFICACY OF THE INJURY PREVENTION PROGRAM 11+ KIDS

LICHTENSTEIN, E., ROESSLER, R., JUNGE, A., BIZZINI, M., VERHAGEN, E., CHOMIAK, J., AUS DER FÜNTEN, K., MEYER, T., DVORAK, J., BEAUDOUIN, F., FAUDE, O.

UNIVERSITY OF BASEL

INTRODUCTION: Physical inactivity has arisen as one of the major challenges of today's society and its prevention has received increasing attention. It is now considered important to motivate people to live an active life starting in childhood. Football (soccer) is one of the most widespread sports among youth. Unfortunately, it entails a considerable risk of injury to the musculoskeletal system, especially to the lower extremities. Injuries could present a stumbling block for lifetime engagement in physical activity. Therefore, prevention of injuries is at the center of research focus. The injury prevention program "11+ Kids" has been developed to tackle the issue. Compliance to this program might be a corner stone to its efficacy, but the magnitude of compliance's effect on the reduction of injury risk has so far not been investigated in children. Also, the program's recommended frequency of usage has so far not been established. Therefore, this study aims to quantify the compliance's influence on the efficacy of the injury prevention program "11+ Kids" among players aged 7 to 12 years and determine a recommended dosage.
METHODS: As part of a cluster-randomized controlled trial injury incidences were compared between the participants of the intervention group with low (LC), medium (MC) and high compliance (HC) as well as to the control group (CON) utilizing hazard ratios. Participants of the intervention group (IG) performed "11+ Kids" as warm-up whereas the control teams (CG) followed their regular training regime. It was also quantified how many injuries could potentially be prevented by additional trainings per month. Coaches and staff entered exposure times and injuries into an online-tool. Anthropometric data was gathered from the parents by questionnaire.
RESULTS: Data were obtained from 3895 participants (IG: 2066; CG: 1829) with a mean age of 10.8 (SD: 1.4) years. The HC group had 50% [95 %-CI: 16;71] fewer injuries compared to LC and 54% [31;72] less injuries compared to CON, but no significant difference was found compared to the MC group (-23% [-54;+30]). The MC group sustained 38% [3;60] fewer injuries compared with CON but not significantly less than LC (-36% [-61;+6]). No significant difference was observed between LC and CON (-32% [-60;15]). Additional session of "11+ Kids" were associated with a significantly reduced injury incidence.
CONCLUSION: The compliance to the injury prevention program "11+ Kids" plays an important role for the efficacy of the program. Frequent use of the program seems advisable to maximize its efficacy and too infrequent use might lessen its preventive effect considerably. Based on the findings of this study, it is suggested that the program is used at least six times per month.

ELITE WOMEN ATHLETES WITH SUPERIOR KNEE FUNCTION PRESENT SIMILAR DYNAMIC KNEE STABILITY, ALTHOUGH DIFFERENT MOVEMENT STRATEGIES, WHEN COMPARED TO CONTROLS

MARKSTRÖM, J.L.1, GRIP, H.2, SCHELIN, L.3, HÄGER, C.K.1

1-3: UMEÅ UNIVERSITY

INTRODUCTION: Neuromuscular training (NMT) of the lower limb is vital for athletes in learning correct movement technique to avoid risk of injury to the anterior cruciate ligament (ACL). The NMT aims for improved knee control while maintaining dynamic knee stability (DKS; resistance to linear/angular accelerations) during knee-challenging tasks. Assessing DKS is commonly attempted by evaluating discrete values of kinematic and kinetic variables during one-leg hops, but these measures may not sufficiently capture knee dynamics. We aimed to evaluate if elite women athletes who regularly perform NMT have greater DKS and/or different landing technique than normally active women who do not perform NMT, and if there are any correlations of DKS to peak knee extensor or flexor strength.
METHODS: A motion capture system (Qualisys) synchronized with two force plates (Kistler) registered hip and knee 3D joint angles and moments during one-leg standardized lateral side hop landings for 39 women (19 athletes, 20 controls). Ten trials were performed for the dominant leg with hands behind their back holding a rope (25 cm), deemed successful following 3 s of single leg stance after landing without putting the contralateral foot on the ground or making major adjustments with the ipsilateral foot. DKS was evaluated using the inclination angle of the knee's helical axis relative to the flexion-extension axis calculated for rotation intervals of 10 degrees, as has been proven useful (Grip and Häger, 2013), to quantify how much knee joint motion deviated from pure flexion-extension at landing. Hip and knee joint angles were analysed at initial contact (IC), and peak angles and peak moments were analysed during the deceleration phase of landing from IC to peak knee flexion (ind. t-tests, $p < 0.05$).
RESULTS: Athletes had more successful hops, faster task execution, greater knee extension strength, greater hip flexion angle at IC, and higher peak moments of hip adduction and knee flexion than controls. There were however, no group differences in DKS or any significant correlations between DKS and knee extensor or flexor strength for any of the groups ($r <$ absolute values of 0.41).
CONCLUSION: Elite women athletes that perform NMT on a regular basis had superior knee function but similar DKS to controls when performing a sport-specific one-leg side hop maneuver. The greater hip flexion at IC for athletes shows a different movement strategy for landing preparation. Potential benefits of NMT in sports contexts, e.g. less ACL injuries (Sugimoto et al., 2016), may be due to movement alterations of the hip to increase landing control to avoid positions that strain the ACL rather than improving DKS. Further emphasis on knee-specific landing control may be important to also improve DKS, which seems unrelated to strength.
REFERENCES:
Grip H, Häger C. (2013). J Biomech, 46(5):855-62.
Sugimoto D, Myer GD, Barber Foss KD, Pepin MJ, Micheli LJ, Hewett TE. (2016). Br J Sports Med, 50(20): 1259-66.
CONTACT:
jonas.markstrom@umu.se

NEUROPLASTICITY OF NEUROMUSCULAR TRAINING WITH AUGMENTED BIOFEEDBACK TO REDUCE INJURY RISK

GROOMS, D., KIEFER, A., RILEY, M., DIEKFUSS, J., ELLIS, J., KITCHEN, K., THOMAS, S., DICESARE, C., GADD, B., BONNETTE, S., BARBER-FOSS, K., SILVA, P., GALLOWAY, R., WEIHONG, Y., LEACH, J., BERZ, K.

OHIO UNIVERSITY

INTRODUCTION: Non-contact anterior cruciate ligament injury is associated with reduced lower extremity motor coordination. Neuromuscular training has been shown to reduce ACL injury risk, but the relation between motor control and neural changes following NMT are unknown. The purpose of this study was to determine the relation between brain activation and biomechanical changes following NMT with real-time biofeedback.

METHODS: Twenty high-school female soccer athletes <15.7±0.95 years; 1.68±0.05 m; 59.91±5.62 kg> participated. Ten participants completed 6 weeks of NMT augmented with real-time biofeedback designed to reduce knee injury-risk movements, and 10 acted as controls completing no training. Brain activation changes were measured with functional magnetic resonance imaging during a unilateral knee extension and flexion positioning task. Knee injury-risk motor changes were captured using a drop vertical jump task with a motion capture system . Neuroimaging and motor assessment were completed before and after 6 weeks of NMT.
RESULTS: Sensory , visual-spatial and motor planning brain activity increased for leg positioning after NMT. This network of increased brain activity was correlated with a post-training decrease in knee abduction moment <28%±6.47% p<.050> during landing . No significant changes or relationship between brain activity and motor control were seen in controls.
CONCLUSION: Increased sensory, visual-spatial, and motor planning network activity for knee positioning control after NMT may improve neural processing to control knee positioning during landing, reducing injury risk. Future work enhancing NMT with sensory, visual-spatial, and motor anticipatory exercises may further improve NMT efficacy.

INDIVIDUALISED RECOVERY: THE BELIEFS, PERCEIVED EFFECTIVENESS, AND PREFERENCES OF RECOVERY METHODS OF ELITE RUGBY LEAGUE PLAYERS

KELLY, V.G.1,2, CAIA, J.1,2, SCOTT, T.M.J.1,2

1:THE UNIVERSITY OF QUEENSLAND , 2: BRISBANE BRONCOS NATIONAL RUGBY LEAGUE CLUB

INTRODUCTION: The implementation of recovery modalities in elite team sport is common. However, athletes have individual preferences and little is known about whether these personal preferences align with perceived and/or reported benefits. Therefore, the aim of this investigation was to examine the recovery methods used and compare the perceptual understanding with personal preferences of different recovery modalities in elite Rugby League players. These findings could assist in the development of personalised recovery protocols.
METHODS: Twenty-five elite National Rugby League with a mean full-time playing experience of 3.1 ± 2.8 yrs volunteered to participate in the study. Players completed a questionnaire containing 11 questions designed to determine the reasons for, the perceived benefits and personal preferences of 16 different recovery modalities. The reasons why the athletes performed recovery was also investigated using a 5-point Likert scale while a 10-point Likert scale was used to examine the perceived benefits of recovery. Players ranked their personal preferences from a list of the recovery modalities.
RESULTS: When comparing the effectiveness of each recovery modality, players perceived massage (36%), sleep (26%), cold water immersion (12%), self-massage (8%) and external counterpulsation (ECP) (7%) to be the most effective. This aligned with their beliefs on the importance of these modalities with massage, sleep, self-massage, ECP and stretching believed to be the most beneficial (9.1, 9.1, 8.4, 8.4 and 8.3 out of 10, respectively). However, there were significant differences ($p > 0.05$) between player's perceived effectiveness of the modalities and their individual preferences. The majority preferred massage (52%), followed by sleep (19%) then ECP (11%). Sleep, massage and stretching were ranked the top 3 methods used on a regular basis, while of the newer methods; ECP (9th/16), was used more than peristatic pulse dynamic compression (13th/16) or cryotherapy (15th/16). The primary reasons players performed recovery was to alleviate 'soreness' (4.7/5) and to assist in the 'ability to back up' (4.5/5) between training sessions and matches. The majority of players (48%) felt there were no barriers to completing recovery with lack of time (28%) or motivation (28%) being the greatest barriers for the remaining players.
CONCLUSION: There were significant differences found between the perception of the importance of recovery and players personal preferences. This study provides information on the prevalence of new recovery methods along with contextual information that could be used by coaches and support staff to individualise recovery strategies. When recommending an individualised recovery protocol it is important to consider athlete's personal preference along with the evidence supporting each modality.

Oral presentations

OP-BN21 Wearables and sports performance

APPLICATION STATUS, OPPORTUNITIES AND CHALLENGES OF WEARABLE DEVICES FOR CHINA PREPARATION FOR THE OLYMPIC GAMES

LI, H.

CHINA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: This presentation analyzes the application status and challenges of wearable devices for China to prepare for 2020 Olympic Games and 2022 winter Olympic Games. This presentation sums up the problems existing in athletes preparing for the Olympic Games and puts forward countermeasures in order to make the Olympic preparation training much more scientifically and reasonably.
METHODS: This presentation distributes 65 questionnaires to coaches and scientific researchers. Besides, this presentation interviewed five athletes and five researchers respectively about the usage of wearable devices.
RESULTS: It is found that wearable devices are much more widely used in football, basketball and hockey than in ice hockey and cross-country skinning. Secondly, gyroscopes and accelerometers are highly stable and reliable when wearable devices are used to evaluate the sports training, but the influence of moving speed, nonlinear movement and signal interference on the measurement results should not be neglected. Nowadays the wearable devices made in China are same as foreign devices in terms of wearable form, main techniques and measurement indicators, but they need to be improved in the field of application, technique support and software matching. The original data that wearable devices can measure is very rich, and the parameters of wearable devices of different brands are different.
CONCLUSION: In the process of preparing for the Olympic Games, how the sports teams draw specific indicators that reflect the characteristics of specialized training to measure the training load scientifically depends on the researchers and coaches' understanding of specialized training and the deeper meaning behind the data. It should be realized that any monitoring method has its limitations. There are still some controversies for wearable devices in integration, measurement error, data integrity and sustainable development.

EVALUATION OF PLAYERLOAD™ DURING A PRE-SEASON INTER-COUNTY GAELIC FOOTBALL COMPETITION

GAMBLE, D.1,2, MOYNA, N.2, MCCARREN, A.2, SPENCER, M.3

1:SPORT NORTHERN IRELAND SPORTS INSTITUTE , 2: DUBLIN CITY UNIVERSITY 3:NORWEGIAN SCHOOL OF SPORTS SCIENCE

INTRODUCTION: The running performance profiles of Gaelic footballers have been reported previously (Malone et al. 2016). Microsensors now enable accelerations, decelerations, changes of direction and impacts to be quantified as PlayerLoad™ (PL; Boyd et al. 2011), which may provide a useful measure of the total load experienced by players (Young et al. 2012). Thus, the aim of this study was to evaluate PL in Gaelic football players during pre-season games.
METHODS: OptimEye S5 devices (Catapult Sports, Australia), incorporating a 10 Hz GPS and 100 Hz; tri-axial accelerometer were used to collect 50 full-game player files from 3 teams during 5 games. The male players (24 ± 3 years, mean ± SD) were grouped as; full-back (FB, n=12), half-back (HB, n=12), midfield (MF, n=4), half-forward (HF, n=10) and full-forward (FF, n=12). The PL was analysed between match halves and positions to examine differences. A two level multi-level analysis was conducted on repeated measurements over the two halves where player was level 1 and match was level 2. Player position and half were treated as fixed effects and an intercept was included for the random effects. An additional post-hoc analysis was conducted on the fixed effects and was adjusted using a Bonferroni correction factor.
RESULTS: Mean PL declined from 341.3 ± 77.0 to 327.7 ± 72.6 from the first to the second half. In FB players, PL increased by 3.2% in the second half, whereas reductions of -3.5 (FF), -5.1 (HF), -6.1 (HB) and -10.3 (MF) were observed. Position and half were both found to be significant for PL ($F_{4, 45} = 10{,}739$, $p<0.001$, $F_{1, 49} = 5.078$, 0.029) using a Type III analysis. There were no significant half-position interactions. Using a post hoc analysis pairwise comparisons demonstrated that the FB position was significantly different from the remaining positions (FF: $p=0.037$, HB: $p<0.001$, HF: $p<0.001$, MF: $p=0.009$).
CONCLUSION: The second half decrease in PL observed in the HF, HB and MF players simulates the greater decline in running performance reported for these nomadic players compared to the inside FF and FB players (Malone et al. 2016). It is plausible that fatigue contributed to this decrement, although the influence of tactical or pacing strategies also needs to be considered (Aughey 2010). The increase in PL in the FB players may be explained by a tactical change requiring these players to track their FF opponents instead of adopting territorial defensive positions or to counter the physical performance of new FF players introduced as substitutes. As PL was designed to evaluate impacts from running and contact related events, this variable may be a potential indicator of muscle damage (Young et al. 2012).
Aughey RJ. (2010). Int J Sports Physiol Perform, 5(3): 394–405.
Boyd LJ, Ball K, Aughey RJ. (2011). Int J Sports Physiol Perform, 6: 311–21.
Malone S, Solan B, Collins KD, Doran DA. (2016). J Strength Con Res, 30(8): 2292–98.
Young WB, Hepner J, Robbins DW. (2012). J Strength Con Res, 26(2): 492–96.
declangamble@sini.co.uk

CONCURRENT VALIDITY OF LPS, GPS AND OPTICAL POSITIONING SYSTEMS TO MEASURE COVERED PLAYER AREA AGAINST A VALIDATED COMPUTER VISION MODEL (FIFA EPTS)

ELLENS, S.1, DUTHIE, G.2, AUGHEY, R.1, ROBERTSON, S.1, SERPIELLO, F.1, VARLEY, M.3, EVANS, N.4, BALL, K.1

1: IHES-VICTORIA UNIVERSITY , 2: ACU , 3: ASPIRE , 4: FIFA

INTRODUCTION: Player position is an important value for team sports. It can provide useful behaviour of a team on the pitch as a whole such as area covered, tactical decisions and geometric centre of players. Most of the team behaviour measures involve calculating the distance and area between players from x,y position data. Any error in the x,y data will be magnified in the calculated covered area between players, resulting in erroneous team information. Thus, it's important that position values are true for analysing team behaviour. However, comparison of positioning systems to calculate covered area has not been done. Therefore, the aim of this study was to concurrent validity of a GPS, LPS and optical positioning system to a validated computer vision system.
METHODS: Three soccer games were played by six different teams, every game was analysed with a different player positioning system. The used player positioning systems were GPS, LPS and optical positioning. For the GPS/LPS games players were equipped with a GPS/LPS unit on their upper back. The data of the player position systems were all analysed at 10Hz in Matlab R2016b. Covered area was calculated between 3 players with the triangles formula and 4 players with the polygons formula, both stated by Younhee L. and Woong, L (2017). Statistics were assessed using mean bias in raw units (m^2), SD of bias (95% CR) and typical error of estimate (TEE) in raw units.
RESULTS: The best performing tracking system was LPS followed by GPS and Optical. Calculated surface in the 3-player situation, GPS (mean bias:35.5, TEE:10.6) and Optical (mean bias:1.26, TEE:32.2) and in the 4-player situation GPS (mean bias:15.9, TEE:23.2), LPS (mean bias:0.69, TEE:8.33) and Optical (mean bias:2.83, TEE:45.1) were higher compared to the criterion system. All systems showed strong correlation ($r > 0.95$) and trivial to small measurement errors.
CONCLUSION: The comparison of covered player area calculated out of the different positioning systems predominantly returned trivial mean bias (<2.83) and trivial to small TEE (<45.1), with exception of the GPS mean bias (15.9,35.5) which returned small measurement errors although it had high correlation values ($r > 0.95$). This suggest that the GPS mean bias was lager towards overestimating the area than LPS or Optical systems. This was probably due to signal obstruction and user satellite geometry measurement errors (Gray et al., 2010).

THE PHYSICAL DEMANDS IN ALPINE SKIING

GILGIEN, M., KRÖLL, J., SPÖRRI, J., MÜLLER, E.

NORWEGIAN SCHOOL FOR SPORT SCIENCES

INTRODUCTION: External forces, such as ground reaction force or air drag acting on athletes' bodies in sports, determine the sport-specific demands on athletes' physical fitness. In order to establish appropriate physical conditioning regimes, which adequately prepare athletes for the loads and physical demands occurring in their sports and help reduce the risk of injury, sport-and/or discipline-specific knowledge of the external forces is needed.
METHODS: Due to methodological shortcomings in biomechanical research, data comprehensively describing the external forces that occur in alpine super-G (SG) and downhill (DH) are so far lacking. Therefore, this study applied new and accurate wearable sensor-based technology to determine the external forces acting on skiers during World Cup (WC) alpine skiing competitions in the disciplines of SG and DH and to compare these with those occurring in giant slalom (GS), for which previous research knowledge exists. External forces were

determined using WC forerunners carrying a differential global navigation satellite system (dGNSS). Combining the dGNSS data with a digital terrain model of the snow surface and an air drag model, the magnitudes and temporal pattern of ground reaction forces were computed as a measure of physical demand.
RESULTS: The study revealed that: 1) the method was effectively applied to capture external force data from WC races; 2) the physical demands in alpine ski racing were mainly characterized by fluctuations in the ground reaction force, which followed a cyclic pattern and was most pronounced for GS, followed by SG and DH, while median and peak ground reaction forces were highest for GS, followed by SG and DH).
CONCLUSION: This study 1) illustrated that the validity of high-end dGNSS systems allows meaningful investigations such as characterization of physical demands in highly dynamic sports; and 2) showed that the physical demands were substantially different between GS, SG and DH (specifically, the ground reaction force fluctuations followed a cyclic pattern, which was most pronounced for GS, followed by SG and DH.

SPORTS TRAINING RECOGNITION WITH WEARABLE SENSOR DATA IN FOOTBALL TEAM

TANAKA, T.1, GOUDA, T.2, MAGOME, T.3, NAKATA, K.3

1:HITACHI, LTD., 2:HITACHI, LTD., 3:OSAKA UNIVERSITY GRADUATE SCHOOL OF MEDICINE

INTRODUCTION: Sports using IT is introduced actively into competitive sports. For prevention of injury and effective training, quantitative assessment of player's performance with measurement technologies is required [1]. However, the actual data measured by sensors such as GPS and accelerometer is too complicated to recognize causal relationship to performance for the staffs of sports teams. Therefore, our purpose is to simplify evaluation of measurement data for injury prevention.
[1] Malone, Shane, et al. "The acute: chonic workload ratio in relation to injury risk in professional soccer." Journal of science and medicine in sport 20.6 (2017): 561-565.
METHODS: We propose new method to normalize and evaluate a daily variation of exercise intensity data. Our approach is extracting periods of a specific training from measured continuous data because a daily variation of exercise intensity in periods of a same training is considered to be correlated to player's performance mainly.
To extracting the periods, we develop the process of classifying the data of a sports team into any types of training automatically using only time-series exercise intensity data measured by our wearable accelerometer [2]. The first process is detecting intervals between training periods and splitting the data. The split period corresponds to a period of a single training. The second process is clustering the data of the each split periods with multiple statistical characteristics of time-series exercise intensity data.
We performed the experiment to assess the accuracy of our developed method. We measured the continuous time-series exercise intensity data per second of 15 players in the U -18 team of the Japanese professional football club for 14 days (only the duration of training). After measurement, we extracted the data of our focused training from the measured data with our developed methods, and compared the result with the observation record of training for 2 days. Data were obtained according to the standards of internal review board on R&D group, Hitachi, Ltd.
[2] Tanaka T., et al., "Life microscope: Continuous daily-activity recording system with tiny wireless sensor." INSS 2008: 5th International Conference on Networked
Sensing Systems (2008): 162165.
RESULTS: The accuracy rate of detecting intervals was 100%, and that of the classification into 5 types of training was 80 % in the training of 2 days. Moreover, classifying into our focused training (the pass possession training) were all corrected.
CONCLUSION: Our developed method realizes extracting exercise intensity of a specific training from measured continuous exercise data, and make it easy to evaluate sports performance for staffs of sports teams. Next, we are going to apply our developed method to injury prevention of athletes.

MEASURING SPORT PERFORMANCE IN TALENTED ATHLETES: THE SPORTS REPORT.

ELFERINK-GEMSER, M.T., HENDRIKS, S., HIJLKEMA, A., HENGEVELD, M., VAN DUINHOVEN, S., VISSCHER, C.

UNIVERSITY OF GRONINGEN, UMCG

INTRODUCTION: In talent identification and development programs, a multidimensional and longitudinal approach is recommended. Underlying performance characteristics, such as anthropometric, physiological, technical, tactical, and psychological skills are best monitored in relation to performance and performance development (Elferink-Gemser et al., 2011). However, measuring the latter in a feasible, reliable, and valid way which can be compared between various sports remains a great challenge (Swann et al., 2015). The goal of the current study is to design and test the psychometric characteristics of such measurement tool: The Sports Report.
METHODS: The Sports Report is a pen and paper tool consisting of a simple 10 cm horizontal line. Outcome measure is the percentage an athlete performs above the average level of performance, ranging from 0% ('average level of performance') to 100% ('top performance'). Trainers/coaches score their athlete's level of performance by comparing them to competitive athletes of the same sex and age. Concerning intra-rater reliability, n=7 licensed trainers (age 36,4 ± 9,5) filled out the Sports Report twice with 2 weeks in between for n=21 talented athletes (age 14,8 ± 1,8) in a variety of sports. A comparison was made between test and retest scores. Concerning criterium and construct validity, n=2 licensed trainers (age 33,5 ± 1,0) filled out the Sports Report for n=41 talented speed skaters), of which n=25 were elite and n=18 were sub-elite speed skaters. A comparison was made between scores on the Sports Report and national ranking as well as between elite and sub-elite skaters. Concerning feasibility, interviews were conducted with n=10 licensed trainers (age 36,4 ± 9,5).
RESULTS: Relative (ICC=.92, p<.05) and absolute intra-rater reliability (95% CI-interval of differences: -0,96-1,25) was good with similar scores on test and retest (p>.05). A strong positive correlation between the scores on the Sports Report and position on the national ranking has been found (Spearman r=.663, p<.05). Elite skaters were assigned higher scores than sub-elite skaters (p<.05). In the interviews, trainers stated the Sports Report to be an easy, clear and useful tool taking minimal time.
CONCLUSION: With support for feasibility, reliability, and validity, the Sports Report seems a promising tool to monitor the sport performance of talented athletes in a variety of sports.

Oral presentations

OP-PM66 Atheletes phenotype 2

ANTHROPOMETRY, PHYSICAL PERFORMANCE, AND MOTOR COORDINATION OF MEDALLIST AND NON-MEDALLIST YOUNG FENCERS

NORJALI WAZIR, M.R.W., MOSTAERT, M., PION, J., LENOIR, M.

UNIVERSITEIT GENT

INTRODUCTION: Fencing is a sport that relies a complex intra play of numerous performance characteristics. Evaluation of these characteristics is important in the field of talent identification and talent development. Multidimensional test batteries have proven their value in different sports. The aim of the present study was to identify anthropometric, physical performance and motor coordination characteristics that discriminate medallist and non-medallist fencers.
METHODS: In this cross-sectional study, 83 young fencers (21 national medallist, 62 non-medallist) between 11 and 16 years old were tested in 2010-2015 using a test battery consisting of four anthropometrical, nine physical performance and three motor coordination tests. The fencers were divided into two groups (medallist and non-medallist at national youth championships). First, descriptive analysis explained their general score (means) for anthropometric, physical performance and motor coordination. Second, MANCOVA was used to explain to what extent the two groups were different from each other, taking into account the effect of maturity (age at peak height velocity – APHV) and calendar age (CA).
RESULTS: APHV significantly affected anthropometry and several strength, speed and explosivity variables. Chronological age had an effect on nearly all parameters of anthropometry, physical performance, and motor coordination. MANCOVA, correcting for APHV and CA showed no significant difference for anthropometric, physical performances and motor coordination between medallist and non-medallist fencers.
CONCLUSION: This study aimed to provide reference values of young fencers and to identify the factors that discriminate between being or not being successful at national level. Generally, the results showed no differences between medallist and non-medallist fencers in anthropometry, physical performance and motor coordination. This study a shows significant effect of APHV and chronological age in anthropometric, physical performance and motor coordination among young fencers. The possibility that only taking into account anthropometry, physical performance, and motor coordination of young fencers in the talent identification process is limited due to the complexity of fencing is discussed.

ABSA CAPE EPIC – TRAINING AND RACING DEMANDS

REINPÕLD, K.1, BOSSI, A.H.2, HOPKER, J.G.2

TALLINN UNIVERSITY

INTRODUCTION: The Absa Cape Epic is an 8-day mountain bike race involving a total distance in excess of 650 km with over 13000 m of climbing, suggesting athletes require targeted ultra-endurance training to develop the necessary capabilities. Despite attracting the worlds best mountain bikers, training and racing demands are yet to be described.
METHODS: Six male mountain bikers (age: 39 ± 7 years; VO2max: 61.9 ± 10.9 ml·kg-1·min-1) were monitored for 4.5 months, including the race. Training was divided into two phases—base (November to December) and pre-race (January to mid-March). In October, January and March, riders performed incremental tests to determine the second ventilatory threshold (VT2) and VO2max. VT2 was used as an anchor point to calculate training-intensity distribution bins: soft-pedalling/coasting (<56%VT2), endurance (56–75%VT2), tempo (76–90%VT2), threshold (91–105%VT2), VO2max (106–120%VT2) and anaerobic (>120%VT2). As the race is contested in pairs, we only analysed prologue and stage-one data, given that two athletes from different teams abandoned on stage two due to injuries. Paired t-tests and one-way repeated-measures ANOVAs with Bonferroni pairwise comparisons were performed. Significance was set at $P \leq 0.05$.
RESULTS: Athletes trained 193 ± 28 h of cycling in total (base: 79 ± 18 h, pre-race: 85 ± 13 h; $t = -0.65$, $P = 0.543$), at mean power outputs of 2.58 ± 0.59 W·kg-1 during base and 2.61 ± 0.48 W·kg-1 during pre-race ($t = -0.23$, $P = 0.826$). Despite no changes in VO2max ($F = 5.18$; $P = 0.069$; $\eta p2 = 0.51$), VT2 improved during the training period ($F = 7.09$; $P = 0.012$; $\eta p2 = 0.59$). VT2 was higher in March (4.08 ± 0.64 W·kg-1) than January (3.89 ± 0.61 W·kg-1; $P = 0.050$), while it tended to be higher in March than October (3.82 ± 0.67 W·kg-1; $P = 0.076$). No differences were found between base and pre-race for proportions of training time spent in each intensity bin. Riders completed the prologue and stage one in 1.5 ± 0.2 and 6.5 ± 1.1 h, at mean power outputs of 3.08 ± 0.74 and 2.43 ± 0.66 W·kg-1, respectively. We found lower proportions of time spent in soft-pedalling/coasting and endurance bins (30.4 ± 6.6 vs 40.5 ± 9.4 %, 14.0 ± 4.1 vs 21.8 ± 5.3 %) and higher proportions in VO2max and anaerobic bins (11.6 ± 4.0 vs 5.8 ± 3.5 %, 15.0 ± 7.7 vs 5.2 ± 2.5 %) during prologue than stage one (all $P < 0.006$), but no differences in tempo and threshold bins (14.5 ± 4.1 vs 15.7 ± 2.8 %, 14.6 ± 1.7 vs 11.0 ± 4.5 %; all $P > 0.129$).
CONCLUSION: Mountain bikers preparing for the Absa Cape Epic typically adopt a pyramidal training intensity distribution, with large proportions of low-intensity cycling (56–75%VT2) and no major shifts across training phases. Race form is achieved through improvements in VT2 but not in VO2max. The prologue involves large proportions of high-intensity efforts (>90%VT2), particularly anaerobic efforts (>120%VT2), whereas stage one involves comparatively greater proportions of low-intensity exercise.

COMPETITIVE GAME DEMANDS OF FEMALE AUSTRIAN LACROSSE PLAYERS

HAUER, R., TSCHAN, H.

UNIVERSITY VIENNA

INTRODUCTION: Lacrosse is one of the fastest growing team sports. However, there is a general lack of research in game-play activity profiles (Polley, Cormack, Gabbett, & Polglaze, 2015). Therefore, this study aims to analyse the activity profile in female lacrosse gameplay using micro technology.
METHODS: Activity in 4 games was recorded from ten female Austrian lacrosse athletes (age: 29.1 ±6.1ys; body mass: 64.2 ±5.0kg; height: 165.3 ±4.1cm) using GPS player-tracking (Polar Team Pro). Activity profile variables included percentage of mean heart rate (% HRmean) in relation to maximum heart rate, time spent (s) in HR-zones (1: 15-59%; 2: 60-69%; 3: 70-79%; 4: 80-89%; 5: 90-100%), total distance covered (m), number of sprints, distance covered (m) in speed zones (1: 0.00-6.99km/h; 2: 7.00-10.99km/h; 3: 11.00-14.99km/h; 4: 15.00-18.99km/h; 5: >19.00km/h), and number of accelerations (1: 0.50-0.99m/s²; 2: 1.00-1.99m/s²; 3: 2.00-2.99m/s²; 4: 3.00-

50.00m/s²) and decelerations (zones staggered the other way round compared to accelerations). Players were separated into position of attack, midfield and defence. Differences between positions were analysed using one-way ANOVA. Significant results were interpreted using post-hoc-analyses. Statistical significance was set at $p<0.05$ with a confidence interval of 95%.
RESULTS: Results showed no significant differences for average HR (75.55 ±7.2%) between positions. Similar results have been found for time spent in HR-zones (1: 842.2 ±775.6s; 2: 813.6 ±503.9s; 3: 89.9 ±280.7s; 4: 957.7 ±376.4s; 5: 878.7 ± 602.7s), with only significant differences in zone 1 between attackers and midfielders. Significant differences in number of sprints (10.2 ±4.8) could be found between defenders and midfielders. Analysis for total distance covered in a game showed a mean value of 3,679.7 ±1,005.7m, with significant higher numbers for defenders compared to other positions. Further, results showed significant differences for distance covered in speed zones (1: 1,408.4 ±407.1m; 2: 789.8 ±256.0m; 3: 838.6 ±251.4m; 4: 468.2 ±196.6m; 5: 174.8 ±129.6m), number of accelerations (1: 214.5 ±55.3; 2: 129.1 ±33.5; 3: 40.1 ±12.0; 4: 6.1 ±3.6) and decelerations (1: 4.9 ±3.1; 2: 33.7 ±13.3; 3: 142.9 ±37.7; 4: 257.7 ±54.9) between positions.
CONCLUSION: The analyses of this study suggest that the game-play activity profile differ between positions in women's lacrosse. These differences should be considered by coaches when preparing lacrosse athletes for competition. Nevertheless, further work needs to be done to determine competitive game demands of female lacrosse athletes.

ENERGY DEMANDS IN HIGHLY TRAINED ALPINE SKI RACERS DURING DIFFERENT DURATION OF IN SITU SLALOM AND GIANT SLALOM RUNS

PRIOUX, J.1, BOTTOLLIER, V.1,2, LE QUELLEC, L.2, COULMY, N.2

1ENS - M2S . 2DDSS - FFS .

INTRODUCTION: There are gaps in the understanding of alpine ski racing metabolic demands: (i) there is still no real consensus on metabolic demands in giant slalom (GS); (ii) the metabolic demands in slalom (SL) have not yet been clarified; and, (iii) the difference in metabolic demands between durations of competitive run races for a discipline have not yet been clarified. Consequently, a more complete understanding of the energetics of in situ alpine ski racing could lead to more focused and specific training goals, and subsequent adaptations. Improving these knowledge have the possibility of both improving performance and reducing injury risks. The purpose of this study was to investigate energy demands of different duration in situ SL and GS events in highly trained alpine ski racers.
METHODS: The sample consisted of eight highly trained alpine ski racers (age: 18.2 ± 0.8 years; stature: 1.72 ± 0.10 m; body mass: 65.8 ± 12.0 kg) who performed an incremental lab-test on cycle ergometer and four in situ standardized alpine ski runs: two SL and two GS, each of which was short (ST) and long (LG) (SLST, SLLG, GSST, GSLG). Oxygen uptake (VO2) and heart rate (HR) were recorded continuously in all conditions. VO2 were recorded (breath-by-breath) using a portable gas exchange system (Metamax, Cortex, Germany) and HR using a HR monitor (V800 and H7, Polar, Kempele, Finland). Blood lactate ([La]b) was determined immediately pre-run, and 3 and 5 minutes post-run. The contribution of aerobic and anaerobic lactic energy systems was estimated by energetic flow method (Di Prampero, 1981).
RESULTS: The aerobic system was the primary energy system involved in the GSLG (64 ± 3.9%) and anaerobic lactic was the primary contributor of energy in SLST (63 ± 9.7%) and SLLG (54 ± 7.1%). No significant difference in the contribution of energy systems was observed in GSST. Peak [La]b was higher in SLLG (11.10 ± 2.41 mmol.L-1) than in GSST (8.01 ± 2.01 mmol.L-1). There was no difference in VO2peak between GSST and GSLG.
CONCLUSION: Energetic training goals should focus on the improvement of both aerobic and anaerobic lactic systems for alpine ski racers who perform SL and GS, with SL specialists' emphasis on the improvement of the anaerobic lactic system and GS the aerobic power system.

PHYSIOLOGICAL DEMANDS OF A SIMULATED BMX RACE

BUBECK, D., BRENNER, M., ALT, W.

UNIVERSITY OF STUTTGART

INTRODUCTION: Bicycle Motocross Cycling (BMX) as a young and upcoming sports discipline is new at the Olympic games since 2008. According to this there is a great demand on interest about the physiological and mechanical requirements for this discipline. So an aim of this study was to investigate the oxygen demands and uptakes needed during the race and to compare it to the values of VO2max achieved during a stationary VO2max test.
METHODS: 12 athletes who regularly participate at international races take part at the project. It consists of a preliminary testing session of VO2max on a stationary bike ergometer and week later of a simulated BMX competition with 6 runs interrupted by 20 min breaks on the BMX training track in Zolder (BEL). In both situations oxygen uptake was measured with a Cosmed K5 spirometer.
RESULTS: Results indicated that there was no clear increase of the VO2 values from race 1 to race 6. But it can be seen that in the individual analysis of the athletes some athletes were limited during the race by their aerobic capacity by reaching their VO2max. Other athletes don't reach VO2max so it was assumed that they were limited due to power output factors like their strength capacity.
CONCLUSION: The comparison of the oxygen uptake during a simulated race situation with the values of a stationary VO2max test reveals interesting information about the athletes capacity needed for a race. Therefore recommendations can be given for the athletes about their main training goals.

Oral presentations

OP-PM68 Youth team sports

A COMPARISON OF THE MAXIMUM LOCOMOTOR INTENSITIES IN AGE-GRADE INTERNATIONAL AND ACADEMY RUGBY UNION

READ, D., TILL, K., BARRON-DALTON, N., BEASLEY, G., JONES, B.

LEEDS BECKETT UNIVERSITY

INTRODUCTION: Age-grade (e.g., U18) rugby union players play in multiple playing levels across a season, including international and academy competition. One method for quantifying the physical characteristics of different playing levels is to calculate the maximum locomotor intensity using relative distance (m·min-1) and high-speed (>5.5 m·s-1) relative distance (HSm·min-1). The aims of the study were to quantify the maximum locomotor intensities from match-play and compare between U18 international and academy levels.
METHODS: In total, 142 U18 male rugby union players provided 232 observations. During match-play each player wore a micro-technology device (S5 Optimeye, Catapult Sports) that contained a global positioning system. Using the raw instantaneous speed (m·s-1) downloaded at 10 Hz, variables were calculated through the use of a 0.1 s rolling mean for time durations (15, 30 s and 1, 2, 2.5, 3, 4, 5, 10 min) relevant to academy rugby union. Players were split into four positional groups of: front row, back five, scrum-halves, and inside and outside backs. A linear mixed model was used to account for the repeated measurements of players and then results were interpreted with effect sizes (ES) ±90% confidence intervals and classified as trivial (0.00-0.19); small (0.20-0.59); moderate (0.60-1.19) and large (1.20-1.99). Ethics approval was granted from Leeds Beckett University.
RESULTS: Differences between levels in relative distance were trivial or small for all time durations and positions, with the relative distance ranging from 148 ± 16 to 189 ± 17 m·min-1 in the one-minute duration. High-speed relative distance for one-minute ranged from 26 ± 11 to 71 ± 24 HSm·min-1 and throughout all comparisons were greater in international players. The differences in high-speed relative distance were moderate to large (ES = 1.17 ±0.64 to 1.59 ±0.64) in front row players. The differences between the back five positional groups were small (ES = 0.31 ±0.52 to 0.45 ±0.57) for high-speed relative distance. There were small differences between the groups of scrum halves in the 15 s, 30 s and 1 min durations (ES = 0.56 ±0.79 to 0.59 ±0.78), with moderate to large differences in time durations ≥2 min (ES = 0.82 ±0.87 to 1.24 ±0.93). The differences in high-speed relative distance were trivial to small (ES = 0.02 ±0.51 to 0.39 ±0.58) in the inside and outside backs comparison.
CONCLUSION: Relative distance was similar between playing levels but appears to be comparable to data from senior international rugby union match-play in previous studies. There is a greater amount of high-speed relative distance per minute completed during U18 international matches compared to U18 academy matches. Coaches working with rugby players can use this information to appropriately overload the intensity of running, specific to time durations and positions.

PITCH DIMENSIONS IN ELITE YOUTH SOCCER TRAINING: IMPACT ON EXERCISE INTENSITY

CONNOLLY, D.R.1, GUALTIERI, A.1, FERRARI-BRAVO, D.1, SASSI, R.1, RAMPININI, E.2, COUTTS, A.J.3

1: JUVENTUS FC , 2: MAPEI SPORT . 3: UNIVERSITY OF TECHNOLOGY SYDNEY .

INTRODUCTION: Soccer training drills are often designed with the aim to replicate movement demands, physiological intensity and technical requirements of match play. Pitch dimensions and the number of players involved can influence the intensity of Small-Sided Games (SSGs) (Hill-Haas et al., 2011) and tactical drills. In this study, we aimed to investigate how pitch dimensions are utilized in youth soccer and the differences in intensity induced across different age groups.
METHODS: In-season training sessions of elite level youth soccer players, ranging from U15 to U17 (age: 15.7±0.9yrs, height: 176.6±6.7cm, weight: 66±7.8kg), were monitored (306 observations) using 10Hz GPS units (StatSports, Ireland) and heart rate monitors (Polar, Finland). The pitch dimensions of each drill were noted to calculate the relative pitch area per player. The pitch dimensions utilized were divided into 3 groups: Large, match-derived relative pitch areas (L, >250m2), Medium (M, 150m215km/h (DS15) and number of accelerations >2ms (ACC)) of each drill were monitored and normalized for time. A sub-analysis was performed on 33 players to investigate the effect of pitch dimensions on exercise intensity. Pearsons Chi-square test was utilized to assess the distribution of pitch sizes. Differences between the pitch dimensions and age groups were analyzed using two-way mixed ANOVAs with Bonferroni post-hoc test. Significance level was set at $p<0.05$.
RESULTS: Overall, more training drills were performed on S pitches ($p<0.001$), however the distribution of pitch dimensions was significantly different between the different age groups. Significantly less D and DS15 was covered in S ($p<0.001$) compared to M and L pitches. A significant interaction between pitch size and age group was found for D and DS15, with increases in pitch dimensions influencing U15 players output significantly more than U16 and U17 ($p<0.01$). More ACC were performed in S ($p<0.001$), with U17 performing less ACC than the younger age groups. No significant effects observed for 85%HR induced by the different pitch dimensions ($p=0.567$); however, U15 performed greater 85%HR than U16 and U17 ($p<0.012$).
CONCLUSION: Pitch dimensions commonly used during training are smaller than match dimensions, producing a greater number of ACC, while contributing lower distance and speed than M and L SSG pitches. Changes in pitch dimensions appear to have a greater impact upon younger players external load.

EVALUATION OF THE EXTERNAL AND INTERNAL MATCH-PLAY DEMANDS OF ELITE UNDER 17 HURLING

YOUNG, D., MOUROT, L., BEATO, M., CORATELLA, G.

UNIVERSITY FRANCHE COMTE

INTRODUCTION: Hurling is an Irish stick and ball invasion game, which has previously been described as one of the fastest and skilful field games in the world. Match-play demands of underage hurling have never been quantified. The current study aimed to quantify the match-play workload of elite male under 17 hurling players, measuring the differences between first and second half and between positions.
METHODS: Fifty elite male hurlers with a mean (± SD) age, height body mass and predicted VO2max of 16.71 ± 0.39 years, 178.40 ± 6.26 cm, 69.32 ± 6.02 kg, and 54.55 ml.kg-1.min-1 respectively, volunteered to participate in the study. GPS (10-Hz Viper, STATSport) and heart-rate (HR) monitors (Team Polar, Polar Electro Oy, Kempele, Finland) were used to collect data from three elite male U17 teams during 12

matches. The participants were categorized into common outfield playing positions of full backs (n=10), half backs (n=11), midfielders (n=9), half forwards (n=10) and full forwards (n=10). Data collected from the GPS units included total distance (TD) (m), high-speed running (HSR) (17-22 km·h-1) (m), the total number of sprints (≥ 22 km·h-1) and sprint distance (≥ 22 km·h-1) (m). Peak HR (HRmax) was taken as the highest HR recorded and mean HR (HRmean) was assumed as the mean value logged during games.
RESULTS: Players' TD, HSR, number of sprints, sprint distance, HRmax and HRmean were 6141 ± 1024 m, 514 ± 158 m, 10 ± 4 and 389 ± 74 m, 192 ± 29 b·min-1 and 160 ± 13 b·min-1 respectively. Decrements in TD ($p < 0.001$, ES = 0.81), HSR ($p < 0.001$, ES = 0.69), number of sprints ($p < 0.001$, ES = 0.78), sprint distance ($p < 0.001$, ES = 0.76) and HRmean ($p < 0.001$, ES = 0.80) were found between halves. Midfielders covered greater TD than full backs ($p < 0.001$, ES = 3.23), half forwards ($p = 0.008$, ES = 2.08) and full forwards ($p = 0.003$, ES = 2.01). However, no differences were found between positions for the total number of sprints, sprint distance or HRmax during the full duration of match-play.
CONCLUSION: The current results are the first to highlight the differences in external and internal position specific workload in elite male under 17 hurlers. The overall total running performances were lower than found at elite senior hurling level. Players need to be sufficiently prepared to be able to perform the match-play demands, with an emphasis placed on being able to repeat HSR distance, sprint distance and the number of sprints for the full duration of the match. Training sessions and drills or matches design should include activities that provide the necessary stimulus to elicit specific positional match-play responses.

CHANGES IN THE PHYSICAL DEVELOPMENT OF ELITE ADOLESCENT RUGBY UNION PLAYERS IN IRELAND: A LONGITUDINAL ANALYSIS OF DEVELOPMENT BY PLAYING POSITION

CASSERLY, N.1, NEVILLE, R.1, DITROILO, M.1, GRAINGER, A.2

UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: The wellbeing of elite rugby union players has been subjected to intense scrutiny in recent years. Understanding the physical development of adolescent players is particularly indicated in this context, since new knowledge in this area can aid in improving programming and help adolescents prepare for the demands of senior rugby.
This study focuses on the physical development of elite adolescent rugby union forwards (n=8) and backs (n=7) over the final two years of their junior competitive career. The focus of the study was on the relative development of players over time taking into account an inventory of performance measures which are widely regarded as discriminators of playing position.
METHODS: Fifteen players (body mass, 90 ± 14; height, 183 ± 9) completed anthropometric measures, CMJ, Yoyo-IR1 and 10m acceleration at baseline, year 2 and year 3. Mixed linear model equations were derived to assess both player development over time and the extent to which this development differed by playing position. Data was analysed by means of standardisation where Magnitude Based Inference (MBI) was used to assess the size and likelihood of the differences between years and differences between groups.
RESULTS: There was a substantial improvement in 10m acceleration (Standardised Improvement, 0.2; 90%CL, 0.7: MBI, small*) and in aerobic capacity as measured by the Yoyo-IR1 (0.5; 0.6: small**). Differences between backs and forwards in relation to these changes are also noteworthy. There was a large difference in 10m acceleration, comparing backs and forwards (-1.3; 1.3 - large**), with backs appearing to get substantially faster over time (-0.8; 0.9: moderate**). A similar trend was observed for aerobic fitness. Backs improved substantially over time (1.0; 1.3: moderate**). However, outcomes for forwards (0.1: 0.5) as well the postdoc estimates regarding differences between groups (0.9; 1.3) were unclear. There is some indication that differences in weight between groups can explain some of the difference in acceleration over time. The effect of weight was moderate in size (0.6; 2.6); however, the confidence interval for this estimate was too wide to be deemed clear. Change in CMJ height and differences between groups in relation to this change were unclear and are therefore not presented.
CONCLUSION: Improvements in acceleration and aerobic capacity for backs reflects the demands of gameplay within this positional unit. Backs are required to cover greater distances at a higher intensity than forwards (Roberts et al, 2008) and to use speed qualities to avoid contact while ball carrying. Differences in body mass can potentially explain some of the difference in performance between positional units. More data is required, however, to ascertain the true magnitude of this effect.
Roberts, S.P. et al, 2008. The physical demands of elite English rugby union. Journal of sports sciences, 26(8), pp.825-833.

PROFESSIONAL YOUTH PLAYERS' DECISION SKILLS: A VALIDATION OF A VIDEO DIAGNOSTIC BASED ON AGE, PLAYING POSITION AND PLAYING STATUS

MURR, D.1, LARKIN, P.2, HÖNER, O.1

UNIVERSITY OF TUEBINGEN, GERMANY <1>; VICTORIA UNIVERSITY, AUSTRALIA <2>

Introduction: In previous research psychological talent predictors in soccer has been investigated extensively. Moreover, cognitive skills, in particular players' ability to make the right decision in different game situations under time constraints are an important performance indicator for soccer. However, there is a lack of diagnostics that accurately measure decision-making performance using soccer specific stimuli in combination with a sport-specific motor response. This study aimed to validate a video-based test battery that assesses decision-making at one of the leading German youth academies. In detail, adolescent soccer players' competence in decision-making was examined based on playing status, age and playing position.
Methods: The sample consisted of 140 data points from 86 German youth academy players born between 1996 and 2001 (16,7 ± 0,9 ys.). The decision-making task required players to interact with a game situation projected on a large video screen by dribbling and passing to one of three targets. The video-based test-battery included 48 video clips, which were separated into two categories: (1) build up (BU); and (2) offensive decision (OD). A total score (SC) and a score for each category (SCBU, SCOD) were calculated and analyzed based on playing status (i. e., first team regular player (FTRP) vs. reserve player (RP)); age (i.e., U16, U17, and U19); and playing position (i.e. defender (DF) vs. midfielder (MF) vs. forward (FW)).
Results: The test instrument showed a satisfactory reliability (odd-even-method) for SC ($r = 0.72$; $p < .01$). Diagnostic validity was assessed with independent two-sample t-tests comparing players' decision-making skill relative to their playing status. FTRP performed significantly better than RP (SC; $d = 0.46$; $p < .01$). One-way ANOVAs identified differences in decision-making competence with regard to age and playing position. Post-hoc analysis revealed U19 and U17 players performed significantly better than U16 players (SC; $d = 0.68$ and $d = 0.79$; $p < .01$). In regard to playing position, MF's performed better in SC, albeit not significantly, compared to DF and FW. Within the individual categories, MF and FW scored higher in SCOD, DF in SCBU.
Conclusion

Overall the applied video-based test, which aims to replicate game situations, seems to be a suitable instrument for discriminating playing status. In addition the findings indicate older players have better decision-making skills than younger players. For playing position no differences in decision-making performance were found at this stage. Ultimately, the success in discriminating playing status makes it of interest for future prospective studies.
Contact: dennis.murr@uni-tuebingen.de

Oral presentations

OP-PM67 Heat exposure

HEAT ACCLIMATION ALTERS PACING STRATEGY AND IMPROVES END-SPURT IN FEMALE ENDURANCE ATHLETES

LUCAS, R.A.I, KIRBY, N., LUCAS, S.J.E.

UNIVERSITY OF BIRMINGHAM

INTRODUCTION: Self-paced time trial performance is impaired in the heat, with less work completed during the end-spurt of time trials (Levels et al., 2017). Heat acclimation (HA) is known to improve self-paced time trial performance in the heat via thermoregulatory adaptations and improved aerobic capacity resulting from plasma volume expansion and reduced cardiovascular strain. However, the effects of HA on pacing strategies are unknown. Therefore, this study examined the effect of HA on pacing strategies and end-spurt during self-paced cycling time trials.
METHODS: Following two familiarisation sessions, 7 female recreational endurance athletes (mean ±SD age 28 ±5 yrs, mass 61 ±5 kg, VO2max 45 ±5 mL/kg/min) completed a 15-minute self-paced time trial in hot conditions (HTT; 35°C, 30%RH) before (HTT1) and after (HTT2) 9-days isothermic HA (40°C, 30%RH). Power output during HTTs were split into the start, middle, and "end-spurt", which consisted of minute 0-2, minute 2-13, and minute 13-15, respectively. Data from HTT1 and HTT2 were compared using paired t-tests.
RESULTS: Following HA there was an increase in overall distance cycled (+260±150 m (3.3%), P=0.003) and mean power output (+10.4±7.4 W (5.5%) P=0.003) in HTT2. Area under the curve (AUC) for power output was greater in HTT2 (P=0.003) and presented a different pacing pattern (HTT2: U-shaped curve vs. HTT1: "even until end-spurt" or J-shaped curve). In HTT2, power output was higher during each of the three phases (start, P=0.017; middle, P=0.005; and end-spurt, P<0.001). Distance completed during the end-spurt increased (+30±10 m; P<0.001) in HTT2. Rectal temperature at rest was lower (-0.13±0.17 °C; P=0.038) and thermal sensation (TS) reported at rest was improved (P= 0.039; inside chamber) following HA. Blood lactate, HR and thermal comfort were similar between HTT2 and HTT1.
CONCLUSION: Alterations in pacing strategy and improvements in each phase of the self-paced time trial were observed following HA in recreational female endurance athletes. Pre HA pacing patterns mirrored patterns from similar shorter distance self-paced time trials (Borg et al., 2018); however, following HA, a more U-shaped curve was observed via the disproportional power output increases during the start phase of HTT2. This improvement during the start may be due to a reduced rectal temperature and improved TS at the initiation of HTT2. Improved aerobic capacity (evident from increased power output without significant increases in HR) likely contributed to improvements during the middle phase of HTT2. However, from these data it is unclear the mechanisms underlying improvements in power output during the end-spurt (the point of supposed greatest fatigue).

EFFECTS OF ACUTE OR CHRONIC HEAT EXPOSURE, EXERCISE AND DEHYDRATION ON PLASMA CORTISOL, IL-6 AND CRP LEVELS IN TRAINED MALES

COSTELLO, J.T., RENDELL, R.A., FURBER, M., MASSEY, H.C., TIPTON, M.J., YOUNG, J.S., CORBETT, J.

UNIVERSITY OF PORTSMOUTH

INTRODUCTION: This study examined the acute and chronic effects of euhydrated and hypohydrated heat exposure, on biomarkers of stress and inflammation.
METHODS: Eight trained males [mean (SD) age: 21 (3) y; mass: 77.30 (4.88) kg; V?O2max: 56.9 (7.2) mL·kg-1·min-1] undertook two heat acclimation programmes (balanced cross-over design), once drinking to maintain euhydration and once with restricted fluid-intake (permissive dehydration). Days 1, 6, and 11 were 60 min euhydrated exercise-heat stress tests (40 °C; 50 % RH, 35% peak power output), days 2–5 and 7–10 were 90 min, isothermal-strain (target rectal temperature: 38.5 °C) exercise-heat sessions. Plasma was obtained pre- and post- exercise on day 1, 2, and 11 and analysed for cortisol, interleukin-6 (IL-6), and C-reactive protein (CRP). Cortisol and CRP were also assessed on day 6.
RESULTS: IL-6 was elevated following the initial (acute) 90 minute isothermal heat strain exercise-heat exposure (day 2) with permissive dehydration ((pre exercise: 1.0 pg.mL-1 [0.9], post-exercise: 1.8 pg.mL-1 [1.0], P = 0.032) and when euhydrated (pre-exercise: 1.0 pg.mL-1 [1.4], post-exercise: 1.6 pg.mL-1 [2.1], P = 0.048). Plasma cortisol levels were also elevated but only during permissive dehydration (P = 0.032). Body mass loss was strongly correlated with ?cortisol (r = -0.688, P = 0.003). Although there was a trend for post-exercise cortisol to be decreased following both heat acclimation programmes (chronic effects), there were no within or between intervention differences in IL-6 or CRP.
CONCLUSION: In conclusion, acute exercise in the heat increased IL-6 and cortisol only when fluid-intake is restricted. There were no chronic effects of either intervention on biomarkers of inflammation as evidenced by IL-6 and CRP returning to basal level at the end of heat acclimation.

THE EFFECTIVENESS OF A MIXED ACTIVE AND PASSIVE HEAT ACCLIMATION PROTOCOL FOR PARALYMPIC AND ABLE-BODIED TRIATHLETES

STEPHENSON, B., TOLFREY, K., GOOSEY-TOLFREY, V.

LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Despite the volume of heat acclimation (HA) studies in the literature, their applicability to the multi-modal sport of triathlon is relatively unknown. Furthermore, given the popularity of the Paralympic Games, surprisingly few studies have examined the effective-

ness of HA for Paralympic athletes. Therefore, the aim of the study was to investigate the efficacy of a novel HA protocol for Paralympic (P) and able bodied (AB) triathletes.
METHODS: 20 triathletes participated in the study, which comprised of 7 elite paratriathletes (4 male, 3 female) of mixed physical impairments (amputation n = 3, spinal cord injury n = 1, cerebral palsy n = 1, lower leg impairment n = 1, visual impairment n = 1) and 13 AB triathletes (9 male, 4 female). Both groups completed an 8-day HA protocol consisting of 5 active and 3 passive heat exposures in 35oC and 60% relative humidity. Active HA was performed in a quasi-isothermic manner whereby participants were instructed to maintain a constant heart rate (HR) for 45 or 90 min each day whilst cycling on an ergometer. During passive HA, participants rested in the heat for 60 min, immediately after the completion of a 30 min moderate intensity run. A 50 min fixed, moderate intensity cycling trial was conducted on the first and last day of HA to assess changes in core temperature (Tc), HR, blood lactate concentration (BLa), and plasma volume (PV). Changes in the aforementioned parameters were assessed via two-way ANOVA or paired samples t-test. Effect sizes were calculated via the use of partial ?2 or d (Cohen, 1988).
RESULTS: During the fixed intensity trial, there was a large decrease in Tc for P (38.02 ± 0.41oC to 37.68 ± 0.53oC, p = 0.039, ?2 = 0.228) and AB (38.11 ± 0.48oC to 37.82 ± 0.56oC, p = 0.041, ?2 = 0.327) post-HA. Whilst HR was practically unchanged for P (133 ± 14 bpm to 130 ± 13 bpm, p = 0.878), there was a large decrease in AB (152 ± 16 bpm to 147 ± 15 bpm, p = 0.008, ?2 = 0.453). BLa was lower to a large extent post-HA in both groups (P: 1.47 ± 0.46 mmol·l-1 to 1.23 ± 0.40 mmol·l-1, p < 0.001, ?2 = 0.899; AB: 2.02 ± 0.76 mmol·l-1 to 1.64 ± 0.73 mmol·l-1, p = 0.002, ?2 = 0.573). There was a large increase in PV for both groups (P: 12.7 ± 10.7%, p = 0.019, d = 2.592; AB 4.4 ± 7.5%, p = 0.025, d = 1.570).
CONCLUSION: A mixed, active and passive, quasi-isothermic HA protocol stimulated beneficial adaptations in both AB and Paralympic triathletes. Whilst the P group did not display any significant changes in submaximal HR, this is the first evidence that athletes with a mix of physical impairments can display positive thermoregulatory adaptations.

PASSIVE HEAT ACCLIMATION IMPROVES SKELETAL MUSCLE CONTRACTILITY IN HUMANS

RACINAIS, S., WILSON, M.G., PERIARD, J.D.
ASPETAR ORTHOPAEDIC AND SPORTS MEDICINE HOSPITAL

INTRODUCTION: In vitro and animal studies have suggested that heat stress can promote skeletal muscle cell proliferation and increase force. The aim of this study was to investigate the effect of repeated passive heat exposure on muscle contractility in humans. It was hypothesized that heat acclimation would improve human skeletal muscle force and contractility in both hot and temperate conditions.
METHODS: Fourteen non-heat acclimated males completed two trials including electrically evoked twitches and voluntary contractions of the plantar flexors in temperate and hot ambient conditions on consecutive days in a counterbalanced order. Rectal temperature was maintained at ~39°C throughout HOT. The trials were repeated after 11 consecutive days of passive heat acclimation <1 hr per day, 48-50°C, 50% RH>.
RESULTS: Heat acclimation induced a decrease in core temperature in CON and an increase in sweat rate during heat exposure . Moreover, passive heat acclimation improved skeletal muscle contractility as evidenced by an increase in electrically evoked peak twitch amplitude without altering contractile speed. Maximal isometric voluntary torque production was also increased in both CON and HOT , despite voluntary activation remaining unchanged. Further, the slope of the relative torque/EMG linear relationship was improved post-acclimation .
CONCLUSION: These adjustments demonstrate that passive heat acclimation improves skeletal muscle contractile function of the plantar flexors in humans. The improvement was verified across both CON and HOT, with voluntary and electrically evoked contractions, at rest and at different contraction intensities <10, 25, 50, 75 and 100% of maximal voluntary torque>. In conclusion, this infers that passive heat acclimation improves skeletal muscle contractile function in humans, irrespective of ambient testing conditions.
PRACTICAL APPLICATIONS:
These results highlight a novel passive method to improve muscle function via repeated heat exposure that may be used with athletes and patients during a period of musculoskeletal unloading, such as post-surgical immobilization.

METHODS: RESULTS: CONCLUSION: Oral presentations

OP-PM46 Nutritional supplements

EFFECTS OF ACUTE INGESTION OF A KETONE ESTER ON PHYSICAL AND COGNITIVE PERFORMANCE IN TEAM SPORT ATHLETES DURING A SIMULATED SOCCER PROTOCOL

EVANS, M., EGAN, B.
DUBLIN CITY UNIVERSITY

INTRODUCTION: The ketone bodies beta-hydroxybutyrate (βHB) and acetoacetate are lipid-derived metabolites that play a role in energy provision under physiological states characterised by reduced glucose availability, such as prolonged starvation and ketogenic dieting. The role of ketone bodies in relation to fuel provision during exercise has become of interest due to the development of exogenous ketone supplements, namely ketone salts and ketone esters. To date, the research on ketone supplements has focused on endurance athletes with a lack of data both in high intensity team sports, and for their effect on cognition function in humans.
METHODS: In a double-blind, randomised crossover design, eleven male team sport athletes undertook two experimental trials during which they performed the Loughborough Intermittent Shuttle Test (Part A: 5x15 min intermittent activity, Part B: run to exhaustion). Before and after exercise, participants completed a battery of cognitive tests (CANTAB Cognition, UK). Each experimental trial was identical with the exception of the drink consumed throughout exercise, which consisted of either (i) a 6% carbohydrate solution (1.2 g min-1 of exercise) (PLA) or (ii) a 6% carbohydrate solution (1.2 g min-1) combined with 745 mg kg body mass-1 of a ketone monoester (KET). KET was ingested in three boluses (50:25:25) at 20 min prior to exercise, and after 30 and 60 min of exercise, respectively. 15 m sprint times and heart rate were collected during exercise, and blood samples were collected at rest and at the end of each 15 min block of exercise for measurement of plasma glucose, lactate and βHB.
RESULTS: KET ingestion produced acute nutritional ketosis with plasma concentrations of ~2-3 mM during exercise. Run time to exhaustion in Part B was not different between PLA and KET (p=0.123, ES=0.45) nor were 15 -m sprint times during Part A. Plasma glucose and lactate concentrations were reduced during exercise in KET compared to PLA, with effects sizes being moderate-to-large. No differences

in heart rate were observed during any block of exercise. The number of incorrect responses in the multitasking test increased from pre- to post-exercise in PLA (2.0±2.4), but not in KET (0.4±1.9) (p=0.019, ES=0.73).
CONCLUSION: Ingestion of a ketone monoester had no effect on run time to exhaustion or 15 m sprint times during simulated soccer performance in team sport athletes, but may have attenuated the decline in managing multitasking with fatiguing exercise. The reduction in plasma glucose and lactate suggest an attenuation of carbohydrate utilisation during exercise, suggesting that exogenous ketones are a readily available source of energy during intermittent running.

NOVEL PLANT-BASED NUTRACEUTICAL SUPPLEMENTATION AND LYMPHOCYTE CELL DNA DAMAGE FOLLOWING HIGH INTENSITY EXERCISE

WILLIAMSON, J., HUGHES, C.M., DAVISON, G.W.

ULSTER UNIVERSITY

INTRODUCTION: The generation of reactive oxygen species is an integral part of the biological redox equilibrium, and play a salient regulatory role in cell signalling (Elokda & Nielsen, 2007). Plant-based nutraceuticals are categorised as nutritional supplements which contain a high concentration of antioxidants, with the intention of minimising the deleterious effects of an oxidative insult. The primary aim of this novel study was to determine the effect of exogenous barley-wheat grass juice (BWJ) on indices of exercise-induced oxidative stress.
METHODS: Ten (n=10) apparently healthy, recreationally trained (V̇O2max 55.9 ± 6 ml·kg-1min-1), males (age 22 ± 2 yrs, height 181 ± 6 cm, weight 87 ± 8 kg, BMI 27 ± 1) volunteered to participant in the study. In a randomised, double blinded, placebo-controlled crossover design, participants consumed either a placebo, a low dose (70ml per day) of BWJ, or a high dose (140ml per day) of BWJ for 7-days. Experimental exercise consisted of a standard maximal oxygen uptake test until volitional fatigue.
RESULTS: DNA damage as assessed by the single cell gel electrophoresis comet assay increased following high intensity exercise across all groups (time x group; $p<0.05$, ES = 0.7), although there was no selective difference for intervention ($p>0,05$). There was a main effect for time in lipid hydroperoxide concentration (pooled group data, pre- vs. post-exercise, $p<0.05$, ES = 0.2) demonstrating that exercise increased lipid peroxidation. Superoxide dismutase activity (SOD) increased by 44.7% following BWJ supplementation (pooled group data, pre-vs. post supplementation). The ascorbyl free radical ($p<0.05$, ES = 0.26), α-tocopherol ($p=0.007$, ES = 0.2) and xanthophyll ($p=0.000$, ES = 0.5) increased between the pre- and post-exercise time points indicating a main effect of time. Although not significant ($P>0.05$), DNA damage and lipid hydroperoxides were reduced by 7.2% and 5.1% in the BWJ group respectively; additionally, supplementation of BWJ increased SOD activity by 14.7% compared to the placebo group.
CONCLUSION: This study demonstrates that exhaustive, high-intensity exercise causes DNA damage and lipid peroxidation, and these perturbations may be physiologically pertinent for normal biological function. Seven-day supplementation of a novel plant-derived nutraceutical product is insufficient at attenuating exercise-induced oxidative damage; however, future research should consider a larger sample size as marginal changes were observed in biomarkers associated with exercise-induced oxidative stress.

THE EFFECT OF MAGNESIUM SUPPLEMENTATION ON MUSCLE FITNESS: A META-ANALYSIS AND SYSTEMATIC REVIEW

WANG, R.1, CHEN, C.2, LIU, W.1, ZHOU, T.1, XUN, P.2, HE, K.2, CHEN, P.1

1 SHANGHAI UNIVERSITY OF SPORT; 2 BLOOMINGTON, INDIANA UNIVERSITY

INTRODUCTION: Increasing evidence supports a role of magnesium in skeletal muscle function. However, no systematic review or meta-analysis has summarized data on Mg supplementation in relation to muscle fitness in humans. Thus, this study aimed to quantitatively assess the effect of Mg supplementation on muscle fitness.
METHODS: Medline database and other sources were searched for randomized clinical trials through July 2017. Studies that reported results regarding at least one of the following outcomes: leg strength, knee extension strength, peak torque, muscle power, muscle work, jump, handgrip, bench press weights, resistant exercise, lean mass, muscle mass, muscle strength, walking speed, Repeated Chair Stands, and TGUG were included. Measurements of the association were pooled using a fixed-effects model and expressed as weighted mean differences with 95% confidence intervals <95% CIs>.
RESULTS: Fourteen randomized clinical trials targeting 3 different populations were identified: athletes or physically active individuals <215 participants; mean age: 24.9 years>, untrained healthy individuals <95 participants; mean age: 40.2 years>, and elderly or alcoholics <232 participants; mean age: 62.7 years>. Beneficial effects of Mg supplementation appeared to be more pronounced in the elderly and alcoholics, but were not apparent in athletes and physically active individuals. The results of the meta-analysis suggested that no significant improvements in the supplementation group were observed regarding isokinetic peak torque extension [WMD = 0.87; 95% CI = <-1.43, 3.18>], muscle strength [WMD = 0.87; 95% CI = <-0.12, 1.86>] or muscle power [WMD = 3.28; 95% CI = <-14.94, 21.50>].
CONCLUSION: Evidence does not support a beneficial effect of Mg supplementation on muscle fitness in most athletes and physically active individuals who have a relatively high Mg status. But Mg supplementation may benefit individuals with Mg deficiency, such as the elderly and alcoholics.

PRO –REGENERATIVE EFFECTS OF A NUTRITIVE ADMINISTRATION OF CARBOHYDRATES AND PROTEIN BY FOOD-STUFFS ON LEG STRENGTH AFTER ACUTE ENDURANCE EXERCISE

ISENMANN, E., PAGANO, S., BIZYAK, D., DIEL, P.

DEUTSCHE SPORTHOCHSCHULE KÖLN

INTRODUCTION: Ingestion of proteins and carbohydrates after exercise is believed to result in an enhancement of regeneration and physical performance after training. Mostly these nutrients are ingested by athletes via whey protein and glucose based shakes. In this study protein and carbohydrates were administrated via a meal. Effects of this meal delivered carbohydrate and protein ingestion directly after acute endurance exercise on leg strength were investigated.
METHODS: 15 male subjects <22,9J±1,98; 185cm±6,26; 79,8kg±7,71>. performed a 10km run at 80% of the individual anaerobic threshold. After exercise subjects ingested nothing , a whey protein based protein/carbohydrate shake, or white bread and sour milk cheese . All 15 subjects were exposed to these nutritive interventions after exercise in a cross over design. As a parameter for skeletal muscle regeneration leg strength was determined in a 3-repetition maximum <3-RM> squat assay of all subjects before endurance exercise and 24 h after endurance exercise.

RESULTS: As expected CK values at T24 were increased in all groups. Hemograms showed no significant changes between T0 and T24 in all groups. Leg strength at T24 was significantly reduced only in the control group. Here the maximum average weight lifted was reduced around 3.00 kg ± 5,10. In comparison in the intervention groups leg strength was only reduced around 0,63 kg ± 4.78 in the SHAKE and around 1,67 kg ± 3,50 in the bread-cheese group. So the leg strength in these groups was nor significantly different between T0 and T24.
CONCLUSION: Our results clearly indicate, that the skeletal muscle damage induced by 10 km running , which is documented by the increase in CK, is associated with a reduced leg force 24h after running. This leg force decrease can be counteract by the uptake of protein- carbohydrate combinations, indication a better regeneration after exercise. Obviously as well an uptake of protein carbohydrate by shake but also by food can result in this effect. These results are in agreement to our previous findings demonstration that parameters of muscle damage and inflammation, induced by physical activity, can be reduced by uptake of protein- carbohydrate combinations immediately after exercise. Moreover they are demonstration that eating a suitable combination of food after exercise can result in the same pro–regenerative effects like consumption of nutrition supplements.

COMPARISON EFFECT OF SHORT TERM AND PROLONGED VITAMIN C SUPPLEMENTATION ON EXERCISE INDUCED MUSCLE SORENESS AND DAMAGE IN SEDENTARY MEN

ATAEI, L.

UNIVERSITY OF NICOSIA

INTRODUCTION: The need for energy in intensive exercise necessitates an increase in oxygen consumption that can lead to increasing accumulation of free radicals and induce oxidative stress in the body . A number of studies have investigated the effect of antioxidant supplementation. However, there is a paucity of information regarding the effect of vitamin C on exercise induced muscle soreness, in sedentary men, in either the short term or with prolonged supplementation. Therefore, this study was conducted to compare the effect of short term and prolonged vitamin C supplementation on exercise induced muscle soreness and damage, in sedentary men.
METHODS: 32 healthy sedentary male volunteers with average age 23.5 ± 2.5 years, body weight 72.2 ± 7.2 kg, and height 175.3 ± 4.3 cm were randomly assigned to one of two experimental groups, namely A) The Prolonged Group (4 weeks supplementation) and B) The Short-Term Group (consumed supplement only 3 hr before Eccentric Exercise).
In both groups participants randomly received either 2gr Vitamin C (VC) – 8 people or Placebo (P)- 8 people. To minimize the effect of diurnal biological variations, each subject was tested at the same time of the day. Therefore, At the end of the 4weeks, all subjects in group A and B , performed Eccentric Exercise(EE) they were also required to take supplement (VC or P) 3hr before EE. First blood samples were collected as base line before supplementation, that was, before 4wk supplementation for group A and for group B on their attendance at the laboratory on the test day. Second blood sample was taken from both groups a 3hr hours after supplementation and before EE. A third test was taken immediately after EE and then further tests 24hr and 48 hr following EE, for the analyses of serum creatine kinase (CK), malondialdehyde (MDA) and VC. The level of perceived muscle soreness in leg extensors was also evaluated.
RESULTS: Plasma vitamin C concentrations in both group increased significantly in the VC in response to supplementation and exercise but there is no significant different between group A and B ($P<0.05$).
CK increased immediately and 3 h after exercise in both groups and 24 h after exercise only in placebo group compared to pre-exercise ($P<0.05$). MDA levels were similar between groups at the baseline, it increased significantly 24 h after exercise, only in the Placebo group. There was no significant difference in the results shown between the VC and P subjects in each group A and B. ($P<0.05$).
Perceived muscle soreness in leg extensors did not show significant change between VC and P in both group after exercise.
CONCLUSION: This finding shows that Vitamin C supplementation might play a role in protecting individuals from eccentric exercise-induced muscle damage but there is no significant different between the influence of prolonged or short time VC supplementation in this .

Oral presentations

OP-BN42 Applied sports biomechanics and motor control

BIOMECHANICS OF NON-CONCENTRIC MARTIAL ARTS

YEUNG, Y.

UNITED KINGDOM PANGRATION ATHLIMA FEDERATION

INTRODUCTION: Non-concentric Martial Arts are those arts that claim to be not using any concentric muscle contraction or known as "brute force" by the practitioners of Internal Chinese Martial Arts. The aim of this research project is to identify and validate the various non-concentric techniques in Martial Arts. Non-concentric techniques are those movements using eccentric muscle contraction and restored muscle elasticity according to the Yin Yang theory of passive and active muscles actions.
METHODS: The research methodology is qualitative exploratory with a panel of long time practitioners and teachers of Taijiquan, Qigong , and other exercise and martial arts. The non-concentric techniques were identified from the review of literatures and videos, and discussions in various internet forums. The panel of experts verified these techniques by practice, observation, and discussion to ascertain their consistency and can be correctly performed by anyone.
RESULTS: The result is established a list of techniques identified and verified as follows: passive stances with various distribution of body weight; rotation of the crotch in moving between forward stance and backward stance; movements of the ribcage which included open, close, ascent and decent; push and pull by arm rotation; connection and coordination between joints; transitions between movements.
CONCLUSION: This research project enabled further research in isolated muscle activities for performance enhancement with eccentric muscle strength and muscle elasticity.

THE RELATIONSHIP BETWEEN CORE STRENGTH AND COUNTERMOVEMENT JUMP WITH AND WITHOUT ARM SWING

GUO, L.

GUANGZHOU SPORT UNIVERSITY

INTRODUCTION: Countermovement jump (CMJ) is a very frequent skill in many physical activities.Core strength (CS) played an important role in transferring energy or maintaining stability to promote CMJ performance (Kibler et al., 2006). But some research observed inconsistent results, they suggested the "specificity" of CS to sport event should be considered (Yaggie et al.,2006).
Therefore, we designed 12 core strength measurements (CSM) (Waldhelm et al., 2006) to investigate the specific relationship between CS and CMJ height with / without AS.
METHODS: 20 active college students were recruited (age: 22.1±0.3 year, body mass: 75.2±3.5 kg, height: 1.72±0.02 m, 7 males and 11 females) from local university.
CMJ height was calculated from vertical ground reaction force data collected using a force platform (AMTI Corporation, Watertown, MA, USA). CSM were conducted on an isokinetic training machine (Biodex Medical Systems, Shirley, NY, USA). The isokinetic tests measured core strength during extension and flexion at speeds 60°/s, 120°/s and 180°/s. The isometric tests measured core strength with the core flexed at 60°, 90° and 120° angles.
RESULTS: All of the CSM were correlated with HAS and HNAS ($p < 0.05$) significantly. No CSM correlated with the difference of CMJ height with / without AS (DAN) significantly. F180 and T120 shared 68.0% variance with HAS. T120 shared 57.0% variance with HNAS.
CONCLUSION: F180 and T120 were good predictors for HAS. T120 was a good predictor for HNAS. Core strength in specific position could be considered for coaches, athletes and recreational players to improve CMJ performance.

CONSISTENCY OF MUSCLE SYNERGIES BETWEEN LEVEL AND UPHILL LOCOMOTION

SAITO, A.1, TOMITA, A.2, ANDO, R.3, WATANABE, K.4, AKIMA, H.2

1: THE UNIVERSITY OF TOKYO , 2: NAGOYA UNIVERSITY , 3: JAPAN INSTITUTE OF SPORT SCIENCE , 4: CHUKYO UNIVERISTY

INTRODUCTION: Human locomotor behaviors responds to changes in the speed and environment . Assuming the existence of the modular control strategies based on the muscle synergy hypothesis, human locomotion might be controlled by a sequence of several muscle synergies . However, modulation of muscle synergies during locomotion on different inclines is unclear. Here, we examined similarity of muscle synergies of the lower limb between level and inclined locomotion.
METHODS: Eight subjects <26.5 ± 6.9 years old> walked and ran on a treadmill at three different speeds <1.0 to 1.6 m/s for walking and 2.5 to 4.1 m/s for running> and two grades <0% and 10% incline> for each locomotor mode. Surface electromyographic signals were recorded from 10 muscles of the lower limb, including deeper muscles such as vastus intermedius , adductor magnus, and adductor longus . Rectified EMGs were smoothed with a low-pass filer and normalized to the peak EMG across all speeds and inclination for each mode. Muscle synergies were extracted applying a non-negative matrix factorization algorithm, and relative co-activations across muscles and the temporal recruitment pattern were identified by muscle synergy vector and synergy activation coefficient, respectively. We determined the number of synergies using threshold which accounted for more than 90% of the variance accounted for in each subject. The scalar product between pairs of synergy vectors and synergy activation coefficients during level and uphill conditions were analyzed as a similarity index, with values above 0.8 recognized as similar.
RESULTS: Mean numbers of synergies were ranged from 3.8 to 4.3 for each condition 90%>. No significant difference in number of synergies was evident between level and uphill conditions at each speed. Synergy vectors 0.83> and synergy activation coefficients 0.84> at each type of synergy were similar between the conditions at each speed.
CONCLUSION: The results of this study suggest that approximately four basic patterns of locomotor muscle activity are consistent between level and uphill locomotion. Specific synergy was additionally recruited to the basic patterns when subjects added a voluntary task to their normal walking . Therefore, the recruited synergies in the lower limb may be shared across different locomotor conditions, because the natural motor behavior of locomotion was performed for individual subjects regardless of the conditions. We conclude that muscle synergies are consistent between the conditions at each locomotion speed, with only minor modulation across different locomotor tasks.

MULTI-JOINT RATE OF FORCE DEVELOPMENT TESTING PROTOCOL EFFECTS THE RELIABILITY OF MEASURES

DRAKE, D., KENNEDY, R., WALLACE, E.

ULSTER UNIVERSITY

INTRODUCTION: Isometric multi-joint tests have traditionally been used to assess peak force and rate of force development (RFD) capacity. However, the reliability of RFD variables is a notable limitation of such tests (Maffiuletti et al., 2016). Given test protocol and instruction are known to effect performance outcome in isometric tests (Sahaly et al., 2001). The aim of this study was to assess the reliability of RFD measures in the isometric squat test by comparing two test protocols and two testing angles.
METHODS: Eight male and two female participants took part in this study (age: 26.8, SD 4.5 years, strength training experience: 7.1, SD 3.03 years). Following familiarisation, participants completed two testing sessions (test and retest) one week apart. A traditional isometric peak force test (isopeak) and novel isometric explosive force (isoexp) test was assessed at two joint angles (knee flexion angle 100° and 125°). Ground reaction force-time traces were sampled at 1000Hz using force plates (Kistler type 9286BA, Winterthur, Switzerland), a custom isometric rack (Samson Equipment Inc, NM, USA) and subsequently analysed for common rate of force development measures (Haff et al., 2015). Thresholds for relative and absolute reliability were set as, ICC ≥ 0.70 and CV ≤ 15% (Haff et al., 2015).
RESULTS: Average and instantaneous RFD variables did not meet reliability criteria in isopeak at 100 or 125. The Isoexp test at 100 met reliability criteria in the RFD 0–200 (ICC = 0.92, CI = 0.77–0.97; CV = 7.00, CI = 5.06-11.78) and 0–250 variables (ICC = 0.94, CI = 0.81–0.98; CV = 6.18, CI = 4.47-10.36). The Isoexp test at 125 met reliability criteria in the RFD 0-150 (ICC = 0.95, CI = 0.85–0.98; CV = 5.83, CI = 4.22-9.77), 0–200 (ICC = 0.97, CI = 0.92–0.99; CV = 4.13, CI = 2.99-6.88) and 0–250 variables (ICC = 0.94, CI = 0.82–0.98; CV = 5.19, CI = 3.76-8.69). Instantaneous RFD variables did not meet reliability criteria in the Isoexp test at 100 or 125.
CONCLUSION: This study provides new insights into the reliability of RFD testing. Average and instantaneous RFD measures obtained using a traditional peak force test do not meet basic reliability criteria. Our findings are in opposition to the findings of Haff et al., (2015) who suggests RFD variables using the traditional test protocol demonstrates adequate reliability. Researchers assessing multi-joint RFD should proceed with the explosive RFD test rather than the traditional test.
REFERENCES:
1. Haff et al., (2015). A comparison of methods for determining the rate of force development during isometric midthigh clean pulls. Journal of strength and conditioning research, 29(2), 386-395.

2. Maffiuletti et al.,. (2016). Rate of force development: physiological and methodological considerations. European Journal of Applied Physiology, 1-26.
3. Sahaly et al., (2001). Maximal voluntary force and rate of force development in humans - importance of instruction. Eur J Appl Physiol, 85(3-4), 345-350.
CONTACT:
daviddrake87@gmail.com

MECHANICAL DETERMINANTS OF SPRINTING ACCELERATION IN RUGBY ATHLETES

CROSS, M.R., BROWN, S.R., MORIN, J.B., BRUGHELLI, M., DE, R., SAMOZINO, P.
UNIVERSITÉ SAVOIE MONT BLANC

INTRODUCTION: The mechanical determinants of short distance sprinting performance are currently unclear. While analyses have been performed on longer distance sprints (Morin et al. 2012), the importance of magnitude and expression of horizontal force production capabilities has not been clearly defined for short distances. This data would provide insight into important variables for targeted training development and monitoring. Our aim was to assess the relationship between key mechanical variables of horizontal force production and sprinting acceleration performance.
METHODS: Rugby code athletes (total N=238, from all levels of the game [club to elite]), performed >30m maximal sprints in field conditions. Instantaneous velocity-time data were collected using radar and processed using a macroscopic-method to determine split times at 5, 10, 20 and 30m, and horizontal force-production capabilities. Force- and power-velocity relationships (Cross et al. 2017) were compiled with associated theoretical maximal force (F0) and velocity (v0), maximum power (Pmax), and slope of the force-velocity curve (SFv). Mechanical variables were then assessed for association with split times using two stepwise regression models: 1) Pmax and SFv and 2) F0 and v0.
RESULTS: Both models explained >98.0% of the variance in performance at all distances (all $P<0.001$). Pmax strongly explained the variance in performance at all distances (88.1 to 98.0%). SFv contributed to model 1 at all distances, despite explaining less variance than Pmax (~0.2-10.0%). In model 2 both F0 and v0 significantly explained variance at all distances, with F0 primarily determining 5 and 10m performance (>78.9%), and v0 primarily determining the variance at 20 and 30m (>63.3%).
CONCLUSION: In rugby athletes, it appears that maximal horizontal force is key to sprinting ability over distances up to ~10m. However, given the frequency and importance of longer distance sprints in game scenarios, it would seem the development of maximum velocity capabilities is warranted - depending on the athletes positional requirements (Quarrie et al. 2013). Given the strong predictive power of Pmax at all distances, coaches might prioritise the development of power in deficient athletes. Once this deficiency is reduced, focus might be placed on a more balanced approach of targeting the expression of distinct force and velocity abilities. Practitioners may use these results to inform their training decisions by prescribing horizontal loading aligning with the mechanical underpinnings of targeted sprint distances.
REFERENCES:
Morin JB, Bourdin M, Edouard P, Peyrot N, Samozino P, Lacour JR. (2012). Eur J Appl Physiol. 112(11):3921-30
Cross MR, Brughelli M, Samozino P, Morin JB. (2017). Sports Med. 47(7):1255-69
Quarrie KL, Hopkins WG, Anthony MJ, Gill ND. (2013). J Sci Med Sport. 16(4):353-9

USE OF RECOVERY STRATEGIES BY SWIMMERS DURING TRAINING AND COMPETITION

SHELL, S.1,2, CLARK, B.3, SLATTERY, K.1,4, MILLER, J.2, HALSON, S.2, KELLMANN, M.5, BROATCH, J.2,6, COUTTS, A.1
1: UNIVERSITY OF TECHNOLOGY SYDNEY, SYDNEY, AUSTRALIA, 2: AUSTRALIAN INSTITUTE OF SPORT, CANBERRA, AUSTRALIA, 3: UNIVERSITY OF CANBERRA, CANBERRA, AUSTRALIA, 4: NEW SOUTH WALES INSTITUTE OF SPORT, SYD

INTRODUCTION: Training and competition demands induce disturbances to homeostasis, and an imbalance between training stress and recovery may increase athlete fatigue. Swimmer fatigue can be reduced through inclusion of recovery strategies. Despite the perceived importance of recovery strategies, there is limited research into athlete recovery beliefs and practices during training and competition in swimmers. Therefore, the aim of this study was to understand why and how athletes, specifically swimmers, use recovery during training and competition.
METHODS: A custom-made questionnaire was developed and administered via an online survey tool (Qualtrics, Utah, U.S.A) to 76 Australian competitive swimmers (33 male, 43 female, 17 ± 3 y). The questionnaire consisted of a combination of short answer, multiple choice and 5-point Likert scale questions, and investigated the swimmers' use/implementation of different recovery techniques (active recovery, stretching, sleep, massage, compression, cold water immersion, and contrast water therapy) during training and competition. The questions focused on athlete practices and perceptions of recovery including the importance, effectiveness, timing, barriers, frequency/duration/mode of use and reasons for inclusion of each strategy in both training and competition.
RESULTS: Differences in the types of recovery strategies used during training and competition were identified, as well as the frequency and duration of use. Specifically, self-reported sleep duration was 11% greater in competition compared to in training. Likewise, cold water immersion was used 32% more in competition compared to training. However, self-reported beliefs of the importance of sleep and cold water immersion were similar for both training and competition. The biggest challenge swimmers reported was managing tiredness/fatigue during training.
CONCLUSION: Competitive swimmers use different recovery strategies in training and competition. To minimise disturbances to performance, athletes are encouraged to develop post-race recovery routines in training for use during competition. Sport scientists and coaches may benefit from using similar questionnaires to understand how and why recovery is used by their athletes. This knowledge may inform athlete education activities, and allow for enhanced individualisation of recovery.

Oral presentations

OP-SH21 Development and effects of exercise interventions

IN SEARCH OF KEY ATTRIBUTES OF PEER LEADER FOR THE PROMOTION OF PHYSICAL ACTIVITY IN OLDER ADULTS

KRITZ, M., THØGERSEN-NTOUMANI, C., NTOUMANIS, N., MULLAN, B.

SCHOOL OF PSYCHOLOGY, HEALTH PSYCHOLOGY & BEHAVIOURAL MEDICINE RESEARCH GROUP, CURTIN UNIVERSITY

IN SEARCH OF KEY ATTRIBUTES OF PEER LEADER FOR THE PROMOTION OF PHYSICAL ACTIVITY IN OLDER ADULTS
Kritz, M., Thøgersen-Ntoumani, C., Ntoumanis N., Mullan B.
School of Psychology, Curtin University (Perth, Australia)
Introduction: Regular physical activity can help older people maintain/and or increase independence, mobility, physical health, mental wellbeing and quality of life. However, the majority of older adults are physically inactive. Peer-led interventions are considered a promising method of promoting physical activity behaviour and these approaches may be cost-effective. However, the attributes making an older peer leader effective at encouraging physical activity among their peers are currently unknown. The aim of the present study is to determine what older adults, differing in their physical activity engagement, perceive to be ideal peer leader characteristics.
Methods: A mixed-methods concurrent triangulation design was used to identify key attributes of effective older peer leaders, as perceived by participants differing in their physical activity engagement and leadership experience. Participants (N=100; M age (SD) = 75.53 (7.58); age range: 60-93) were recruited from retirement villages and existing walking groups in Perth, Australia. Participants consisted of inactive individuals interested in joining a walking group (N=46), physically active residents interested in the peer leader role (N=22), and individuals who had already served as walk peer leaders (N=15) or had taken part in other peer-led walking programs (N=17). Semi-structured interviews (N=68) were conducted and complemented with questionnaire data (N=100) to identify leadership traits that were considered important by participants. Interviews were analysed using content analysis.
Results: Questionnaire data showed that, both prospective and experienced, walkers rated the attributes "friendly", "outgoing and dependable" as the most important traits of an older peer leader. Content analysis revealed that being encouraging (47%), compassionate (44%) and inclusive (41%) were the most frequently mentioned leadership attributes across the whole sample. Most experienced leaders described effective leaders as communicative (62%), caring (62%) and enthusiastic (54%). In contrast, inexperienced leaders placed higher importance on the leader being encouraging (65%) and showing leadership competence (47%). Most experienced walkers described effective leaders as friendly (73%) and inclusive (67%) while the majority of inexperienced walkers sought a leader who can function as a competent (48%) motivator and "role model" (43%).
Conclusion
Results suggest that perceptions of an effective older peer leader may differ depending on individual leadership experience and physical activity engagement. These differing perceptions may need to be taken into account in the planning of future peer leader training in order to effectively promote walking in older adults.

HEALTH COACHING IN A PILOT EXERCISE INTERVENTION FOR PEOPLE WITH PARKINSONS DISEASE TO SUPPORT BEHAVIOUR CHANGE

MCCLEAN, S., OREILLY, G., MCGRATH, D.

UNIVERSITY COLLEGE DUBLIN

Introduction: The benefits of exercise for people with Parkinson's (PwP) are numerous however, PwP have to overcome many barriers before they can reap these benefits e.g. access to safe and affordable exercise services, disease related apathy and depression, difficulties around diagnosis, and social stigma. Only one study to date has explored the use of behavioural change theories to change and maintain exercise behaviours in PwP, focusing on Bandura's Social Cognitive Theory (SCT)1. It is currently not known what theory of behaviour change is most appropriate in the design of exercise interventions in PwP, given the complex array of motor and non-motor symptoms experienced with the condition. This pilot study sought to explore this question from a qualitative perspective.
Methods: Twenty-three PwP, split into two smaller groups, were recruited to a 12-week exercise intervention that consisted of 3 x 1 hour exercise classes per week plus one hour of health coaching every two weeks. Group A's health coaching session was based on SCT while Group B's health coaching was based on "Multi-theory model"2, which integrates different elements from a number of behavioural change theories, including self-efficacy from SCT. The structure of the sessions for both groups were therefore quite similar in terms of goal setting exercises, sharing of exercise-related knowledge, outcome expectations and focus on social support. The main difference between these approaches is that Multi-theory model incorporates the person's emotional experience, whereas SCT does not. The health coach was an exercise scientist and accredited psychotherapist. He¬ facilitated both Group A and Group B sessions with a participatory, person-centred approach. Following each session with the agreement of participants, the health coach provided an anonymous report of the session on the themes that were discussed in both sessions. These reports were analysed using thematic analysis.
Results: Improvements in self-efficacy and deriving strong social support from the group were prevalent themes in both groups. Both groups reported similar life challenges e.g. uncertain future, anxiety, self-consciousness, safety and physical debilitation. Similarly, themes such as hope, inspiration, learning and humour were evident in both groups. A prevalent theme in Group A was task-specific self-efficacy. Socio-cultural challenges featured more in Group B's, and the personal and emotional experiences of those challenges.
Conclusions
PwP need a supportive environment to develop the psycho-social competencies required to self-manage their complex condition, and this can be achieved in a group setting. Providing space for emotional expression is an important element that should be incorporated into health coaching with an appropriately trained facilitator.
1. Bandura, A., (1986). Englewood Cliffs, NJ, US: Prentice-Hall, Inc.
2. Nahar, VK et al (2016) Health Promot Perspect. 6(2): 58–65.

COMPARATIVE EFFECTIVENESS OF EXERCISE TO TREAT BINGE EATING DISORDERS: A META-ANALYSIS

HUANG, S.

CHINA INSTITUTE OF SPORT SCIENCE

Background

In 1959, Binge Eating Disorders (BED) was to describe recurrent episodes of eating a large amount of food without self-control as a consequence of uncomfortable full feelings and senses of guilt, listed in DSM-5 in 2013. Different to Bulimia Nervosa, BED patients will not adopt subsequently compensatory behaviors, like vomiting or taking cathartics, therefore BED groups were usually diagnosed with obesity or overweight. Exercise was viewed as an effective intervention for obesity, so this study collected all previous published trials using exercises to quantify the effect of exercises to treat BED group.
Methods: Medline and PubMed databases were searched to identify eligible randomized clinical trials published in English from 1996 to 2016 with keywords "exercise", "physical activity", "binge eating disorder", "RCT", and "human". A total of 27 studies were identified. Compared with the control group, moderate intensive exercise was chosen as the treatment. Considering the inconsistent measurements of intervention outcomes, studies containing Binge Eating Scale(BES), Beck Depression Inventory (BDI) and prevalence of BED abstinent were chosen. As a result, only 8 studies were included. All data analysis was conducted using Stata 14.1. Random effect meta-analysis was used for categorical and/or continuous responses, where appropriate.
Findings
Based on 8 RCT studies, 3 heterogeneity studies recorded the prevalence of BED abstinent (I2=83.9% , p=0.002), and no significant differences between control and exercise groups(R2:10.05, 95%CI: 0.54~186.83). 5 studies reported scores of BDI. Because 2 of them used combined interventions, the subgroup analysis was applied, totally, I2=70.4%, p=0.009, and exercise treatment demonstrated a significant reduction of BDI (i.e., exercise-only group, SMD:-1.14, 95%CI: -1.85~-0.43; exercise-combined group, SMD:-1.54, 95%CI:-2.35~-0.73). Lastly, the remission data provided by 4 studies, based on the scores of BES. Because 2 of them used combined interventions, the subgroup analysis was also applied. There was heterogeneity among 4 studies, I2=71.6%, p=0.014, and treatment demonstrated significant changes in scores, exercise-only group, SMD: 1.46, 95%CI: 0.75~2.17; combined group, SMD: 0.589, 95%CI: 0.202~0.976.
Conclusions
According to meta-analysis, exercise-only intervention did not show any statistically significant effect on BED abstinent, but in terms of reduction in binge eating behaviors. Whereas, combined therapy showed the more positive results in all clinical indicators, which indicated combined treatment would be more beneficial for BED patients recovery.
Reference:
American Psychiatric Association. 2013., DSM 5.
Davis, C. 1997, Normal and neurotic perfectionism in eating disorders: An interactive model. International Journal of Eating Disorders, vol.22, no.4, pp.421-426
Hausenblas, H.A., Cook, B.J. & Chittester, N.I. 2008, "Can exercise treat eating disorders?", Exercise and sport sciences

EFFECT OF EXERCISE INTERVENTION ON EXECUTIVE FUNCTION OF CHILDREN WITH AUTISM SPECTRUM DISORDERS: AN EVENT-RELATED POTENTIAL AND BEHAVIORAL STUDY

SUNG, M.C.1, CHEN, P.L.1, MA, W.Y.2, HUANG, C.Y.1, CHU, C.H.1, PAN, C.Y.1

1: NATIONAL KAOHSIUNG NORMAL UNIVERSITY , 2: NATIONAL TAIWAN NORMAL UNIVERSITY

Introduction: Autism spectrum disorders (ASD) are neurodevelopmental disorders that identified through developmental deficits in social interaction, communication, and restricted and repetitive patterns of behaviors (American Psychiatric Association, 2013). In addition, the children with ASD also experience executive function deficits such as attention and inhibitory control (Tsai, Pan, Wang, Tseng, & Hsieh, 2011). To-date, many studies have already confirmed that exercise intervention is beneficial to typically developing children on executive function. Nonetheless, few studies have probed into exercise intervention as a means of improving the executive function of children with ASD. To the best of our knowledge, this study provides the first electrophysiological evidence for the brain activity induced in children with ASD's by long-term exercise intervention.
Methods: Twenty children with ASD, aged 6 to 12, were divided into intervention group (n = 10) and control group (n = 10). The intervention group took 12 weeks of in-line skating exercise intervention, and another group continued their daily activities throughout the study. Visuo-spatial attention orienting task was administered for executive function while recording event-related potentials (ERPs) simultaneously before and after the 12 weeks intervention. Mixed design of three-way and four-way ANOVAs were used to compare the behavioral (i.e., reaction time, accuracy) and ERP (i.e., N2, P3 and CNV components) performance, respectively.
Results: There were no significant differences between the experimental group and control group before and after the intervention in the reaction time, accuracy, N2, P3 and CNV components.
Discussion: The current study reveals that there were no significant improvements in both behavioral and ERPs performance of the intervention group after the 12 weeks in-line skating exercise intervention, which might be attributed to the small sample size and large within person variability. Our results provide initial evidence of brain activity in children with ASD after the long-term exercise intervention. Since engaging in the physical activity and exercise is crucial for the children with ASD; future research is required to clarify which types of exercise intervention are most conducive to executive function in children with ASD.
Acknowledgments
Supported by Taiwan MOST grants 106-2410-H-017-022-MY3.
References: American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Washington, DC: American Psychiatric Association.
Tsai, C. L., Pan, C. Y., Wang, C. H., Tseng, Y. T., & Hsieh, K. W. (2011). An event-related potential and behavioral study of impaired inhibitory control in children with autism spectrum disorder. Research in Autism Spectrum Disorders, 5(3), 1092-1102.
Contact: mcsung8@gmail.com

LONG-TERM EFFECTS OF PARTICIPATION IN A 12 WEEK COMMUNITY-BASED EXERCISE REHABILITATION PROGRAMME ON CANCER SURVIVORS LEVELS OF FATIGUE, DEPRESSION AND QUALITY OF LIFE

CANTWELL, M.1, MOYNA, N.M.1, FURLONG, B.1, MCCAFFREY, N.1, WOODS, C.2

1 DUBLIN CITY UNIVERSITY; 2 UNIVERSITY OF LIMERICK

INTRODUCTION: The aim of this study was to determine the long-term effects of a community-based exercise programme, 'MedEx Move On', on cancer survivors' levels of fatigue, depression and quality of life.
METHODS: Adults with an established diagnosis of cancer, who had completed their adjunctive therapy, were referred to 'MedEx Move On'. Participants attended two 60 minute supervised exercise classes each week for 12 weeks. Fatigue, depression and quality of life were measured using questionnaires (Functional Assessment of Cancer Therapy (FACT)–Fatigue Scale, Patient Health Questionnaire

Depression Scale and FACT–General Questionnaire) at baseline, programme completion (week 12) and 12 month follow-up. One-way repeated measures ANOVAs were used to compare mean differences. Post-hoc tests were conducted to identify where the differences occurred.
RESULTS: Twenty cancer survivors (mean age 52 ± 9 yrs; 70% female) completed the trial. Cancer diagnoses were breast (60%), colorectal (20%), prostate (15%) and cervical (5%). There was a statistically significant reduction in depression and fatigue measures at 12 weeks, which was maintained at the 12 month follow-up ($F=7.463$, $p<.05$; $F=10.598$, $p<.05$). A statistically significant improvement was observed for quality of life from baseline to week 12 and the 12 month time point ($F=9.771$, $p<.05$).
CONCLUSION: Participation in a 12 week community-based exercise rehabilitation programme has a long-term effect on cancer survivors' self-reported levels of fatigue, depression and quality of life.
This research is funded by the Irish Cancer Society.

(FROM) VIRTUAL (TO) REALITY: CAN VIRTUAL EXPERIENCES OF NATURE ENCOURAGE PEOPLE TO VISIT NATURAL ENVIRONMENTS?

CALOGIURI, G., LITLESKARE, S., BIRKHEIM, S.L., THURSTON, M.
INLAND NORWAY UNIVERSITY OF APPLIED SCIENCES

Introduction: Visiting natural environments has been shown to be beneficial for people's health: not only can being in nature facilitate physical activity, it can also promote psychophysiological restoration from stress. Virtual reality (VR) has emerged as a potentially valuable tool in the field of lifestyle-change interventions. Specifically, it might also be used to encourage people to engage in 'active visits' to natural environments. Thus, the purpose of this study was to explore the potential of VR as a tool for eliciting enhanced motivation for visiting real natural environments.
Methods: This study is part of a larger project investigating the effectiveness of VR in reproducing 'green-exercise' outcomes (Calogiuri et al., 2017). Twenty-six healthy adults (46% females; 26±8 yo; BMI: 23.12±5.03) were exposed, in a randomized cross-over design, to two VR conditions: one while sitting on a chair and one while walking on a manually driven treadmill. The VR technology consisted of a head-mounted display with headphones reproducing a first-person 360o video and sound of a nature walk. After each condition, the participants reported their motivation for visiting the natural environment shown in the VR video ('motivational effect'; ME), alongside measurements of enjoyment and affect. Additional measurements included presence, perceived environmental restorativeness (PER), and background characteristics (sex, age, BMI, and exercise levels). Moreover, data from open-ended questions were analysed thematically to give in-depth insight into participants' perceptions.
Results: The ME did not significantly differ between the sitting and the treadmill condition, although enjoyment and positive affect were significantly higher in the treadmill. The ME was significantly and positively correlated with 'realism', PER and (in the treadmill) enjoyment, whereas no significant correlation was found with affect or any of the background characteristics. In both conditions, a mediational analysis showed an indirect effect of 'realism' on ME via the PER component 'fascination'. The qualitative data corroborated the quantitative findings, but also revealed large inter-individual differences in participants' perceptions of the VR experience as well as the extent to which they thought it could influence people's motivation.
Discussion: VR technology might have the potential to encourage people to engage in 'active visits' to natural environments, especially if the VR is highly realistic and shows environments with high restorative value. Because of better affective responses, administering the VR in concomitance with treadmill-based walking might have a stronger effect on future behaviour. In order to explore these associations further, future studies should apply intervention designs with follow-up assessments.
References: Calogiuri, G., et al. (2017) Frontiers in Psychology 8, 2321

Oral presentations

OP-MI03 Multidisciplinary perspective on youth to young adults athletes

PSYCHOLOGICAL CORRELATES BETWEEN SPORT COMMITMENT PROFILES AMONG ADOLESCENT ATHLETES.

BERKI, T., PIKÓ, B.
UNIVERSITY OF SZEGED

Introduction: Physical activity and sport participation is one of the key for healthy lifestyle. Many motivational theories tried to understand reasons behind adolescent sport participation; therefore, the purpose of this study was to examine psychological scales and sport motivation among different sport commitment profiles.
Methods: Participants were 526 adolescent athletes ranging in age from 14 to 18 years . Several scales were used in this study: Sport Commitment Questionnaire 2 , Satisfaction with Life Scale , Consideration of Future Concequences Scale and Aspiration index . Sport Commitment profiles were created by cluster analysis using commitment determinants and ANOVA were used for further analysis.
Results: Three Sport Commitment profiles were emerged. The first profile was based on the Enthusiastic athletes and they had higher scores on Sport Enjoyment, Desire to Excel, Social Support, Personal Investment, Valuable Opportunities, but lower on Other Priority. The second profile were the based on the Obligatory athletes : they had higher scores on Other Priorities and Social Constraints, but lower on Sport Enjoyment, Social support, Desire to Excel, Valuable Opportunities and Personal Investment. The last group, Entrapped athletes had low scores on all of the determinants. Analyses of variance compared emergent clusters on different psychological scales. Enthusiastic athletes had significantly higher scores on SWL, CFC and intrinsic aspirations. Obligatory athletes had significantly higher scores on extrinsic aspirations. Age differences showed that Entrapped athletes were significantly older than athletes with other profiles.
Discussion: The cluster analysis showed diverse sport commitment profiles. As it was expected results revealed that Enthusiastic athletes had significantly higher scores on most of the psychological scales. Positive experience of physical activity and sport may have a significant role in life satisfaction and affect the short- and long-term future goals. Our results suggest that athletes who participate in sport only for obligatory reasons are more likely to have extrinsic aspirations. As the age increases, the motivation to sport decreases. More investigations are needed to understand the psychological background of sport motivation, but we believe that our study provides useful information for better understanding of young athletes' sports participation.
Contact: berkitamas@edu.u-szeged.hu

MATURITY STATUS AND INJURY RISK IN HIGHLY TRAINED MIDDLE-EASTERN YOUTH ATHLETES

REJEB, A., JOHNSON, A., FAROOQ, M., PULLINGER, S., VAEYENS, R., WITWROUV, E.

ASPETAR, GHENT UNIVERSITEIT

INTRODUCTION: There is limited and contrasting evidence on the relationship between maturity and injury in youth sports. Studies of the anthropometric characteristics and biological maturity status as injury risk factors in youth middle- eastern are also limited, highlighting the need for more research to be conducted.
The purpose of the present study was to investigate injury according to biological maturity in highly trained youth athletes based at a Middle Eastern Sports Academy
METHODS: A total of sixty-seven male athletes representing four sport disciplines were enrolled and grouped into 2 sport categories: individual sports and racquet sports .
Assessment of risk factors:
Athletes' anthropometric characteristics were assessed using non-invasive methods to calculate age at peak height velocity and total years from PHV. Participants predicted mature height were collected and categorized into four PMH quartiles. Consenting athletes had wrist and hand radiographs taken for assessment of skeletal age , using Fels method. Early and late maturers were those with a SA of >1 year older or younger than their chronological age , respectively.
RESULTS: For the total sample across all sport groups, 43 <64%> athletes had one or more injuries totaling 212 injuries. Injury incidence was 4.9 injuries per registered athlete. Survival analysis using Cox regression of maturity status found that early mature athletes had two-fold higher injury risk over time compared to late maturers HR <2.04, 95%, 1.15-3.61, P=0.015>. PMH was associated with injury risk HR <1.05; 95% CI: 1.01-1.08, p=0.006>.
Compared to participants in the 1st quartile <<176cm> for PMH, athletes in the 4th quartile <≥ 184 cm> have higher injury risk HR <2.41, 95% CI: 1.42 – 4.08, p=0.001>.
In this study, injury risk in racquet sports was similar to individual sports HR 1.14 <95% CI: 0.86 – 1.52, p= 0.37>.
CONCLUSION: Early maturity and gradient for PMH were significant predictors of injuries in youth.

AN EXAMINATION OF THE FUNCTIONAL MOVEMENT SCREEN IN YOUTH ATHLETES.

WRIGHT, M.D.

TEESSIDE UNIVERSITY

INTRODUCTION: The Functional Movement Screen (FMS) is an assessment tool consisting of 7 functional tasks, rated on a scale of 0 to 3 and totalled to quantify movement quality (FMS total). Whilst FMS total is often used in youth sport, it assumes the FMS is uni-dimensional and does not consider that the tasks may measure different constructs, or how each task may be affected by maturation. The aims of this research were to identify the internal consistency and factor structure within the 7 tasks in youth athletes and to investigate the effect of maturity upon each task.
METHODS: The seven FMS tasks and anthropometric variables were measured in 144 youth athletes (96 female, 48 male) from multiple sports as part of an athlete support programme (age 14.1 ± 2.3 years; standing stature, 162.0 ± 13.9 cm; sitting stature, 66.6 ± 20.7 cm; body mass, 71.0 ± 14.9 kg; 1.27 ± 2.0 years from peak height velocity [PHV]). Biological maturation was estimated from anthropometric data and players were categorised as before-PHV (<-0.5 years), at-PHV (-0.49-0.50 years) and after-PHV (>0.51 years). Each FMS task-score was converted to standardised units (z-score) and the internal consistency evaluated before subjecting the data to principle component analysis (PCA). Principle components were extracted when an eigenvalue was greater than 1. A General Linear Model was used to evaluate differences between maturation groups whilst controlling for differences in gender.
RESULTS: The 7 tasks of the FMS showed poor internal consistency (Cronbach's Alpha, ±90% Confidence Limit; 0.53, ±0.10). The Kaiser-Meyer-Olikn measure of sampling adequacy and Bartlett's test of sphericity indicated the data were suitable for PCA, with values of 0.64 & p<0.01 respectively. Two components were extracted, representing 47% of the total variance. The highest loadings for principle component 1 were; In-line Lunge (0.71), Rotatory Stability (0.67) and Hurdle Step (0.61). The highest loadings for principle component 2 were Shoulder Mobility (0.73) and Active Straight-Leg Raise (0.66). Small but likely decrements in task performance were observed in athletes who were before-PHV. In-line Lunge (Effect size ±90% Confidence Limit; -0.45, ±0.49), Hurdle Step (-0.48, ±0.49), Rotatory Stability (-0.37, ±0.49) and Trunk Stability Press-up (-0.55, ±0.46) were all lower compared with athletes at-PHV, whilst In-line Lunge (-0.44, ±0.37), Rotatory Stability (-0.44, ±0.37) and Trunk Stability Press-up (-0.33, ±0.34) were lower than those after-PHV. No likely differences were observed between athletes at- or after-PHV or for the other tasks (Deep Squat, Active Straight-Leg Raise or Shoulder Mobility).
CONCLUSION: The 7 task have poor internal consistency and do not represent a single uni-dimensional factor. When evaluating FMS data on youth athletes, individual task scores are more relevant than a total score. Furthermore, in our population of young athletes, a small but clear maturation affect was observed in four of the seven tasks.

DO PERFORMANCE DETERMINANTS CHANGE WITH AGE IN YOUNG SWIMMERS?

SEFFRIN, A., LIRA, C.A.B., ANDRADE, M.S.

UNIVERSIDADE FEDERAL DE SÃO PAULO

INTRODUCTION: Swimming is a very popular sport with great adherence of children and adolescents. It is known that swimming performance is influenced by several factors, such as anthropometric and physiological aspects. However, it is not clear if the level of association of these variables with swimming performance depends on the age of the swimmer. The aim of the present study was to describe the level of association of height, total body mass, body composition and muscular strength and the performance in 100 meters freestyle and to compare the association of variables between different age groups from 11 to 23 years old.
METHODS: Sixty swimmers participated in the study (13.80 ± 2.61 years, 1.62 ± 0.10 m, 52.36 ± 12.01 kg]), 44 males and 16 females were divided into three groups (A, B e C) according to age. (A) 11 or 12 years old, (B) 13 or 14 years old and (C) 15 to 23 years old. They were submitted to anthropometric evaluations to determine total body mass (kg), height (m), fat mass (%) and fat free mass (kg) through Dual-energy X-ray absorptiometry. Isokinetic peak torque (Nm) of flexors and extensor knee muscles were assessed at 60°/s. Handgrip strength (kgf) was measured using a handheld dynamometer with an accuracy of 2 kgf. The relations of these variables along with the performance were analyzed by scatter plots and Pearsons linear correlation coefficients, with a significance level of 5%.
RESULTS: The data presented normal distribution (Shapiro-Wilk) and homogeneous variances (test F). Performance over 100 meters was significantly associated with: total body mass for male groups A (r = -0.58, P = 0.02) and female group A (r = 0.84, P = 0.04) and male group B (r = -0.78, P < 0.01), height for male groups A (r = -0.51, P = 0.05) and male group B (r = -0.57, P = 0.02), fat mass for female

group A (r = 0.84, P = 0.04) and female group B (r = 0.84, P = 0.04), fat free mass for male groups A (r = -0.60, P = 0.01) and male group B (r = -0.83, P < 0.01). Considering the neuromuscular properties association with performance, significant values were shown for PT Flex for male groups A (r = -0.62, P = 0.01) and male group B (r = -0.84, P < 0.01) , and for female group C (r = -0.99, P = 0.01), PT Ext for male group A (r = -0.51, P = 0.04) and male group B (r = -0.76, P < 0.01) and the handgrip strength for male group A (r = -0.77, P < 0.01) and male group B (r = -0.74, P < 0.01).
CONCLUSION: The data of the present study show that the performance was related to anthropometric and neuromuscular variables and, in addition, the associations vary according to age and sex. Height, fat free mass and muscular strength are significantly associated with performance for males between 11 to 14 years old, but for females of the same age, the fat mass was the most significantly variable associated with performance. The understanding of these variables can contribute to the development of proper training programs for each age group, thereby maximizing results.

THE MISCONCEPTION OF LEARNING THE TENNIS SERVE: THE AD VERSUS THE DEUCE COURT PARADOX

FERRAUTI, A., FETT, J., VUONG, J., OBERSCHELP, N.

RUHR-UNIVERSITY BOCHUM

INTRODUCTION: The official rules of the International Tennis Federation say that players have to serve from two different basic positions (deuce and ad court side) into two different target boxes during singles and doubles tennis match. Principally, the applied techniques could be the same regarding the underlying kinematics. While coaches and scientists agree that the serve is one of the most important techniques in todays top level tennis (Girard et al, 2005; Kovacs, 2007) we recommend to adjust both techniques in order to improve the time cost: learning benefit ratio. In a comparative study, elite junior squad players of the German Tennis Federation were analyzed with respect to kinematic parameters during the service from the ad and the deuce court side.
METHODS: For the investigation, the service motions (flat 1st serve) of 15 elite junior squad players (age: 14.7 ± 1.8 years, weight: 61.3 ± 15.7 kg, height: 175.8 ± 15.4 cm) were captured from both service positions in a matched and counterbalanced order by using a Vicon Motion Capturing System. A specifically modified version of the whole body model originally designed by the University of Western Australia (Reid et al., 2008) was used to record the kinematic parameters. After a warm-up consisting of serves with increasing velocity, eight first serves were performed to a target in the middle of both service boxes. For comparative analysis of the parameters, the respective values of the fastest three serves were averaged. The detection of the peak ball speed was recorded using a Stalker Professional Sports Radar.
RESULTS: Mean service velocity was similar from both sides (deuce: 151.4 ± 19.8 vs. ad: 150.5 ± 19.4 km/h; ES 0.04). In the basic position, the front foot angle to the baseline (deuce: 39.7 ± 17.6 vs. ad: 31.1 ± 17.4°; ES 0.50*) and the thorax axis (deuce: 60.9 ± 15.7 vs. ad: 69.6 ± 15.0°; ES 0.57*) were significantly different, each showing moderate effect sizes. Total thorax rotation from the end of the loading phase until the hitting point showed a strong significant effect with a larger rotation angle from the deuce court side (deuce: 114.9 ± 16.5 vs. ad: 96.2 ± 16.6°; ES 1.13*).
CONCLUSION: The results indicate a partly but insufficient adjustment of the foot positioning when changing from the deuce to the ad court side. Coaches can be recommended to teach an adjustment of foot positioning in relation to the target box and not in relation to the baseline. It can be speculated that the baseline seems to be the more logical reference point for young players.
REFERENCES:
Girard, O. et al. (2005). Med Sci Sports Exerc, 37, 1021–1029.
Kovacs, MS. (2007). Sports Med, 37, 189–198.
Reid, M. et al. (2008). Med Sci Sports and Exerc, 40, 308-315.
ACKNOWLEDGEMENT:
The study was supported by the Federal Institute of Sport Science, Germany (ZMVI4-072017/16).
CONTACT:
alexander.ferrauti@rub.de

THE INFLUENCE OF WANTED SUPPORT AND RECEIVED SUPPORT ON AFFECT: A CROSS-CULTURAL STUDY AMONG ATHLETES IN UK AND CHINA

FU, D.

UNIVERSITY OF ESSEX

Introduction: The presence of supportive relationships can play a crucial role in sporting contexts yet the actual receipt of supportive behaviours from these relationships is sometimes ineffective. The support adequacy model predicts that optimal social support occurs when the amount of support individuals receive matches what they want (Dehle, Larsen, & Landers, 2001), but limited research has examined this model in sport. Further, research has highlighted that cultural differences may exist in social support processes (Kim, Sherman, & Tylor, 2008). As such, this study examined the support adequacy model among British and Chinese athletes.
Methods: The study comprised 236 British athletes (107 females, Mage = 20. 7, SD = 2.4 years) and 265 Chinese athletes (189 females, Mage = 20. 8, SD = 2.5). Participants reported the amount of support they wanted and received during the week, along with the satisfaction with support, and their positive and negative affect. Polynomial regression analyses were conducted and response surface graphs plotted.
Results: British athletes wanted [t(499) = -2.54, p = .01, d = .23] and received [t(499) = -2.38, p = .02, d = .21] less support than Chinese athletes, but there was no statistically significant difference for satisfaction with support [t(499) = 1.67, p = .10, d = .15]. The total effects of support adequacy model explained 30% and 36% of the variance in positive and negative affect respectively in the British sample ($p < .05$), and 32% and 37% of the variance in positive and negative affect respectively in the Chinese sample ($p < .05$). More specifically, across both samples: 1) athletes experienced better positive affect (but not the negative affect) when they received adequate support (received= wanted), especially at higher levels of received and wanted support; 2) athletes experienced worse affect (both positive and negative) when wanted and received support were not congruent; 3) athletes experienced better affect when they experienced overprovision of support rather than underprovision; 4) support (in)adequacy predicted affect indirectly through satisfaction with support.
Discussion: Overall, the study found that received support was associated with more favourable affect when it was congruent with what athletes wanted, these effects were partially mediated by support satisfaction, and these relationships were generally consistent across British and Chinese athletes despite differences in the absolute amount of support each sample wanted and received. The findings provide support for the support adequacy model and highlight that novel insights can be provided by using polynomial regression in social support research.

References: Dehle, C., Larsen, D., & Landers, J. E. (2001). Social support in marriage. American Journal of Family Therapy, 29, 307-324.
Kim, H. S., Sherman, D. K., & Taylor, S. E. (2008). Culture and social support. American Psychologist, 63, 518.
Contact: dfua@essex.ac.uk

Saturday, July 7th, 2018

08:00 - 09:30

Invited symposia

IS-PM12 Mechanisms and strategies to increase mitochondrial biogenesis

MOLECULAR REGULATION OF MITOCHONDRIAL ADAPTATIONS TO EXERCISE

ZIERATH, J.

KAROLINSKA INSTITUTET, STOCKHOLM AND UNIVERSITY OF COPENHAGEN, COPENHAGEN

The circadian clock, an intrinsic molecular system in virtually all cells, is a key element in homeostatic regulation that controls a large array of metabolic genes. Disruption of the circadian clock is linked to the development of type 2 diabetes. Importantly, intimate links between epigenetic regulation and the circadian clock exist that are likely to contribute to the plasticity of insulin sensitive organs to exercise and nutrition. Therefore, we are currently addressing whether synchronizing exercise and nutrient interventions to the molecular circadian clock will maximize the health promoting benefits of exercise to enhance insulin sensitivity and mitochondrial biogenesis. Work is now underway to identify the time of day for optimal exercise intervention to induce the greatest metabolic effect on signal transduction, mitochondrial function, and expression of exercise-responsive genes. The ultimate goal is to develop novel strategies to maximize the health promoting effects of exercise and nutrition by synchronizing these interventions with the peripheral clocks.

CAN WE OPTIMISE THE EXERCISE TRAINING PRESCRIPTION TO MAXIMISE IMPROVEMENTS IN MITOCHONDRIA FUNCTION AND CONTENT?

BISHOP, D.

VICTORIA UNIVERSITY

While there is agreement that exercise is a powerful stimulus to increase both mitochondrial function and content, we do not know the optimal training stimulus to maximise improvements in mitochondrial biogenesis. This presentation will focus predominantly on the effects of exercise on mitochondrial function and content, as there is a greater volume of published research on these adaptations and stronger conclusions can be made. The results of cross-sectional studies, as well as training studies involving rats and humans, suggest that training intensity may be an important determinant of improvements in mitochondrial function (as determined by mitochondrial respiration), but not mitochondrial content (as assessed by citrate synthase activity). In contrast, it appears that training volume, rather than training intensity, may be an important determinant of exercise-induced improvements in mitochondrial content. The importance of mitochondria for both athletic performance and health underlines the relevance of this topic for ECSS delegates. This topic will therefore be of interest to both delegates interested in athletic performance, as well as those interested in population health.

NUTRITIONAL STRATEGIES TO ENHANCE MITOCHONDRIAL ADAPTATION TO ENDURANCE EXERCISE

PHILP, A.

GARVAN INSTITUTE OF MEDICAL RESEARCH

Endurance exercise, when performed regularly as part of a training program, leads to increases in whole-body and skeletal muscle-specific oxidative capacity. The increase in mitochondrial biogenesis (increased volume and functional capacity) following endurance training is fundamentally important as it leads to greater rates of oxidative phosphorylation and an improved capacity to utilize fatty acids during sub-maximal exercise. Given the importance of mitochondrial biogenesis for skeletal muscle performance, considerable attention has been given to understanding the molecular cues stimulated by endurance exercise and the role that alterations in nutritional status may play in augmenting this adaptive response. In this session, I will discuss a variety of exercise and nutritional approaches used to augment mitochondrial adaption to exercise, examine proposed modes of action and finally discuss the feasibility of such approaches to alter mitochondrial adaptation to endurance training in humans.

Oral presentations

OP-PM22 Genomics

A MULTI-STAGE GENOME-WIDE ASSOCIATION STUDY OF ENDURANCE ATHLETE STATUS AND RELATED PHENOTYPES INVOLVING ATHLETES FROM DIFFERENT ETHNIC GROUPS

SEMENOVA, E.A.1,2, MIYAMOTO-MIKAMI, E.3, AL-KHELAIFI, F.4, KOSTRYUKOVA, E.S.2, KULEMIN, N.A.2, POPOV, D.V.5, CIESZCZYK, P.6, PICKERING, C.7, ELRAYESS, M.A., GENEROZOV, E.V.2, FUKU, N.8, AHMETOV, I.I.

1: KFU , 2: SRI PCM , 3: NIFS , 4: ADL QATAR , 5: SSC RF IBMP , 6: GUPES , 7: UCLAN , 8: JUNTENDO UNIVERSITY , 9: LJMU

INTRODUCTION: Over the previous twenty years, various genetic markers have been associated with endurance athlete status. Here, we used a whole-genome approach in different ethnic groups to detect genetic markers associated with endurance athlete status and related phenotypes.
METHODS: We used a multi-stage genome-wide association study to identify genetic markers linked with endurance and functional analysis, such as VO2max, VO2max trainability, muscle fibre composition.

RESULTS: In the discovery phase, we identified 15 gene polymorphisms associated (P<0.05) with endurance athlete status in three case-control studies (211 elite Russian long-distance athletes vs 252 controls; 96 elite Russian middle-distance athletes vs controls; 60 elite Japanese endurance athletes vs 406 controls). In the replication phase, we confirmed the association of 4 markers (favorable alleles: HFE rs1799945 A, NACC2 rs4409473 C, near LINC00444 rs4941615 T, CTC-229L21.1 rs6878578 C) in additional case-control studies (25 African endurance athletes vs 661 controls; 21 American endurance athletes vs 347 controls; 163 European endurance athletes vs 503 controls). Overall, 11 genetic markers passed meta-analysis criteria (P<0.0033), with one polymorphism (NACC2 rs4409473) reaching genome-wide significance level (P<10-9). To explain these associations, we performed a functional analysis, revealing 6 SNPs associated with maximal oxygen consumption rate (mVO2max): RPL15P3 rs12199205 A, near SMIM20 rs17685537 A, HFE rs1799945 G, near CNR1 rs3857490 T, NACC2 rs4409473 C, ARHGAP15 rs938817 A. In addition, NACC2 rs4409473 CC genotype was associated with greater increase of VO2max following a 12-week aerobic training in Polish women (P=0.039). Furthermore, rs3857490 T allele (near CNR1) was associated with an increased percentage of slow-twitch muscle fibres (P=0.018).
CONCLUSION: In conclusion, we identified 6 genetic markers associated with endurance athlete status and related phenotypes.
Contact: alecsekaterina@gmail.com

AGE-SPECIFIC RESPONSE OF SKELETAL MUSCLE EXTRACELLULAR MATRIX TO ACUTE RESISTANCE EXERCISE

CSAPO, R., LIEBENSTEINER, M., NACHBAUER, W., WESSNER, B.
UNIVERSITY FOR HEALTH SCIENCES, MEDICAL INFORMATICS AND TECHNOLOGY

INTRODUCTION: Skeletal muscle is a highly malleable tissue that is sensitive to mechanical and metabolic stress as imposed by physical exercise. While studies typically report the effects of exercise on contractile muscle cells, little is known about the adaptability of the extracellular matrix (ECM), which has been shown to play an essential role in the development[1], growth and repair of muscles[2] as well as the transmission of contractile force[3]. The fibrotic phenotype often observed at older age[4] indicates altered ECM regulation. The purpose of this pilot study was to compare the changes in ECM gene expression induced by an acute bout of resistance exercise between young and elderly men.
METHODS: Five young (23.8 ± 2.2 y) and 5 elderly (66.8 ± 4.1 y) untrained men participated in a single training session consisting of unilateral leg press and leg extension exercise (3 × 12 reps at 70% 1-RM). Six hours post-exercise, biopsies were taken from the m. vastus lateralis of both the trained and non-trained leg. Total RNA was extracted and used to profile the expression of 84 genes related to the ECM by a PCR array. Eight selectively chosen genes that were either induced or repressed by exercise were validated on individual samples using quantitative real-time PCR. Differences in (> 1.5–fold) changes between young and old participants were determined by Mann-Whitney U tests (IBM SPSS Statistics).
RESULTS: PCR array data showed differential gene expression, with 4 (COL7A1, SELE, MMP15, CTNND2) and 9 genes (ITGB3, COL1A1, ITGAL, CD44, LAMB3, CDH1, SELL, ADAMTS1, ADAMTS8) being selectively down- and upregulated, respectively, in either young or older subjects. Four further genes (MMP3, LAMA1, MMP9, SPP1) were upregulated in young but downregulated in older subjects. Of the 8 genes validated on individual samples, MMP9 gene expression increased in young and decreased in older subjects (Y: 9.7-fold vs. O: 0.2-fold change, p = 0.032). MMP15 was downregulated in older subjects only, although differences between age groups failed to reach significance (Y: 1.0-fold vs. O: 0.6-fold change, p = 0.056). A significant correlation between leg extension 1-RM and COL7A1 expression (ρ = -0.71, p = 0.023) further indicated a potential influence of baseline fitness levels.
CONCLUSION: The results of our pilot study indicate that acute resistance exercise induces or represses ECM gene expression in skeletal muscle in an age-specific manner. In particular, the activity of genes encoding several matrix metalloproteinases (MMP3, MMP9, MMP15) may be of relevance for the pathogenesis of muscle fibrosis. Further research including larger samples is required to verify the age-associated differences in gene expression profiles and establish their functional implications.
References: 1. Thorsteinsdottir S, et al. Dev Biol. 2011;354(2):191-207.
2. Almada AE, et al. Nat Rev Mol Cell Biol. 2016;17(5):267-79.
3. Huijing P. J Exp Biol. 1998;201 (Pt 12):683-91.
4. Serrano AL, et al. Exp Cell Res. 2010;316(18):3050-8.

DNA INSTABILITY FOLLOWING ACUTE AEROBIC EXERCISE: A SYSTEMATIC REVIEW AND META-ANALYSIS

TRYFIDOU, D.V.1, MCCLEAN, C.1, NIKOLAIDIS, M.G.2, DAVISON, G.W.1
1: UU , 2: AUTH

INTRODUCTION: Exercise is widely recognized for its health enhancing effects, contributing to the prevention of cardiovascular disease and other chronic conditions. Despite this, previous research has establish a link between strenuous/exhaustive exercise and the increased formation of reactive oxygen and nitrogen species (RONS). An overproduction of RONS without sufficient antioxidant defence mechanisms can lead to a state of (chronic) oxidative stress. DNA is a vulnerable target of RONS attack and thus can be altered in several ways. If left unrepaired, such DNA modifications may cause genetic instability. This review/meta-analysis aimed to systematically investigate studies reporting DNA damage after an acute aerobic exercise bout, assessing the overall effect.
METHODS: Web of Science, PubMed, MEDLINE, EMBASE and Scopus were searched until March 2017 and limited to articles published in English. Risk of bias was assessed using a tool recommended by the Cochrane Back Review Group. Outcomes included multiple time-points (TPs) of measuring DNA damage post-exercise, two different quantification methods (Comet Assay and 8-OHdG) and protocols of high-intensity (≥75% VO2 max) and long duration (≥42km).
RESULTS: Literature search identified 4202 non-duplicate records of which 32 studies were included in the meta-analysis with a total of 423 participants. Across studies, risk of bias was found to be low. The evidence was strong, showcasing an increase in DNA alteration immediately following acute aerobic exercise with a large effect size at TP 0 (SMD = 1.19; 95% CI: 0.95, 1.42; P < 0.05) while significance remained at TP 1 with a moderate effect (SMD = 0.62; 95% CI: 0.31, 0.94; P < 0.05) but no differences were observed in further TPs. When comparing the two methods of DNA damage, significance was observed only in studies using the Comet Assay. Finally, when isolating protocols of high-intensity and long duration, significance remained stable (SMD = 1.65; 95% CI: 0.46, 2.83; P < 0.05 & SMD = 0.53; 95% CI: -0.25, 1.32; P < 0.05, respectively).
CONCLUSION: A large increase in DNA damage occurs following acute aerobic exercise. The relationship between exercise and DNA damage can be explained through the hormesis concept, which is somewhat one-dimensional. This describes how exercise modulates any advantageous or harmful effects mediated through levels of RONS by increasing DNA oxidation between the two end points of the hormesis curve, physical inactivity and overtraining. We propose a multi-dimensional model in order to develop a better understanding of the complexity of the relationship between DNA integrity and exercise.

Keywords: DNA integrity, Exercise, Hormesis, Reactive Oxygen Species, Multi-dimensional Model.

SEROTONIN GENETIC VARIANTS' LINKAGE TO EXERCISE MOTIVATION AND AEROBIC/ANAEROBIC PERFORMANCE

BEN-ZAKEN, S.

WINGATE ACADEMIC COLLEGE

INTRODUCTION: Motivation plays a pivotal role in physical activity (PA) and performance. However, the genetic mechanism underlies motivated performance is unknown. A possible modulator of PA motivation is serotonin - a neurotransmitter affecting a wide range of physical and psychological functions. We explored the role of serotonin receptor (SR) genetic variants in PA motivated performance.
METHODS: One hundred and sixty-three participants responded to aerobic/anaerobic motivation questionnaires, performed aerobic/anaerobic tests, and their genomic DNA was analyzed.
RESULTS: Three SR genetic variants (rs6311, rs6313, rs3742278) were associated with motivation and performance. Participants carrying zero or one minor alleles were characterized by moderate aerobic/anaerobic motivation and low aerobic/anaerobic performance. Participants carrying more minor alleles were more motivated aerobically and less anaerobically, with higher aerobic and anaerobic performance.
CONCLUSION: We conclude that carrying more of the minor alleles is associated with higher aerobic and anaerobic performance. A direct linkage between carrying minor alleles, motivation, and performance was revealed, mainly for aerobic exercise.

IMPROVEMENT OF IRON METABOLISM RESPONSE AFTER MARATHON RACE IN ACTN-3 XX GENOTYPE

CURY-BOAVENTURA, M.F.1, SIERRA, A.P.R.2,3, OLIVEIRA, R.A.1, SILVA, E.D.4, LIMA, G.H.O.4, BENETTI, M.P.2, KISS, M.A.P.2, SIERRA, C.A.3, GHORAYEB, N.3, PESQUERO, J.4

1 CRUZEIRO DO SUL UNIVERSITY, 2 UNIVERSITY OF SÃO PAULO, 3 DANTE PAZZANESE INSTITUTE OF CARDIOLOGY, 4 FEDERAL UNIVERSITY OF SAO PAULO

INTRODUCTION: The iron deficiency is associated to impairment on oxygen transport and utilization, consequently on athletic performance and increases the risk to sports anemia. The aim of this study was to determine the influence of ACTN3 R577X polymorphisms on iron metabolism response induced by marathon race.
METHODS: Blood samples (30 mL) were collected 1 day before, immediately after marathon race and 1, 3 and 15 days after marathon race (81 amateurs runners). ACTN3 R577X polymorphism and the following parameters were carried out to evaluate iron metabolism: Iron, Ferritin, Transferrin, erytropoetin, total bilirubin, direct bilirubin and indirect Bilirubin. age, 39 ± 1 years; height, 1.74 ± 0 m; body mass, 74 ± 1 kg; % of fat mass, 20 ± 1%; body mass index, 25 ± 0.3 kg/m2; average training race, 56 ± 2 km/week; training experience, 6 ± 0.5 years; frequency of training, 4.4 ± 0.7 time/week; time on 10 km race, 46 ± 0.7 minutes.
RESULTS: Immediately after race we observed an increase on transferrin (by 2%, $p<0.05$), total and direct bilirubin (by 22 and 33 %, respectively, $p<0.05$). In addition, our results demonstrated an elevation on Iron (by 20%, $p<0.05$), total and indirect bilirubin levels and transferrin saturation (by 23%, $p<0.001$) one day after race. Three days after race iron (19%, $p<0.05$) and transferrin levels (6%, $p<0.05$) decreased and erythropoietin (33%, $p<0.05$) increased as a compensatory response. We not observed differences on the effect of marathon race on erythropoietin response between RR, RX and XX genotypes. Iron concentration increased in XX and RX genotypes one day after race and decreased 3 days after race in RR and RX genotypes. Ferritin levels elevated immediately after race and returned to baseline levels one day after marathon in XX genotypes and 3 days after race in RR and RX genotypes. The transferrin saturation (%) elevated one day after race in RR, RX and XX genotypes, however, decrease 3 and 15 days after race in RR and RX genotypes, while was reestablished 3 days after race in XX genotypes. We also observed lower levels of transferrin immediately after and 15 days after race in RR and RX genotypes, but not significantly. In RR genotypes, total bilirubin and unconjugated bilirubin decreased 3 and 15 after race while in XX genotypes increased one day after race. In RX genotype total and unconjugated bilirubin increased 1 day after race and then decreased 3 days after race.
CONCLUSION: Marathon race induced impairment on iron metabolism increasing the risk of iron deficiency and sports anemia. The ACTN-3 XX genotype has an improvement on iron metabolism response after the marathon race.

TRANSCRIPTOME-WIDE RNA SEQUENCING ANALYSIS OF IMMOBILISATION-INDUCED MUSCLE ATROPHY

ASHTON, K.J., THOMPSON, J.M., BUDIONO, B.P., SHIKE, K., MACKENZIE-SHALDERS, K., DOERING, T.M., COFFEY, V.G.

BOND UNIVERSITY

INTRODUCTION: Disuse atrophy is a secondary complication that often exacerbates the aetiology of injury and chronic disease. Identifying the mechanisms that control muscle mass associated with changes in function is necessary to characterize atrophy and better understand the effects of disuse on skeletal muscle. RNA sequencing was used as a high resolution, untargeted approach to study gene expression in human skeletal muscle following short-term limb immobilisation.
METHODS: Twenty-one healthy male participants (aged 20-45 years) completed 4 weeks of standardized physical activity prior to a 14-day limb (left leg) immobilisation period. Participants also underwent 21 days (7 days prior; 14 days during immobilisation) of dietary control. Skeletal muscle biopsies were collected from the m. vastus lateralis before and after 3 and 14 days of immobilisation. Skeletal muscle RNA was isolated and analysed using Illumina RNA next generation sequencing to determine differential gene expression with subsequent GO term/pathway analysis. Strength testing, DEXA and MRIs were also performed pre- and post-immobilisation to determine changes in muscle mass and function.
RESULTS: Following 14 days of limb immobilization, strength (-16.4%), leg lean mass (-3.2%) and quadricep cross-sectional area (-8.5%) were all significantly reduced. RNA sequencing identified significant changes in mitochondrial processes and carbohydrate metabolism which became more pronounced throughout the immobilisation period. Furthermore, changes in transcription regulation and chromatin remodelling processes occurred during the early unloading phase at 3 days, but not later at the end of 14 days. Conversely, changes in protein localisation, ribosome biogenesis, translation, nucleotide metabolism and oxidoreductase activity were identified after 14 days of immobilisation but were unchanged at 3 days.
CONCLUSION: This study provides the first transcriptomic sequencing of short-term disuse atrophy in human skeletal muscle. These data provide further support for changes in gene expression related to mitochondrial dysfunction and reduced protein synthesis as key events. Interestingly, changes in transcription regulation including chromatin remodelling processes were observed as an early event and may be responsible for modifying later transcriptomic responses to short-term disuse atrophy.

Oral presentations

OP-PM85 Hypoxia 2

MUSCLE BLOOD OXYGEN LEVEL DEPENDENT (BOLD) RESPONSES TO BRIEF CONTRACTION AND CUFF OCCLUSION: EFFECTS OF HYPOXIA AND HYPEROXIA

LARSEN, R.G.1, KARBING, D.S.1, ROKKEDAL-LAUSCH, T.1, FRØKJÆR, J.B.2,3, FRANCH, J.1, THOMSEN, L.P.1

AALBORG UNIVERSITY

INTRODUCTION: Blood oxygen level dependent (BOLD) MR imaging monitors muscle oxygenation, and BOLD responses to brief maximal voluntary contraction (MVC) and cuff occlusion (reflecting hyperemia) are used as indices of microvascular reactivity (Meyer, 2004; Schulte 2008). While oxygen availability is proposed to influence vasomotor tone, the purpose of this study was to examine the effects of acute normobaric hypoxia and hyperoxia on microvascular reactivity in response to brief MVC and cuff occlusion in human skeletal muscle.
METHODS: Nine normotensive men were positioned supine in a 3T MR scanner with the dominant foot secured to a foot plate, and a cuff wrapped around the thigh. Participants were breathing through a face mask connected to a gas mixing chamber controlling the fraction of oxygen in the inspired air. The BOLD images (TR = 1000 ms, TE = 40 ms, FOV = 18 cm, Slice thickness = 10 mm) were acquired from the belly of tibialis anterior (TA) during i) 5 min of acclimatization, ii) five brief (1-2s) MVCs of the TA with 1 min of rest in between, and iii) 5 min of cuff inflation (250mmHg) + 5 min of reperfusion. These procedures were performed during normoxia, hypoxia (~12% O2), and hyperoxia (100% O2) in a randomized and balanced order. Time-to-peak (TTP, s) and peak (% of minimum) of the BOLD responses were analyzed using one-way (condition) repeated measures ANOVAs, with pairwise comparisons when appropriate. Data are reported as means±SEM.
RESULTS: The BOLD response to MVC was altered by condition, such that TTP was delayed in hypoxia (10.8±0.6s) compared with normoxia (7.8±0.3s, p=0.003) and hyperoxia (8.2±0.4s, p=0.01). Peak BOLD was lower in hypoxia (1.9±0.4%) compared with normoxia (3.3±0.6%, p=0.004) and hyperoxia (4.5±0.9%, p=0.002). Similarly, the BOLD response to cuff occlusion was altered by condition, such that TTP was delayed in hypoxia (75.2±12.4s) compared with normoxia (31.5±5.4s, p=0.006) and hyperoxia (32.5±3.4s, p=0.003). Peak BOLD amplitude was lower in hypoxia (3.2±0.9%) compared with normoxia (6.6±1.1%, p<0.001) and hyperoxia (9.1±1.8%, p<0.001), and higher in hyperoxia compared with normoxia (p=0.03).
CONCLUSION: Delayed and blunted BOLD responses during hypoxia indicate impaired microvascular reactivity in response to brief MVC and cuff occlusion. Acute exposure to hypoxia may elevate sympathetic vasoconstrictor activity and subsequently constrain vasodilation of the microvasculature. In contrast, maintained BOLD responses during hyperoxia suggest preserved microvascular reactivity in response to brief MVC and cuff occlusion during acute exposure to hyperoxia.
References: Meyer et al., NMR in Biomedicine, 17: 392-98, 2004.
Schulte et al, Radiology, 247: 482-89, 2008
Contact rl@hst.aau.dk

EFFECTS OF ACUTE HYPOXIA ON CARDIAC AUTONOMIC MODULATION FOLLOWING MAXIMAL CARDIOPULMONARY EXERCISE TESTING (CPET)

FORNASIERO, A., SAVOLDELLI, A., SKAFIDAS, S., STELLA, F., BORTOLAN, L., BOCCIA, G., ZIGNOLI, A., SCHENA, F., MOUROT, L., PELLEGRINI, B.

CERISM - UNIVERSITY OF VERONA

INTRODUCTION: Hypoxia acts as a stimulus for an increased sympathetic activity and a reduced parasympathetic cardiac control, that can turn in slower recovery of HR (HRR) and HRV indices after sub-maximal exercise, but not after brief periods of supra-maximal exercise (Al Haddad et al., 2012). However, the effects of hypoxia on cardiac autonomic recovery after a maximal exercise, where cardiovascular and respiratory systems are maximally stressed, have not yet been investigated. This lack of knowledge certainly limits recovery interpretation of hypoxic exercise. Therefore, the purpose of this study was to investigate the effects of hypoxia on post-exercise cardiac autonomic modulation following maximal cardiopulmonary exercise testing (CPET).
METHODS: 13 healthy men (age 34.1 ± 9.7 years, VO2max 55.3± 7.1 mL/kg/min) performed maximal CPET in normoxia (N) and normobaric hypoxia (H) (FiO2=13.4%, ≈3500m asl). Post-exercise cardiac autonomic modulation was assessed during subsequent recovery (300s) through the analysis of fast-phase HRR, slow-phase HRR and recovery of HRV indices.
RESULTS: An increase in resting HR (MD 4.2 bpm, 95% CI 0.6 to 7.8, p=0.025, ES 0.76) with concurrent reduction in HRpeak (MD -6.2 bpm, 95% CI -9.3 to -3.2, p<0.001, ES -0.50) was found in H. Both short-term, T30 (MD 60.0 s, 95% CI 18.2 to 101.8, p=0.009, ES 1.01) and long-term, HRRt (MD 21.7 s, 95% CI 4.1 to 39.3, p=0.020, ES 0.64) time constants of HRR were increased in H. Fast-phase (30s, 60s) and slow-phase (300s) HRR indices were reduced in H when expressed in bpm or as percentage of HRpeak (p<0.05). Differently, chronotropic reserve recovery (CRR) was reduced in H at 30s (p=0.028) and at 60s (p=0.003) but not at 300s (p=0.436). Concurrently, Ln-RMSSD was reduced in H at 60s (p= 0.007, ES -0.87) but not at 300s (p=0.578, ES -0.12).
CONCLUSION: Acute hypoxia (FiO2=13.4%, ≈3500m asl) modified post-exercise cardiac autonomic modulation, causing a reduction in fast-phase HRR, slow-phase HRR and recovery of HRV indices, suggesting both delayed parasympathetic reactivation and reduced sympathetic withdrawal after maximal exercise. However, a similar cardiac autonomic recovery was re-established within 5 minutes after exercise cessation. The findings of this study have several implications in cardiac autonomic recovery evaluation and in HR assessment in response to high-intensity hypoxic exercise.

ADAPTATIONS IN MUSCLE OXIDATIVE CAPACITY, FIBER SIZE AND OXYGEN SUPPLY CAPACITY AFTER REPEATED-SPRINT TRAINING IN HYPOXIA COMBINED WITH CHRONIC HYPOXIC EXPOSURE

VAN DER ZWAARD, S., BROCHERIE, F., KOM, B.L.G., MILLET, G.P., DELDICQUE, L., VAN DER LAARSE, W.J., GIRARD, O., JASPERS, R.T.

VRIJE UNIVERSITEIT AMSTERDAM

INTRODUCTION: In this study, we investigate adaptations in muscle oxidative capacity, fiber size and oxygen supply capacity in team-sport athletes after six repeated-sprint sessions in normobaric hypoxia or normoxia combined with 14 days of chronic normobaric hypoxic exposure.
METHODS: Lowland elite field hockey players resided at simulated altitude (≥14 h·d-1 at 2800-3000 m) and performed regular training plus six repeated-sprint sessions in normobaric hypoxia (3000 m; LHTLH; n=6) or normoxia (0 m, LHTL; n=6) or lived at sea level with regular training only (LLTL; n=6). Muscle biopsies were obtained from the m. vastus lateralis before (pre), immediately after (post-1) and 3 weeks after the intervention (post-2). Changes over time between groups were compared using magnitude and likelihood of effect sizes (ES).
RESULTS: Succinate dehydrogenase activity in LHTLH largely increased from pre to post-1 (~35%), likely more than LHTL and LLTL (ES = large-very large), and remained elevated in LHTLH at post-2 (~12%) vs. LHTL (ES = moderate-large). Fiber cross-sectional area remained fairly similar in LHTLH from pre to post-1 and post-2, but was increased at post-1 and post-2 in LHTL and LLTL (ES = moderate-large). A unique observation was that LHTLH and LHTL, but not LLTL, improved their combination of fiber size and oxidative capacity. Small-to-moderate differences in oxygen supply capacity (i.e. myoglobin and capillarization) were observed between groups.
CONCLUSION: In conclusion, elite team-sport athletes substantially increased their skeletal muscle oxidative capacity, while maintaining fiber size, after only fourteen days of chronic hypoxic residence combined with six repeated-sprint training sessions in hypoxia.

THE PATTERN OF BREATHING DURING NORMOXIC AND HYPOXIC EXERCISE IN PREPUBERTAL CHILDREN AND ADULTS: KIDSKI PROJECT

MEKJAVIC, I.B., DEBEVEC, T., KAPUS, J., UŠAJ, A., MCDONNELL, A.C., NAJDENOV, P., MEKJAVIC, M., JAKI MEKJAVIC, P.

JOZEF STEFAN INSTITUTE

INTRODUCTION: Families with children now take advantage of the easy accessibility of ski resorts in the European Alps situated at altitudes in excess of 3000m. The aim of the KidSki project was to investigate the effect of hypoxia at these altitudes on the physiological functions relevant for ensuring safe skiing, particularly in children. We have previously shown that breathing pattern is not modified during exercise in normobaric and hypobaric hypoxia. In this study, conducted within the framework of the KidSki project, we compared the normoxic (940 m) and normobaric hypoxic (3000 m) exercise breathing pattern between adults and prepubertal children.
METHODS: Thirteen prepubertal children (5 females and 8 males; age= 8.3 ± 1.6yrs, body mass = 29 ± 7 kg, FVC= 2.09 ± 0.69 L) and thirteen adults (6 females and 7 males; age= 39.9 ± 3.8 yrs, body mass = 73 ± 12 kg, FVC=5.11 ± 1.21 L) participated in this study conducted at the Olympic Sport Centre Planica (Rateče, Slovenia) situated at an altitude of 940m. Subjects were confined to the facility for 48 hrs. During the first 24 hrs they were exposed to normoxia, and during the second 24 hr period to normobaric hypoxia (simulated altitude of 3000m). They performed an incremental load exercise on a cycle ergometer on two occasions: once in normoxia (PIO2= 134 ± 0.4 mmHg), and again in normobaric hypoxia (PIO2= 105 ± 0.4 mmHg) while being confined to the facility. During the exercise we measured capillary-oxygen saturation (SpO2), and cardiorespiratory responses, specifically tidal volume (Vt, Litres) expressed as a percentage of forced vital capacity (%FVC), and inspiratory time (Ti, sec).
RESULTS: SpO2 was significantly ($p<0.05$) lower in hypoxia (91 ± 2%) than in normoxia (97 ± 1%), with no difference between the groups. Both the children and adults exhibited the expected increase in Vt with a concomitant decrease in Ti. The normoxic breathing pattern, reflected in the relation of %FVC as a function of Ti, was not modified by hypoxia. However, at any given inspiratory flow rate (Vt/Ti, L.sec-1), children had a significantly ($p<0.05$) lower Ti and Vt compared to the adults. The adults attained a Vt of 49.6 ± 12% FVC upon completion of the exercise, whereas in children Vt attained 41 ± 4 %FVC.
CONCLUSION: The pattern of breathing during normoxic exercise, defined as the Vt-Ti relation, remained unaltered at 4000m in both groups. The exercise breathing pattern of children is different from that of the adults, such that a given inspiratory flow rate is achieved with a higher frequency of breathing and lower relative Vt (expressed as %FVC).
Acknowledgements: Supported by the Foundation of Sport of the Republic of Slovenia (Project number RR-2015-5228-11659).
(1) Mekjavic I.B., Eiken O., LaPrairie A., Banister E.W. (1987). Eur. J. Appl. Physiol. 56: 619-622.
(2) Mekjavic I.B., Moric C., Goldberg S.V., Morrison J.B., Walsh M.L., Banister E.W., Schoene R.B. (1991). Eur. J. Appl. Physiol. 62: 61-65.

Oral presentations

OP-PM21 Diabetes

OXYGEN UPTAKE KINETICS AND VASCULAR FUNCTION WITH TYPE I DIABETES

THOMAS, S., GOODMAN, J., RIDDELL, M., MERINO, D.

UNIVERSITY OF TORONTO FACULTY OF KINESIOLOGY & PHYSICAL EDUCATION

INTRODUCTION: Slower oxygen kinetics may occur when oxygen delivery is slow relative to oxygen uptake at the muscle. We tested two hypotheses: 1) Oxygen kinetics and blood flow (plethysmography) will be correlated in those with T1D; 2) Measures of vascular health, and fitness (VO2 max), and oxygen uptake kinetics will not differ between people with T1D compared with controls.
METHODS: People with type I diabetes and age matched control participants (20-40 y), with no other health impairments were recruited. Vascular function was measured using pulse wave analysis (PWA), velocity (PWV), and plethysmography. Following determination of aerobic fitness (VO2max) participants performed 6 repeated work; rest intervals (85% of ventilation threshold; 3 min 0 load pedaling) to estimate oxygen kinetics. The correlation between oxygen kinetics (measured as tau) and blood flow measured via plethysmography was calculated to assess the strength of the relation between oxygen delivery and blood flow.
RESULTS: Twenty-one participants (9 T1D; 12 control) completed the study. There were a total of 7 men and 14 women with an average age of 24.9 ± 4.9 years. All T1D participants had adequate blood glucose control with an average HbA1C of 7.41 ± 0.62%. Measures of

vascular health PWA (T1D: 0.00 ± 9.25%, Control: 8.55 ± 8.86%), PWV (T1D: 6.87 ± 0.83 m/s, Control: 7.34 ± 1.14 m/s) and plethysmography blood flow (T1D: rest: 4.23 ± 1.73, max: 59.18 ± 12.5 mL100mL-1 min-1); Control: rest: 4.82 ± 2.21, max: 50.94 ± 12.69 mL100mL-1 min-1) were not significantly different between the two groups (p=>0.005). Aerobic fitness (T1D: 36.11 ± 6.79 mLkg-1min-1); Control: 36.24 ± 9.43 mLkg-1min-1), perceived exertion (T1D: RPE: 12.8 ± 2.6, RPD: 2.7 ± 1.3; Control: RPE: 13.5 ± 1.7, RPD: 2.6 ± 1.8), and oxygen uptake kinetics (T1D: 27.9 ± 4.5 s; Control: 29.2 ± 9.3 s) were not significantly different between the two groups (p=>0.05). Finally, non-significant correlations between resting blood flow and oxygen kinetics (r=0.15, p=>0.05), and maximal blood flow and oxygen kinetics (r=0.10, p=>0.05) were observed across both groups.
CONCLUSION: The absence of differences in oxygen kinetics in participants with T1D and controls may be a consequence of their similar aerobic fitness and rapid kinetics. The lack of a significant relationship between oxygen kinetics and blood flow suggests this aspect of blood flow did not limit oxygen kinetics for these participants. However, this study did show that vascular health and exercise capacity between the groups were not significantly different. This result suggests that people with T1D can have comparable vascular health and exercise capacity to a control population of a similar age. This result could encourage people with T1D to participate in regular exercise and maintain appropriate glucose levels to achieve good vascular health.

EFFECTS OF SPIRULINA SUPPLEMENTATION ON SKELETAL MUSCLE MASS, PROTEOSYNTHESIS/PROTEOLYSIS MARKERS AND EXERCISE-INDUCED MUSCLE DAMAGES IN DIABETIC RATS

MEZIAT, C., GROUSSARD, C., BAZUREAU, E., COSTE, P., ANDRÉ, J., CHAOUHACHI, M., LEMOINE-MOREL, S., SALIGAUT, D., LEFEUVRE-ORFILA, L., VINCENT, S.

LABORATOIRE MOUVEMENT SPORT SANTÉ - UNIV RENNES

INTRODUCTION: Diabetes is characterized by chronic hyperglycemia, inflammatory and oxidative stress state. Inflammatory markers (TNFα, NFκB) can reduce proteosynthesis and increase proteolysis, leading to loss of skeletal muscle (SM) mass. This phenomenon increases the risk of exercise-induced skeletal muscle damages (SMD). Nutritional supplementations are now integrated into the therapeutic management of diabetes as additive strategies. Spirulina (SPI), a microalgae presenting high content of proteins, and exhibiting anti-inflammatory, antioxidant and insulin-sensitive effects could be an interesting strategy to protect SM in diabetes.
The aim of this study was to evaluate SPI supplementation effects in diabetic rats on the SM proteosynthesis/proteolysis markers and it potential protective effect on SMD induced by eccentric exercise
METHODS: 68 male Wistar streptozotocin-diabetic rats were divided into placebo (P, n=34) or Spirulina (SPI, n=34, Arthrospira platensis: 300 mg/kg/day/4w) groups. Rats of exercise groups (n=22 per group P or SPI) realized an individualized treadmill downhill exercise (-16°,16m/mn) until exhaustion. Plasma glycemic assessment (glucose and fructosamine) and creatine kinase (CK) concentrations were determined. Markers of inflammation were evaluated by histological staining (CD68, CD163, macrophages) or western blotting (TNFα), as markers of proteosynthesis/proteolysis (mTor, FoxO3a, NFκB) on Soleus. Assays were performed after the exercise (T0) or 24h after (T24) (respectively; n=11/condition).
RESULTS: 4w of SPI supplementation did not improve glycemic assessment nor the body and SM mass. Proteosynthesis (mTor expression) was increased in SPI group, but there was no decrease in proteolysis (NFκB and FoxO3a expression).
However SPI seemed to reduce basal SMD as shown by CK concentration. SMD was induced by eccentric exercise as it shown by plasma CK content at T0 and T24 in both groups. SPI supplementation significantly reduced CK levels in T24 group, and tended to increase time to exhaustion.
Histological data seemed to show different profiles of CD68 and CD163 markers (M1 and M2 types of macrophages, respectively) in both groups.
CONCLUSION: 4w SPI supplementation was not sufficient to improve SM mass but increase proteosynthesis whithout limiting proteolysis. Theses effects are probably linked to AO and anti-inflammatory effects of SPI. Moreover, SPI alters positively post-exercise SMD and regeneration profile.
KEYWORDS: Arthrospira platensis, downhill-exercise, skeletal muscle mass and damages, diabetes.
ACKNOWLEDGMENT : Brittany region, Algae Green Value

EFFECT OF THE MUSCLE METABOREFLEX ACTIVATION IN TYPE 2 DIABETES MELLITUS

ROBERTO, S.1, MILIA, R.1, DONEDDU, A.1, PALAZZOLO, G.1, SERRA, S.1, PINNA, V.1, ORRÙ, A.1, MULLIRI, G.1, PAGLIARO, P.2, CRISAFULLI, A.1

1UNIVERSITY OF CAGLIARI, 2UNIVERSITY OF TORINO

INTRODUCTION: It is well known that, in healthy subjects, when the muscle metaboreflex (MM) is activated, mean blood pressure (MBP) increases due to a sympathetic-induced increase in both systemic vascular resistance (SVR) and cardiac output (CO)1. It has been reported that this reflex is dys-regulated in patients suffering from metabolic diseases, such as type 1 Diabetes Mellitus (DM1) and Metabolic Syndrome. In detail, in DM1 it was demonstrated a blunted MBP response during the MM due to sympathetic impairment2; moreover, patients suffering from metabolic syndrome show an exaggerated SVR during the MM because of their sympathetic hyperactivation. Several evidence suggests that, similarly to what observed for metabolic syndrome, also in type 2 Diabetes Mellitus (DM2) there is an exaggerated sympathetic tone in response to exercise. Our aim was to discover whether or not the MM is dys-regulated in these patients.
METHODS: Two groups took part in this study: DM2 group composed by 14 subjects (4 females, 62.7±8.3yrs); and a control (CTL) group composed by 15 healthy subjects (4 females, 65.5±8.2 yrs). After a preliminary cardiopulmonary exercise test on cycle-ergometer up to exhaustion, they underwent randomly assigned the following protocol: the post-exercise muscle ischemia (PEMI) session, to study the MM, and a control exercise recovery (CER) test. Response to the metaboreflex for each cardiovascular parameter was assessed as PEMI minus CER level. Hemodynamic parameters were measured by impedance cardiography.
RESULTS: Patients with DM2 showed an exaggerated SVR response as compared to the CTL group (+392.5±549.6 vs. -38.2±278 dynes•s-1•cm-5 respectively, p<0.05), and a decrease in ventricular emptying rate response as compared to CTL (-10.1±30.9 vs. +10.6±23 ml•s-1 respectively, p<0.05) whereas MBP response was not significantly different between groups (+8.9±5.7 vs. +9.5±11.6 mmHg respectively, p>0.05).
CONCLUSION: This investigation indicates that patients with DM2 have an exaggerated vasoconstriction in response to the MM activation. This phenomenon is different to what observed in DM12 and similar to what reported for metabolic syndrome3.
1 Crisafulli A et al. Muscle metaboreflex-induced increases in stroke volume. Med Sci Sports Exerc 2003; 35: 221-228.

2 Roberto S et al. Altered hemodynamics during muscle metaboreflex in young, type 1 diabetes patients. J Appl Physiol 2012; 113: 1323-1331.
3 Milia R et al. Differences in hemodynamic response to metaboreflex activation between obese patients with metabolic syndrome and healthy subjects with obese phenotype. Am J Physiol (Heart Circ Physiol) 2015; 309: H779-789.

EFFECTS OF A PROGRESSIVE SELF-DIRECTED STEP TRAINING AND WALKING PROGRAMME INVOLVING SHORT ACCUMULATED BOUTS ON SEDENTARY INDIVIDUALS WITH TYPE 2 DIABETES MELLITUS: A PILOT STUDY.

BYRNE, H.1,2, CAULFIELD, B.1,2, LOWEREY, M.1,3, GRIFFIN, M.4, SMITH, D.5, THOMPSON, C.J.5, DE VITO, G.1,2

1 = INSIGHT CENTRE, IRELAND 2 = UCD SCHOOL OF PUBLIC HEALTH, PHYSIOTHERAPY & SPORTS SCIENCE, IRELAND 3 = UCD SCHOOL OF ELECTRICAL AND ELECTRONIC ENGINEERING, IRELAND 4 = BEACON HOSPITAL, IRELAND 5 = B

INTRODUCTION: Compliance to self-directed exercise is poor in individuals with type 2 diabetes. Step training and walking offer simple forms of exercise that may yield high adherences in any setting. Progressive programmes of short accumulated bouts may also boost motivation and evidence suggests that short bouts of step training or walking improve health related benefits. This pilot study evaluates the effects of a novel self-directed exercise programme on individuals with type 2 diabetes mellitus. It aims to identify if the programme yields compliance and improves health-related outcome measures.
METHODS: 10 sedentary individuals with type 2 diabetes mellitus were included in this study (2 female, Age = 51.7 ± 6.5 years, Disease duration = 8.1 ± 4.7 years, BMI = 30.1 ± 2.5 kg/m2, HbA1c = 59.4 ± 4.9mmol/mol). The novel exercise programme consisted of small bouts of walking and/or step training spread throughout the day over 16 weeks. The programme began with 2-minute sessions twice/day at 12/20 on the Borg RPE scale on 3 days for the first week and progressed to three 12-minute sessions each day at 16 on the Borg scale in week 16. Participants were given the choice of carrying out step-training and/or walking for all exercise sessions to provide them with greater autonomy and remove Irish weather as a potential barrier to exercise.
RESULTS: Of 245 total sessions the mean attempted and completed were 82.6 ± 24.7% and 81.6 ± 25.4% respectively. Self-reported minutes of physical activity per week increased from 106.0 ± 38.3 at baseline to 397 ± 305.5 at follow up (P = 0.01). Six-minute walk test distances increased from 466.9 ± 32.7m to 535.7 ± 59.9m (P < 0.01), bodyweight reduced from 93.7 ± 13.0kg to 91.5 ± 13.3kg (P = 0.73), BMI decreased to 29.4 ± 2.5kg/m2 (P = 0.56), and HbA1C reduced to 55.7 ± 5.0mmol/mol (N = 9, P = 0.15). Handgrip strength increased from 41.2 ± 6.7 to 45.2 ± 7.2 kg (P = 0.24).
CONCLUSION: The results of the pilot study indicate that this novel progressive self-directed exercise programme of accumulated short bouts of step training and/or walking has the potential of yielding high adherences in previously sedentary individuals with type 2 diabetes mellitus, increasing overall levels of physical activity and improving health related outcomes including functional fitness. Further work will need to include a control group of supervised training and a larger sample size.
References: Eriksen et al. (2007) Diabetologia 50: 2245.

EFFECTS OF INTENSIVE LIFESTYLE INTERVENTION ON PANCREATIC BETA-CELL FUNCTION IN PATIENTS WITH TYPE 2 DIABETES – A SECONDARY ANALYSIS FROM THE U-TURN TRIAL.

RIED-LARSEN, M., JOHANSEN, M.Y., HANSEN, K.B., ELLINGSGAARD, H., ALMDAL, T.P., PEDERSEN, B.K., KARSTOFT, K.

RIGSHOSPITALET, UNIVERSITY OF COPENHAGEN

INTRODUCTION: The objective of the study was to investigate the effects of an intensive lifestyle intervention with high volume of exercise on indices of pancreatic beta-cell function in patients with type 2 diabetes.
METHODS: This is an explorative analysis of data from the U-TURN trial. The U-TURN trial was a single center assessor-blinded, randomized study conducted from April 2015-August 2016 at RH, Denmark. Adult participants with short standing, non–insulin-dependent type 2 diabetes (T2D, time from diagnosis<10 years) were included (n=98). Participants were randomly assigned (2:1; stratified by sex) to a lifestyle intervention group (U-TURN, n=64) or a standard care group (StC, n=34). All participants received individual T2D counseling and standardized, blinded, target-driven medical therapy. In addition to this, the U-TURN group also received dietary plans as well as 5-6 weekly aerobic training sessions, of which 2-3 sessions also included resistance training. Indices for pancreatic beta-cell function were based on a 2-hour standard oral glucose tolerance test (2h-OGTT) performed following 48 hours of pharmacological and exercise discontinuation at baseline and at 12-month follow-up. Differences between the groups in change from baseline to 12-month follow-up for the Disposition (DI, primary outcome), Matsuda (ISI) and Insulinogenic (IGI) indices are reported. Data are presented as mean differences with [95% confidence intervals] adjusted for sex and the respective baseline values.
RESULTS: Among the 98 randomized participants (mean age, 54.6 years; women, 48%; mean baseline HbA1c, 6.7%), 60 and 27 participants in the U-TURN and StC groups, respectively, completed both 2h OGTT's. Insulin secretion normalized for insulin sensitivity (DI) improved in both groups (U-TURN; 90% [62-123] and StC; 38% [8-77]), but the U-TURN group improved 38% [2-86] more than the StC group. Whole body insulin sensitivity (ISI) improved 23 % [1-51] more in the U-TURN than in the StC group. No difference in the change in beta-cell responsivity (IGI) from baseline to follow-up was observed between the groups.
CONCLUSION: A 12-month intensive lifestyle intervention with high volumes of exercise improved indices of pancreatic beta-cell function in patients with short standing type 2 diabetes. However, more studies are needed with gold-standard measures of beta-cell function in order to clarify mechanisms and exercise dose.

Invited symposia

IS-BN08 Neuromuscular fatigue in children

DIFFERENCES IN NEUROMUSCULAR FATIGUE BETWEEN CHILDREN AND ADULTS

RATEL, S.

CLERMONT AUVERGNE UNIVERSITY

INTRODUCTION: Fatigue, as a concept, has initiated many debates over the last century. However, fatigue could be defined as an exercise-induced reduction in muscle performance. Two different measurement models have been used in children to quantify such impair-

ment. The first consisted of quantifying the reduction of power output during real exercise such as maximal cycling (1) or short running bouts (2). The second was based on the assessment of maximal muscle force-generating capacity during repeated maximal voluntary contractions (MVC) in isometric or dynamic conditions. Taken together, studies have reported a lower fatigability in children compared to adults whatever the nature of the task (1-3). No sex-related difference in fatigue development was observed before and after the pubertal period. The fatigability may be maturity-dependent given that studies have reported a greater fatigability in adolescents compared to children and in adults compared to adolescents (1). This lecture will be devoted to provide an overview of recent studies on the effects of age, maturation and sex on the development of fatigue during repeated MVC or real activities. Practical implications that emerge from these findings will be discussed in relation with sports settings.
(1) Ratel et al. JAP 92(2):479-85, 2002
(2) Ratel et al. IJSM 27(1):1-8, 2006
(3) Ratel et al. MSSE 47(11):2319-28, 2015.

MECHANISMS UNDERPINNING CHILD-ADULT DIFFERENCES IN NEUROMUSCULAR FATIGUE

PATIKAS, D.A.

ARISTOTLE UNIVERSITY OF THESSALONIKI, GREECE

INTRODUCTION: Fatigue is a complex phenomenon that is affected by the function of several neuromuscular mechanisms on both peripheral and central levels. Structural and physiological differences between children and adults could underpin some age-related diversities in the behaviour of the neuromuscular system. The topic of this lecture will focus on such neuromuscular differences between children and adults and will distinguish between peripheral (muscular) and central (neural) factors of fatigue. Recent findings, consistently converge to a less peripheral fatigue in children compared to adults (1). These differences could be explained by the lower force production, the higher proportion of fatigue resistant slow-twitch fibres and the higher muscle oxidative capacity in children compared to adults. The contribution of central factors is more controversial, since Ratel et al. (3) and Streckis et al. (2) reported higher reduction in the voluntary activation (VA) in children after fatigue, which possibly acts as a protective mechanism to prevent any extensive peripheral fatigue. However, we have recently reported no difference in the VA after fatigue between children and adults (1). The presented findings have significant implications in future research in this field and should be accounted when planning training programs in young populations.
REFERENCES:
(1) Hatzikotoulas et al. MSSE 46(7):1326-33, 2014
(2) Streckis et al. Muscle Nerve 36(3):357-63, 2007
(3) Ratel et al. MSSE 47(11):2319-28, 2015

FATIGUE OR FATIGABILITY IN PATIENTS WITH NEUROMUSCULAR DISEASE

HABETS, L.

HU UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Paediatric patients with neuromuscular fatigue often report their daily activities are limited by fatigue. In many situations, the patients are describing the feelings to exert more than the usual amount of effort to accomplish a task. This lecture will focus on exercise testing in patient with Duchenne and Becker Muscular atrophy as well as fatigability in patients with Spinal Muscular Atrophy (SMA). Fatigability, defined as the decline in performance during and after prolonged motor tasks, has emerged as a rather common but often overlooked complaint among patients with SMA. Fatigability is a highly disabling symptom during repetitive activities of daily living e.g. eating, walking and computer use. The currently used outcome measures for SMA have been developed to determine muscle strength and specific motor skills, but do not specifically assess fatigability. The aim of this lecture is to discuss the role of exercise testing in neuromuscular disease using the development of a new outcome measure to assess fatigability as an example.

METHODS: RESULTS: CONCLUSION: Invited symposia

IS-MI02 Physical activity and cognitive function

THE EFFECTS OF ACUTE AND CHRONIC PHYSICAL ACTIVITY ON COGNITIVE AND BRAIN HEALTH

HILLMAN, C.

NORTHEASTERN UNIVERSITY

There is a growing public health burden of poor health behaviors among children of industrialized nations. Children have become increasingly inactive, leading to concomitant increases in the prevalence of being overweight and unfit. Particularly troubling is the absence of public health concern for the effect of physical inactivity on cognitive and brain health. It is curious that this has not emerged as a larger societal issue, given its clear relation to childhood obesity and other inactivity-related disorders that have captured public attention. My program of study has examined the relation of health behaviors and their related physiological correlates to cognitive and brain health across the human lifespan, with particular interest in preadolescent childhood. My techniques of investigation involve a combination of neuroimaging, behavioral assessments, and scholastic achievement in an effort to translate basic laboratory findings into everyday life. Central to this translational approach is the identification of etiological substrates of brain structures and networks that are susceptible to health behaviors. Findings from my area of research have indicated that greater amounts of physical activity, aerobic fitness, maintenance of healthy body weight, and diet quality are positively related to brain structure and function, cognition, and scholastic achievement.

EFFECTS OF AEROBIC EXERCISE ON INHIBITORY CONTROL IN ADOLESCENTS AGED 16-19 YEARS

GEJL, A.K.

UNIVERSITY OF SOUTHERN DENMARK

Background and objectives: Aerobic exercise has been acknowledged as a promising approach to induce brain alterations in humans, also implying changes in cognition and behavior. However, literature in adolescents is scarce and more studies are needed to elucidate details about the exact relationship between aerobic exercise and cognitive performance. Therefore, we conducted two studies including adolescents with the following aims: Study I) to clarify the acute effects of short bouts of aerobic exercise at different intensities on inhibitory control, and Study II) to clarify the effects of nine weeks of aerobic training on cardiorespiratory fitness, inhibitory control and plasma BDNF.
Methods: Study I was conducted as a randomized crossover study including 52 adolescents. In a randomized and counterbalanced order, participants completed three 5-minutes cycling conditions varying in exercise intensity (50%, 65% and 80% of maximal oxygen reserve (VO2R)), one 30-minutes cycling condition at 65% VO2R and one rest condition. Inhibitory control was assessed following each condition using a modified flanker task. Study II was conducted as a three-arm randomized controlled trial including 115 subjects. Subjects were randomized to three conditions: 1) non-intervention (control), 2) low-to-moderate intensity aerobic exercise, or 3) high-intensity intermittent aerobic exercise. Inhibitory control (flanker task), cardiorespiratory fitness and plasma brain-derived neurotrophic factor (BDNF) were measured at baseline and following nine weeks.
Results: Study I: No specific effects of the 5-minutes conditions were observed for inhibitory control. However, compared to the rest condition, better performance (i.e. response accuracy) was observed across stimuli requiring variable amount of inhibitory control after all 5-minutes conditions, with the high-intensity exercise demonstrating the largest differences (i.e. response accuracy and reaction time). Study II: Cardiorespiratory fitness was increased in both exercise groups, with the largest effects in the high-intensity group. There were no effects of nine weeks of aerobic exercise on either inhibitory control or plasma BDNF.
Conclusion: Short bouts of aerobic exercise, and particularly high-intensity exercise, may be an efficient approach to improve information processing in general, but not specifically inhibitory control in adolescents. Nine weeks of aerobic exercise increase cardiorespiratory fitness, but not inhibitory control or plasma BDNF in adolescents.

DO PERIPHERAL BRAIN-DERIVED-NEUROTROPHIC-FACTOR RELATE TO COGNITIVE FUNCTION? A VALIDATION STUDY.

ANDERSEN, L.

WESTERN NORWAY UNIVERSITY OF APPLIED SCIENCES

Brain derived neurotrophic factor (BDNF) is believed to be a key mechanism for the effect of Physical Activity to improve cognitive function. Animal models have shown increased level of BDNF in Hippocampus in relation to increased physical Activity. However, in humans BDNF can only be measured in blood and this Level may not reflect what happens in the brain. Recent studies found a positive Association between cardiovascular disease risk factor levels and serum BDNF, which is t opposite of what we would expect given the fact that high Fitness is positively Associated With cognitive function, but negatively Associated With CVD risk factors. In blood, 99% of BDNF is stored in platelets and they cannot pass the blood-brain barrier. Therefore we conducted a validation study of different measurements of BDNF in serum and plasma samples. The aims of the study were to investigate the impact of storage time and centrifugation strategy on brain-derived neurotrophic factor (BDNF) levels in human serum and plasma samples, and to clarify how these measures are related. Moreover, we aimed to establish whether BDNF levels associated with cardiorespiratory fitness and waist circumference.
Method. The study included seventeen male students (mean age=25.2 (4.1) years). Fasting blood samples were drawn and treated according to different protocols varying in time before centrifugation (30, 60, 180, 240 and 300 min.) and subjected to different centrifugation strategies. Mature BDNF was analysed in serum, normal and platelet-poor plasma after ~eight months storage. In addition, waist circumference and cardiorespiratory fitness were measured.
Result. A systematic increase in BDNF was observed over time in serum, but not in normal plasma or platelet-poor plasma. No correlation was observed between serum and plasma BDNF levels. Waist circumference was positively associated with serum BDNF levels in samples left for 300 min., whereas cardiorespiratory fitness was negatively associated with the difference in BDNF levels in serum left for 30 min. and 60 min., respectively.
Conclusion. BDNF levels measured in serum and plasma, respectively, differ and have different biological relevancies. Our data suggest that the rate, rather than the full extent, of BDNF release is associated with cardiorespiratory fitness. In future using measures of peripheral BDNF, it is essential to consider the biological medium and treatment hereof carefully, as these factors significantly affect the results.

Invited symposia

IS-SP03 Recent methodologies for enhancing biomechanical comprehension and applications - Sponsored by adidas

OPTIMAL CONTROL BASED STUDIES OF RUNNING MOTIONS IN SPORTS

MOMBAUR, K., KLEESATTEL, A.L.

HEIDELBERG UNIVERSITY

In this talk, we want to show how optimal control methods based on whole-body dynamic models of human athletes can be used to analyze and generate running motions in sports. The goal of this research is to gain a better understanding of the underlying principles of these movements and to ultimately use this knowledge to improve the individual movements and training of athletes. It is a common assumption that human movement is optimal due to evolution, development and learning, in this case in form of a specific training, which motivates the use of optimization techniques in this context.
Different types of optimization problems are of interest:
• Optimal control for motion analysis, using recorded motions of human athletes and solving a least squares fitting problem. If a reliable model is used, this leads to a detailed reconstruction of the motion including also variables that cannot be measured;.

• Optimal control for motion synthesis or motion prediction, generating new motions and computing optimal position and velocity histories as well as inputs at the same time by using some suitable objective function . Several choices will be discussed that are relevant for the situation.
• Inverse optimal control which solves the problem to identify which optimization criterion was optimized in a particular situation for which human recordings are available. Typically the criteria consist of several components, and the goal is to identify classes of motions and subjects for which they are valid.
Running is considered as a multiphase motion with alternating single foot contact ad flight phases. We use multibody system models of athletes that describe the full dynamic properties of the segments relevant for a motion. Depending on the particular question asked, our models are either fully 3D or in the sagittal plane and have typically between 16 and 35 degrees of freedom. Equations of motion are set up based on our multibody system modeling tool RBDL and the human meta-model HeiMan. If a particular athlete is studied, subject specific parameters can be identified from motion capture by the tool Puppeteer or by more detailed MRT based information. As input variables we use joint torques or so-called muscle-torque generators that summarize the accumulated torque of all muscles at a joint. Other details of interest could be added to the model, e.g. external compliance models at the soles describing the effect of different shoe types.
Different results will be presented in this talk including running motions that are optimal with respect to different criteria such as energy minimization, efficiency maximization, speed maximization, as well as criteria mimicking pain in different parts of the body.

APPLICATIONS OF FUNCTIONAL DATA ANALYSIS IN SPORTS BIOMECHANICS

HARRISON, A.J.

UNIVERSITY OF LIMERICK

Theoretical Background: Most biomechanical data present as temporal waveforms or time series representing specific biomechanical measures such as angles, moments, or forces measured over time, generating large quantities of high-dimensional data that can be represented as curves or groups of curves. Analysis of such data is challenging and although various procedures have been explored, no standard technique for analysis of curve data has been established. Experimental studies often aim to determine differences in curve-based data between several groups or individuals. Functional data analysis (FDA) was developed by Ramsey and Dalzell (1991) and in contrast to other methods; FDA considers the entire sequence of measurements in a trial as a single functional entity rather than a series of individual data points. There are four main steps in FDA:
1. Data representation: derivation of smooth functions often using B-spline basis functions
2. Registration of data (i.e. time normalisation or landmark registration)
3. Functional principal component analysis (fPCA)
4. Visual representation and statistical analysis
This presentation focuses on steps 3 and 4 and demonstrates the potential benefits of implementing fPCA using various sports biomechanics data sets. In fPCA, the functional principal components (FPC) are presented in the same domain as the original function with high and low scorers on each FPC presented as functions in comparison to the ensemble mean function. In addition, each trial is assigned an FPC score which can be analysed using conventional group statistics and/or effect sizes.
Applications in Sport Science: fPCA has previously been used by Donoghue et al. (2008) to examine the effects of in-shoe orthoses on the kinematics of the lower limb function in subjects with previous Achilles tendon injury compared to uninjured controls. The results provided evidence of in-shoe orthoses constraining some movement patterns while restoring some aspects of variability in other movements.
Dona et al. (2009) applied fPCA bilaterally to sagittal knee angle and net moment data in race-walkers of national and international level. They concluded that fPCA was sensitive enough to detect potentially important technical differences between higher and lower skilled athletes, and therefore fPCA might be a useful and sensitive aid for the analysis of sports movements, if consistently applied to performance monitoring in sport.
References: Dona, G., Preatoni, E., Cobelli, C., Rodano, R., & Harrison, A. J. (2009). Application of functional principal component analysis in race walking: An emerging methodology. Sports Biomechanics, 8: 284–301.
Donoghue, O. A., Harrison, A. J., Coffey, N., & Hayes, K. (2008). Functional data analysis of running kinematics in chronic Achilles tendon injury. Medicine & Science in Sports & Exercise, 40: 1323–1335.
Ramsay, J. O., & Dalzell, C. J. (1991). Some tools for functional data analysis. Journal of the Royal Statistical Soc

POSSIBILITIES AND LIMITATIONS OF MUSCULOSKELETAL MODELLING IN SPORT, TRAINING AND REHABILITATION

LORENZETTI, S.

SWISS FEDERAL INSTITUTE OF SPORT MAGGLINGEN SFISM

INTRODUCTION: Muscle strengthening activities are recommended by the WHO for adults to maintain general fitness and health . Strength training guidelines should aim to guide correct exercise execution for stimulating positive tissue adaptation without overloading. Here, musculoskeletal modelling has become a powerful tool to estimate the internal loading conditions during strength exercises in vivo for science-based training recommendations . The aim of this study is to validate the accuracy of musculoskeletal modelling in predicting the knee joint reaction forces during the "squat" exercise using data from instrumented knee arthroplasty as gold standard.
METHODS: Using a synchronised system of motion capture and ground reaction force plates, 6 subjects <5M, 68 years, 88 kg, 173cm> with an instrumented knee implant were measured while performing five valid repetitions of a squat exercise without additional weight . The internal total joint forces were derived from the kinetic and kinematic input parameters using the software OpenSim with a generic musculoskeletal model that was uniformly scaled to subject-specific dimensions.
RESULTS: The measured total joint contact forces from the instrumented implant were between 2 and 3.3 times bodyweight. The absolute magnitudes of the predicted joint forces were only accurate within 20 % error for a limited knee flexion range of about 25 to 60 degrees; yet, a relative comparison was still possible.
CONCLUSION: The present results indicate that generic musculoskeletal models are valid tools for predicting peak values of total joint forces during loading. Further efforts are needed to better capture subject-specific musculoskeletal anatomy for analysing joint forces throughout exercise execution, and thus, allowing the targeted design of exercises for specific structures while avoiding overload of other structures.
References: WHO, 2010. Global recommendation on physical activity for health, ISBN: 9789241599979
Schellenberg F, Oberhofer K, Taylor WR and Lorenzetti S. 2015. Review of modelling techniques for in vivo muscle force estimation in the lower extremities during strength training. Comput Math Meth Med. 483921.

Schellenberg F, List R, Schütz P, Kutzner I, Schwachmeyer V, Taylor WR, Lorenzetti S. 2016. Musculoskeletal squat simulation evaluation by means of an instrumented total knee arthroplasty. ISBS Tsukuba, p. 347–50.
Schellenberg F, Taylor WR and Lorenzetti S. 2017. Towards evidence based strength training: a comparison of muscle forces during dead-lifts, goodmornings and split squats. BMC Sport Sci, Med. & Reh. Doi: 10.1186/s13102-017-0077-x

Oral presentations

OP-BN08 Visuo-cognitive performance in ball games

HOW IS SCANNING BEFORE BALL POSSESSION RELATED TO PERFORMANCE WITH THE BALL? AN INVESTIGATION OF FOOTBALL PLAYERS' EXPLORATORY ACTION

MCGUCKIAN, T.1, COLE, M.1, CHALKLEY, D.1, SHEPHERD, J.2, JORDET, G.3, PEPPING, G.J.1

1. AUSTRALIAN CATHOLIC UNIVERSITY, 2. GRIFFITH UNIVERSITY, 3. NORWEGIAN SCHOOL OF SPORT SCIENCES

INTRODUCTION: Performance analysis in football is commonplace in applied and research settings (Sarmento et al., 2017), however, researchers have rarely investigated players' off-the-ball behaviour, before they gain possession of the ball. As they are surrounded in 360-degrees, players need to visually explore (i.e. scan, head-check) in order to gain knowledge of their environment and prospectively guide their actions with the ball. Preliminary investigations suggest that field constraints influence players' exploratory actions (McGuckian et al., 2017) and that more frequent exploratory actions prior to receiving the ball is related to better pass success (Jordet et al., 2013). However, the relationships between these exploratory actions that occur before gaining ball possession and subsequent performance with the ball are unknown.
METHODS: We used inertial measurement units to quantify the exploratory head movements of 15 (mean (SD) age = 18.67 (3.90) y/o) competitive football players during 11v11 match-play and manually coded subsequent actions. Here we report on pass direction, one-touch passes and turns with the ball. Odds Ratios (OR) were calculated to estimate the effect of head turn frequency before receiving the ball on the occurrence of subsequent actions with the ball. An OR above 1 indicates the action with the ball occurred more often when players' head turn frequency was higher than their individual average. Ten time-periods (0-1s, 0-2s, … up to 0-10s) before possession were analysed, and the time-period before possession with the highest OR (i.e. most important time-period for that action with the ball) are reported.
RESULTS: When players turned their head more frequently before receiving the ball they were more likely to play a forward pass (0-8s, OR=2.80), play a one-touch pass (0-1s, OR=1.68), turn with the ball (0-4s, OR=2.53) and play a pass in the direction opposite to which it was received (0-2s, OR=4.49).
CONCLUSION: When players had a higher frequency of head movement, they were more likely to play a forward pass, a one-touch pass, turn with the ball, and play a pass in the opposite direction it was received. This suggests a higher frequency of head turns is related to increased knowledge about their surroundings. The findings demonstrate the value of exploration and frequent head movements before receiving a pass, and therefore the development of these behaviours in training should be a high priority.
REFERENCES:
Jordet, G., Bloomfield, J., & Heijmerikx, J. (2013). Paper presented at the MIT Sloan Sports Analytics Conference, Boston.
McGuckian, T. B., Askew, G., Greenwood, D., Chalkley, D., Cole, M. H., & Pepping, G.-J. (2017). In J. A. Weast-Knapp & G.-J. Pepping (Eds.), Studies in Perception & Action XIV: Nineteenth International Conference on Perception and Action (85 - 87): Taylor & Francis.
Sarmento, H., Clemente, F. M., Araújo, D., Davids, K., McRobert, A., & Figueiredo, A. (2017). Sports Med. doi: 10.1007/s40279-017-0836-6
CONTACT:
Thomas.mcguckian@acu.edu.au

USING STROBOSCOPIC VISION TO RESTRICT VISUAL FEEDBACK IN A SOCCER SPECIFIC SKILL ASSESSMENT

BEAVAN, A.1,2, FRANSEN, J.3, HANKE, L.4, SPIELMANN, J.5, SKORSKI, S. , MAYER, J.5, HAUSER, T.2, MEYER, T.1

1: SAARLAND UNIVERSITY , 2: DFB . 3: UTS , 4, DHFPG , 5: TSG 1899

Introduction: The most prominent source of sensory information required during sport specific skills is visual feedback. When visual feedback was limited, skilled (S) soccer dribblers suffered greater performance decrements compared to their lesser-skilled (LS) counterparts in a dribbling test (Fransen et al., 2017). Yet soccer performance requires players to find functional movement solutions based on problems dictated by the performance environment and the requirements of the task. Therefore, soccer skill assessments require external factors to dictate how and when the skill is performed (Sunderland et al., 2006). Therefore, this study aims to investigate how restricted visual feedback affects a soccer-specific skill assessment that requires a more complex, reactive perception-action coupling.
Methods: Eighty-four amateur male participants completed two counterbalanced sessions in the Footbonaut under separate conditions: stroboscopic vision (frequency of 1Hz, clear vision for 266ms, opaque for 620ms) and full vision. The Footbonaut consists of a 14x14m artificial turf surrounded by 72 square targets (1.5x1.5m). An auditory and visual cue alerted the participant which gates the ball would be dispensed from and passed into. Ten familiarisation balls were given prior to the first session, and each session consisted of 32 consecutive balls separated by a 10 minute rest.
Results: Players were subdivided into S and LS participants using age-standardised z-scores. A MANOVA with points, accuracy, and speed as dependent variables revealed a multivariate effect of stroboscopic vision on performance (p=<.001). Univariate analyses revealed significantly larger decrements (full–stroboscopic session performance) in S participants in the stroboscopic session in points (S: 13653au; LS: 5391au; p=<0.001) and accuracy (S: 11.7%; LS: 0.4%; p=<.001), but not in speed (S: 0.21s; LS: 0.18s; p=.543) compared to their LS counterparts.
Conclusion
The results are comparable with previous research in a soccer-dribbling task (Fransen et al., 2017), where restricting visual feedback affected the S participants to a greater extent than their LS counterparts. The interpretation of these findings is twofold: i) the specificity of practice hypothesis states greater performance decrements are apparent in more experienced players when afferent feedback conditions are dissimilar to the environment which they learned the skill (Proteau & Marteniuk, 1993) and ii) stroboscopic vision relates to a higher amount of visual restriction in absolute terms when skills are executed faster. In conclusion, stroboscopic vision may be used to induce performance errors during practice to stimulate larger skill training effects, particularly in more skilled players.

References: Fransen, J, et al., (2017). Motor control, 21(2), 158-167.
Sunderland C, et al., (2006). Int J Sports Med. 27(05):395-400.
Proteau, L., & Marteniuk, R. G. (1993). Hum Mov Sci, 12(5), 515-536.
E: adam.beavan@uni-saarland.de

COGNITIVE LOAD IMPAIRS THE USE OF CONTEXTUAL PRIORS DURING ACTION ANTICIPATION IN SOCCER – AN EEG STUDY

GREDIN, N.V.1, BROADBENT, D.P.1, WILLIAMS, A.M.2, BISHOP, D.T.1

1: BRUNEL UNIVERSITY LONDON , 2: UNIVERSITY OF UTAH

COGNITIVE LOAD IMPAIRS THE USE OF CONTEXTUAL PRIORS DURING ACTION ANTICIPATION IN SOCCER – AN EEG STUDY
Gredin NV.1, Broadbent DP.1, Williams AM.2, Bishop DT.1
1: Brunel University London (Uxbridge, UK), 2: University of Utah (Salt Lake City, USA)
Introduction: In elite sport, performance analysts are an integral part of the coaching process, providing athletes with information relating to the tendencies of forthcoming opponents (i.e., contextual priors). In soccer, expert players use such information to enhance performance when anticipating the actions of oncoming opponents (Cañal-Bruland and Mann, 2015). However, the cognitive demands of this process have typically been measured using self-report ratings rather than more robust neurophysiological measures. We used electroencephalography (EEG) to assess the cognitive demands of processing contextual priors and examined the impact of cognitive load on the use of this information during anticipation.
Methods: Altogether, 18 male soccer players (age = 21 ± 1 yrs [M + SD]; playing experience = 11 ± 2 yrs) performed a video-based task where they anticipated the actions of an oncoming opponent. They performed the task with and without contextual priors pertaining to the opponent's action tendencies (dribbles = 67%, passes = 33%), under conditions with high (secondary n-back task) and low (no secondary task) cognitive load. Cognitive demands were assessed using self-report ratings and EEG recordings of electrical power within the Theta and Alpha frequencies obtained over frontal and parietal regions, respectively (Brower et al., 2012). Anticipatory performance was registered via a button-press system that captured both accuracy and response time.
Results: The provision of contextual priors increased the EEG manifestation of cognitive demands (d = 0.27 ± 0.20 [90% CL]), but the self-reported demands concurrently decreased (d = -0.33 ± 0.36). Under low-load conditions, contextual priors enhanced anticipatory performance (d = 0.29 ± 0.34) but this improvement was not found under high-load conditions (d = 0.03 ± 0.45).
Conclusions
Our findings provide the first evidence that contextual priors increase cognitive demands during action anticipation in sport – seemingly in the absence of self-awareness of these demands. The contradictory self-report and EEG findings have methodological implications for the assessment of cognitive demands during task performance. Furthermore, we found that the beneficial performance effects of contextual priors may not be retained under task conditions with high cognitive load. This novel finding makes a significant contribution to the development of an overarching theoretical framework that can predict anticipatory behaviour in sport (Cañal-Bruland and Mann, 2015).
References: Cañal-Bruland R, Mann DL. (2015). Front Psychol, 6, 1518.
Brouwer A-M, Hogervorst MA, van Erp JBF, Heffelaar T, Zimmerman PH, Oostenveld R. (2012). J Neural Eng, 9, 45008.
Contact: viktor.gredin@brunel.ac.uk

THE IMPACT ON PASS RECEPTION AND DELIVERY OF A FOOTBALL FOLLOWING A TRAINING INTERVENTION WITH SPATIAL OCCLUSION GOGGLES.

DUNTON, A., ONEILL, C., COUGHLAN, E.K.

CORK INSTITUTE OF TECHNOLOGY

INTRODUCTION: Visual Occlusion is comprised of temporal and/or spatial occlusion and is the process of limiting the vision of an object, limb or critical information source from the visuomotor workspace (Vickers, 2007). The aim of the current research was to measure the impact on pass reception and delivery of a football following a training intervention using spatial occlusion goggles on a skilled soccer player cohort.
METHODS: Fifteen male skilled soccer players were randomly assigned to one of three groups; Occlusion (OCC), Practice (PRA) and Control (CON). Participants were instructed to stand in a designated zone on a synthetic grass surface in front of a concealed ball projector where a ball was delivered at a speed of 40 km/h. Concurrently, a series of randomly generated numbers were displayed on a wall behind the ball projector for the duration of the task. Participants were required to call each number presented while attempting to control and pass the ball towards one of two mini goals in front of the participant. The direction of the pass was determined by a timed presentation of an arrow next to one of the displayed numbers to coincide with a ball release, every three, four or five seconds. Performance was determined by three variables: Number Call Error, Outcome Error and Control Error. The study design consisted of a pre-test, acquisition phase (400 trials), post-test and a 2-day retention test.
RESULTS: A 3 group x 3 test ANOVA was conducted to analyse the impact of the acquisition phase on each of the three selected variables. There was a significant decrease in number error ($p < 0.05$) and outcome error ($p < 0.05$) for the OCC group from pre- to post-test and pre- to retention test. No significant decrease was experienced from post-test to retention test ($p > 0.05$) demonstrating a learning effect. There was no significant decrease in control error ($p > 0.05$) for the OCC group across any test. No significant decrease was experienced for the PRA or CON group across any variable.
CONCLUSION: Using spatial occlusion goggles to remove vision of an incoming football showed a significant improvement for performance. There was a significant reduction in number call error and outcome error for the OCC group. Although a different form of visual occlusion was used in the current research the results are consistent with results from studies that have used visual occlusion as a training tool to improve sports performance (Farrow et al, 2005; and Muller & Abernathy, 2014).
References: Farrow, D., Abernethy, B., and Jackson, R. (2005). Probing Expert Anticipation with the Temporal Occlusion Paradigm: Experimental Investigations of some Methodological Issues. Motor Control, 9, 330-349.
Muller, S., and Abernathy, B. (2014). An Expertise Approach to Training Anticipation using Temporal Occlusion in a Natural Skill Setting. Tech, Inst., Cognition and Learning, 9, 295-312.
Vickers, J.N. (2007). Perception, cognition, and decision training: The quiet eye in action. Human Kinetics, Champaign, IL.

THE EFFECT OF A 4-WEEK STROBOSCOPIC TRAINING ON SPORT-SPECIFIC VISUOMOTOR PERFORMANCE AND VISUAL FUNCTION IN TOP LEVEL BADMINTON PLAYERS

HÜLSDÜNKER, T.1,2, RENTZ, C.1, STRÜDER, H.K.1, MIERAU, A.1,2

<1> GERMAN SPORT UNIVERSITY COLOGNE, <2> LUNEX INTERNATIONAL UNIVERSITY OF HEALTH, EXERCISE AND SPORTS

INTRODUCTION: An increasing number of studies suggest stroboscopic training is a promising training approach to improve visuomotor performance in sports. However, previous research mainly focused on untrained participants. Thus it remains unclear if stroboscopic interventions are also effective for athletes that already reached a high skill level in visuomotor demanding sports. Further, previous experiments were restricted to behavioural parameters although research indicated visuomotor performance in experienced athletes is substantially determined by visual processes. Therefore, this study evaluated stroboscopic training at the behavioural and neurophysiological level in skilled athletes.
METHODS: Ten German top level badminton players (intervention: n=5, control: n=5) participated in this study. Within a training period of 4 weeks, athletes performed identical badminton-specific visuomotor tasks either wearing shutter glasses (intervention) or under normal visual conditions (control). Prior to and after the training period, smash defence tests were performed to examine modulations in sport-specific visuomotor abilities as indicated by the proportions of successful hits, frame hits and missed balls. In addition, neurophysiological analyses of the N2 motion onset visual evoked potential (VEP) latency identified adaptations of visual motion perception/processing speed in the athletes' motion sensitive mid-temporal visual area MT.
RESULTS: Badminton training improved visuomotor performance in both groups however, performance gains were significantly higher following stroboscopic training. Specifically, athletes participating in the stroboscopic intervention group achieved stronger improvements in the proportion of successful hits (p=0.028) as well as a greater reduction of missed balls (p=0.007). In contrast, N2 latency modulations in area MT following training did not significantly differ between groups. Nonetheless, there was a strong correlation between changes in N2 latency and visuomotor performance (r=-0.55) indicating higher performance gains following training were associated with a stronger reduction of the N2 latency.
CONCLUSION: The results indicate badminton training under stroboscopic conditions may be more effective than conventional visuomotor training to improve visuomotor abilities even for athletes performing at high skill level. Furthermore, visuomotor performance gains may potentially be mediated by neural adaptations in the cortical visual motion system. Given the importance of visuomotor abilities in badminton, the results suggest stroboscopic training is a promising training approach for visuomotor demanding sports. Moreover, information about the underlying neural mechanisms could help coaches to individualise stroboscopic training interventions based on the athlete's neurophysiological profile.

EFFECTOR-SPECIFIC RESPONSE INHIBITION OF TEAM HANDBALL EXPERTS AND RECREATIONAL ATHLETES

HEPPE, H., ZENTGRAF, K.

UNIVERSITY OF MUENSTER, UNIVERSITY OF FRANKFURT

INTRODUCTION: In interactive sports, athletes have to respond quickly to their teammates´ or opponents´ actions and, equally important, frequently inhibit initiated responses (e.g., when reacting to feints or when the previously opened passing lane is suddenly closed). There is some evidence that athletes from interactive sports are superior in inhibiting their motor responses based on perceptual input, both for younger (Huijgen et al., 2015; Verburgh et al., 2014) and adult athletes (Wang et al., 2013; Zhang et al., 2015). In previous studies, participants had to respond by pressing buttons with their index fingers. In this experiment, we aimed at investigating whether response inhibition is effector-specific and related to motor expertise. Apart from the usage of their hands, handball athletes likewise respond to actions with their lower extremity (e.g., reactions on feints). Therefore, response inhibition of hands and feet was tested. We hypothesized that handball players perform better in both conditions compared to recreational athletes.
METHODS: Male professional handball players playing in the second league in Germany (n = 30) and male recreational non-handball athletes (n = 30) were tested in a response inhibition paradigm (DV was stop-signal reaction time, SSRT). A repeated-measures ANOVA with factors response-effector (hands, feet) and group (expert, recreational) was conducted.
RESULTS: Results showed significant main effects of response-effector ($F(1,58) = 26.54$, $p < .001$, $\eta p^2 = .314$) and group ($F(1,58) = 7.89$, $p = .007$, $\eta p^2 = .120$) with shorter SSRTs in the hands condition and shorter SSRTs of handball experts. The interaction between response-effector and group was not significant ($F(1,58) = 2.87$, $p = .096$, $\eta p^2 = .047$).
In the feet condition, a post-hoc test (one-tailed) showed no significant difference between handball experts ($M = 259.5$ ms, $SD = 41.6$) and recreational athletes ($M = 276.74$ ms, $SD = 38.4$), $t(58) = 1.67$, $p = .10$, 95% CI [-0.08, 0.943], $d = .43$. In the hands condition, a post-hoc test (one-tailed) showed a significant difference between handball experts ($M = 229.36$ ms, $SD = 32.83$) and recreational athletes ($M = 261.52$ ms, $SD = 39.00$), $t(58) = 3.46$, $p = .001$, 95% CI [0.362, 1.423], $d = .89$.
SSRTs of hands and feet were positively correlated, Pearson´s $r(58) = .625$, $p < .001$.
CONCLUSION: In general, our findings replicate previous findings that expert athletes from interactive sports show better performance in tests on response inhibition and speak for the relevance of cancellation of initiated responses in handball. When responding with their hands, handball experts showed substantial shorter SSRTs, indicating superior response inhibition, compared to recreational athletes. When responding with their feet, the difference between groups halved. Since the frequent use of hands is an important feature in interactions in handball, it could be speculated that this explains why handball experts show superior performance when responding with their hands.

SUPERIOR EXECUTIVE FUNCTIONS IN ELITE GAME SPORTS THAN IN ENDURANCE SPORTS ATHLETES

BIRKLBAUER, J., GONAUS, C., WINKLER, B., MÜLLER, E.

UNIVERSITY OF SALZBURG

INTRODUCTION: There is converging evidence that cognitive and academic performance is causally linked to cardiovascular fitness (e.g. Fedewa & Ahn 2011), which is attributed to several neurobiological mechanisms that benefit from physical activity (e.g. Vivar & van Praag 2017). Besides physical demands of endurance sports (ES), games sports (GS) provide additional demands on higher-order cognitive functions, such as working memory, inhibitory control and cognitive flexibility, since players need to consider large amounts of information in every new moment, rapidly suppress responses and quickly change strategies. Therefore, we hypothesized that GS athletes outperform ES athletes in general executive functioning.

METHODS: The performance of executive functions in 122 elite GS athletes (including soccer, ice hockey, basketball and tennis) and 112 elite ES athletes (including triathlon, swimming, cycling, running, orienteering and speed skating) were tested by means of the non-verbal Design Fluency test. At time of testing, athletes in GS (age: 24±5) and in ES (age: 24±8) were competing at the national top level and trained on average 10.7±2.5 and 12.4±5.4 hrs/wk, respectively. In order to control for confounders we assessed age, sex, test time, school education, training age, starting age, training frequency, age at inception, type of sport and second sport.
RESULTS: As predicted, GS athletes showed significantly better executive functions than ES athletes in all three sub-conditions ($p<.001$; eta2=.061-.078). Taken all conditions together, in the best design fluency quintile 68% were GS athletes, while in the quintile with the lowest test results 74% of the subjects belonged to ES (corrected for the sampling distribution). The best results were achieved by soccer players, who performed on average 28% more designs than road cyclists and long-distance runners. Remarkably, both groups, GS and ES athletes, performed much better on the executive test than the standard population.
CONCLUSION: Our findings confirm that general executive functions are important in GS, which is in line with a number of studies in various ball sports that found superior metacognitive functioning in elite players than in sub-elites or normal population (e.g. Vestberg et al. 2017). However, it is still unclear whether this is the consequence of practice or the result of a selection process. In the former case, it opens new possibilities for further performance improvements in GS by early interventions and it emphasizes the importance of game-based exercises as an integral part of school sports programs. In the later case, it may change the way how new talents are recruited. To further unravel this issue, longitudinal and long-term intervention studies are needed.
REFERENCES:
Fedewa AL, Ahn S (2011). Res Q Exerc Sport, 82(3), 521-35.
Vestberg T et al. (2017). PLoS One, 12(2), e0170845.
Vivar C, van Praag H (2017). Physiology, 32(6), 410-24.
*shared first authorship

Invited symposia

IS-SH02 Encountering Transnational Sports Migration

DREAMS TO REALITY? RIGHT TO DREAM, FC NORDSJÆLLAND AND FEMALE FOOTBALL MIGRATION FROM GHANA TO DENMARK

AGERGAARD, S., DARBY, P.
AALBORG UNIVERSITY

In May 2013, Right to Dream (RtD), a Ghanaian based football academy with a considerable record of producing migrant professional football players, opened the first residential girls' football academy in Africa. Following its purchase of the Danish Superleague team FC Nordsjælland (FCN) in late 2015, FCN and RtD announced their intention to launch a woman's football academy in 2018, to establish a team in the elite women's league in Denmark the following year and to pursue entry into the Women's Champions League by 2023. This paper is based on three bouts of ethnographic fieldwork in Ghana, Sweden and Denmark which involved interviews with the first cohort of girls recruited by RtD (n: 16), key personnel involved in the inception and development of the academy in Ghana (n: 7), and the core staff who lead the women's football academy in Denmark (n: 3). The paper presents preliminary findings on how the collaboration between an African football academy and a Danish football club came about; what its key objectives are, and how these objectives are likely to be realised in the future. Also, the paper describes, how young Ghanaian girls imagine the possibilities of transnational mobility through football, how they act to produce mobility and enhance their visibility, and how the RtD/FCN collaboration might facilitate these processes. The paper concludes that the collaboration between RtD and FCN on women's football calls for new perspectives on transnational connections between African and European football and on migration pathways for African players seeking professional football careers in Europe.

HUMAN TRAFFICKING IN FOOTBALL: DEBATES, POLICIES AND ETHICS

ESSON, J.
UNIVERSITY OF LOUGHBOROUGH

Reports of human trafficking within the football industry have become a topic of academic, policy, and media concern. The movement of young hopeful footballers from Africa to Europe, and more recently to Asia, dominates these accounts. This paper examines academic debates over the trafficking of African footballers, and evaluates the key policy responses that have emerged to address this issue. It is argued that existing understandings of football trafficking suffer from two key limitations, namely, a receiving country bias, and a tendency to misread the significance of socio-economic conditions within origin countries. Building on these insights, the paper draws on ethnographic fieldwork with would-be football migrants in Accra (Ghana) to demonstrate how a critical examination of the contemporary perception of professional football as a vehicle for social mobility can help extend conceptual understandings of this issue, particularly in relation to understanding better the risks young people are willing to take to migrate through football. Through doing so, I seek to illustrate why existing policy responses may prove to be ineffective, and to think through how we can generate responses that are ethically sound, feasible and practical.

PRECARIOUS POST-CAREERS. OCCUPATIONAL CHALLENGES AMONG FORMER WEST AFRICAN FOOTBALLERS IN NORTHERN EUROPE

UNGRUHE, C.
AARHUS UNIVERSITY

Entering a career's "after life" is a challenging turning point in the lives of many professional athletes. In general, lack of alternative occupational opportunities, financial difficulties and a declining social status have been identified as crucial and (often interconnected) obstacles for their post-career trajectories. While migrant athletes form a notably vulnerable group, this counts in particular for athletes from

the so-called global South who have embarked on professional careers in Europe. So far, however, existing studies on the phenomenon have focused on experiences of athletes from the global North, leaving others, e.g. African athletes out of the picture.
Taking former West African footballers in Northern Europe as a case study, this paper focusses on the reasons for and experiences of occupational challenges that migrating players from the global South face after their careers conclude. It particularly highlights the impact of low salaries, the subordinate role of education, and the problem of limited job opportunities outside football. While pointing to specific precarious challenges for this group of migrants, the paper also aims to expand knowledge about the phenomenon of transnational football migration from the global South beyond the time of pre- and actual careers. It is based on multi-sited ethnographic research and 20 interviews with West African footballers who played in Northern Europe between the mid-1990s and 2015.

Invited symposia

IS-SH07 Acute and chronic exercise effects on attention and executive function: domain-specific implication for sport and domain-general relevance across the lifespan.

ACUTE AND CHRONIC EXERCISE EFFECTS ON ATTENTION AND EXECUTIVE FUNCTION: DOMAIN-SPECIFIC IMPLICATION FOR SPORT AND DOMAIN-GENERAL RELEVANCE ACROSS THE LIFESPAN

MEMMERT, D.

GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: Attention is a crucial factor regarding sport related performance. As athletes and referees are constantly overwhelmed with a multitude of visual and auditory stimuli, which they cannot process at once due to a limited capacity of in-formation processing, the question arises how attention can be directed efficiently to make optimal decisions. Athletes and referees should also be able to control the direction of their attention to such an extent that they can distinguish between relevant and irrelevant information. Based on neurological and psychological findings, different kinds of attentional sub-processes are presented. Additionally, I will demonstrate that the new attention window paradigm is important to measure attention breadth in complex environments like training situations of athletes. Different testing procedures were developed regarding measurements of all dimensions of attention, and numerous strategies for optimal attentional direction and control were tested. This has direct consequences for the development of new training programs for players and referees.

PHYSICAL EXERCISE, BRAIN AND SUSTAINED ATTENTION: EVIDENCE FROM CROSS-SECTIONAL STUDIES.

SANABRIA, D.1, HUERTAS, F.2

1. UNIVERSITY OF GRANADA; 2. UNIVERSIDAD CATÓLICA DE VALENCIA "SAN VICENTE MÁRTIR"

The ability of being vigilant is fundamental for maintaining optimal performance in many daily tasks such as driving or attending to an academic lesson. Here, we show that the vigilance capacity is positively related to the level of regular practice of exercise, in children, adolescents and young adults. Over a series of studies, we consistently reported that individuals who practice exercise regularly outperformed those with a sedentary life style . In an attempt to pinpoint the factors that might drive that relationship, we will present data revealing the influence of both the type of exercise activity and cardiovascular fitness. Finally, we propose a novel hypothesis to explain the influence of the regular practice of exercise on cognitive and brain functioning based on the enhancement of brain-heart communication and interoception.
References:
- Ballester R, Huertas F, Yuste FJ, Llorens F, Sanabria D. <2015>. The relationship between regular sports participation and vigilance in male and female adolescents. PLoS ONE, 10<4>.
- Luque-Casado, A., Perakakis, P., Ciria, L., & Sanabria, D. <2016>. Transient autonomic responses during sustained attention in high and low fit young adults. Scientific Reports, 8, 6:27556.
- Luque-Casado, A., Perakakis, P., Hillman, C. H., Kao, S.-C., Llorens, F., Guerra, P., & Sanabria, D. <2015>. Differences in sustained attention capacity as a function of aerobic fitness. Medicine and Science in Sports and Exercise, 48, 5:887-895.

THE CONTRASTING EFFECTS OF PHYSICAL ACTIVITY ON ATTENTIONAL AND COGNITIVE AGING: DO THE QUANTITY AND QUALITY OF PHYSICAL ACTIVITY MATTER?

PESCE, C., FORTE, R., CONDELLO, G., CAPRANICA, L.

UNIVERSITY OF ROME

Physical activity, fitness and expertise in cognitively demanding sports seem to benefit not only domain-specific cognition, but also domain-general cognition, as executive function and attention, across the lifespan until old age. This presentation provides an overview of aging studies that try to disentangle the effects, on executive function and attention, of being physically active and fit from those of being an experienced athlete in cognitively demanding sports [1,2,3]. Both individual and joint effects of acute exercise bouts and chronic physical activity and sport practice are considered. Aging research data gathered with a testing paradigm that taps the efficiency of orienting and executive attention networks are summarized to show to what extent physical activity and deliberate sport practice may preserve attention or promote the development of compensatory strategies. Finally, we propose designed exercise training for older non-athletes realized by embedding cognitive and specifically executive function challenges into physical activity tasks [4,5]. We discuss potential mediating mechanisms and associations between cognitive and functional mobility outcomes of designed physical-cognitive dual-task training.
[1] Pesce C, Cereatti L, Forte R, Crova C, Casella R. <2011>. Acute and chronic exercise effects on attentional control in older road cyclists. Gerontology, 57, 121-128.
[2] Pesce C, Audiffren M. <2011>. Does physical activity switch-off switch costs? A study with younger and older athletes. J Sport Exerc Psychol, 33, 609-626.
[3] Condello G, Forte R, Falbo S, Shea JB, Di Baldassarre A, Capranica L, Pesce C. <2017>. Steps to health in cognitive aging: effects of physical activity on spatial attention and executive control in the elderly. Front Hum Neurosci, 11:107.

[4] Forte R, Boreham CAG, Costa Leite J, Ditroilo M., Brennan L, Gibney E, De Vito G, Pesce C. <2013>. Enhancing cognitive functioning in the elderly: multicomponent vs. resistance training. Clin Interv Aging, 8, 19-27.
[5] Falbo S, Condello G, Capranica L, Forte R, Pesce C. <2016>. Effects of physical-cognitive dual-task training on executive function and gait performance in older adults: a randomized controlled trial. BioMed Res Int. 2016:5812092.

Oral presentations

OP-PM60 Injury/injury prevention

A NEW TAPING TREATMENT: TREATMENT OUTCOME FOR RESTRICTION OF ANKLE DORSIFLEXION FOLLOWING LATERAL ANKLE SPRAIN

TAKESHI, T.1, AKITO, T.1, SHIRO, S.1,2, KEITA, N.1, SATORU, N.1
1:NISHIKAWA ORTHOPEDIC CLINIC, 2:CHIBA UNIVERSITY

INTRODUCTION: Restriction of ankle dorsiflexion is one of the sequelae of lateral ankle sprain. Although some factors that might influence the sequelae have been reported, reports on conservative treatment outcomes are lacking. In addition, Kobayashi et al. have reported that the fibula of the ankles with chronic ankle instability had more lateral position than that of the healthy ankles. This study aimed to report the efficacy of our original taping treatment based on patients characteristics.
METHODS: We evaluated medical records of our outpatients who were diagnosed with lateral ankle sprain within 1 month of trauma and underwent diagnostic magnetic resonance imaging. Inclusion criteria were restriction of ankle dorsiflexion and receiving our original taping. Of 65 potentially relevant patients, 15 met the inclusion criteria. First, we assessed improvement rate and duration for improvement of the restriction of ankle dorsiflexion with the taping treatment. Second, on the basis of these assessments, we divided the patients into the improvement and remaining groups. Periods of attendance at our clinic, ratio of anterior talofibular ligament (ATFL) tear as well as of bone bruise of the talus, and the distance between the tibia and fibula were compared between the two groups. Categorical variables were compared using Fishers exact test, whereas continuous variables were analyzed using Students t-test or Mann-Whitney U test, as appropriate.
RESULTS: The improvement rate of restriction of ankle dorsiflexion was 64.7%. The average period of up to improve from the first visit to our clinic was 37.1 ± 24.6 days. Statistical analyses showed a significant difference ($p < 0.01$) both in the period of attendance at our clinic (improvement group: 37.1 days; remaining group: 89.5 days) and ratio of bone bruise of the talus (improvement group: n = 3/9; remaining group: n = 5/6). No significant difference was observed in both the distance between the tibia and fibula (improvement group: 0.07; remaining group: 0.08) and ratio of ATFL tear (improvement group: n = 6/9 remaining group: n = 6/6).
CONCLUSION: Our study suggested that our taping treatment might be effective only for patients with restriction of ankle dorsiflexion without bone bruise of the talus. Hence, a new treatment method for patients with restriction of ankle dorsiflexion with bone bruise of the talus should be investigated.

STRESS AND FATIGUE AS RISK FACTORS FOR INJURIES IN AMATEUR FOOTBALL PLAYERS

FERRARI, P.1, GAZZANI, D.2, ASSISI, E.1, SPIRIDONOVA, M.1, GROSSGASTEIGER, S.1, MUR, C.1, RESNYAK, S.1
1 AZIENDA SANITARIA DELLALTO ADIGE, BOLZANO, ITALY 2 UNIVERSITÀ DI VERONA,VERONA, ITALY

INTRODUCTION: Adult amateur football players (AF) are the major part of football players worldwide, despite this the interest and number of researches on them are fewer compared to professional football players. Indeed there are few informations on AF and their injuries. In particular, on our knowledge few researches evaluate amateur outfield players (OP) who are for more aspects completly different in respect to goalkeepers and represent most part of the team. Therefore our aim was to evaluate OP, their injures and the possible risck factors.
METHODS: The partecipants undergo to anthropometric measurements and they had to complete a questionnaire. In the questionnaire we required information about player characteristic and about football injuries in the previous year. In addition, it was asked if playing football generally causes them significant physical fatigue or emotional stress. We considered AF who were over 20 years old.
RESULTS: 365 OP partecipated in the study, 27,7% were overweight and 99 had an injury. The total number of injuries was 129 and the more frequents were on muscle (29,4%). The OP injured were older and referred important physical fatigue and emotional stress compared to non injured players. We used multivariate logistic regression analysis in which the outcome was to be injured and the factors were age, BMI, role,years of playing, physical fatigue, emotional stress. Fatigue (OR 2.4; 95% CI 1.4-4.2; p=0.002) and stress (OR 2.5, 95% CI 1.06-5.9; p=0.037) were significantly and indipendently associated with injury.
CONCLUSION: In our study, an intresting result is that above a quarter of non goalkeeper players were overweight and that the more frequent site of injury was muscle. Previous studies reported an older age as a risk factor, but our final results were different; we found that, in OP only stress and physical fatigue are significative risk factor for injuries.

PERFORMING PART 2 OF THE FIFA11+ AFTER TRAINING REDUCES SEVERE INJURIES AND DAYS LOST TO INJURY WHILST INCREASING PLAYER DOSE EXPOSURE

WHALAN, M., LOVELL, R., STEELE, J.R., SAMPSON, J.A.
UNIVERSITY OF WOLLONGONG, WESTERN SYDNEY UNIVERSITY

INTRODUCTION: The FIFA11+ warm up has been shown to reduce injuries in sub-elite football (Thorborg et al., 2017) and high program compliance augments the injury reduction effect (Silvers-Ganelli et al., 2015). However, poor program compliance (Bizzini et al., 2015) and potential fatigue associated with Part 2 of the program (Lovell et al., 2016) suggest that strategies to optimize the delivery of the FIFA11+ are necessary. This study therefore examined the effect of re-scheduling the Part 2 of the FIFA11+ after training upon injury incidence and individual player exposure.
METHODS: 806 semi-professional Australian football players from 20 clubs were recruited during the 2017 season. Clubs were randomly allocated to either the control group (standard FIFA11+ program; 10 clubs; 398 players) or experimental group (Part 2 post training; P2post; 10 clubs; 408 players), with clubs instructed to perform the program twice a week. Coaches and trainers undertook a FIFA11+

training course and were provided with reference material. Injury and exposure data were collected by an on-site primary data collector as per the Football Consensus statement (Fuller et al, 2006). Individual player FIFA11+ dose was recorded and an independent sample T-test performed to examine any significant between group difference. A Poisson regression assessed between group differences of the total injury count, total severe injuries and total days lost to injury considering group, FIFA11+ dose, and total football exposure (hours) as predictor variables (SPSS v25, IBM, USA).
RESULTS: 651 time loss injuries were recorded during 54604 hours of exposure (training and matches combined) across both groups. Players in the P2post (29.1 ± 15.3) had a higher FIFA11+ dose exposure versus FIFA 11+ (18.9 ± 18.6; p<0.0001). Injury incidence rates of 12 injuries/1000hrs and 11.8 injuries/1000hrs were observed in the FIFA 11+ and P2post groups with no between group differences (p=0.636; Exp(B)=1.04; 95% CI, 0.88 to 1.23) observed. P2post had a lower number of severe injuries (33 vs 58 injuries; p<0.002; Exp(B)=2.03; 95% CI, 1.30 to 3.17) and total days lost to injury (4300 vs 5925 days; p<0.0001; Exp(B)=1.66; 95% CI, 1.59 to 1.73) versus FIFA 11+.
CONCLUSION: Rescheduling Part 2 of the FIFA11+ resulted in a higher individual player exposure yet a similar injury incidence was observed when compared to the normal program. However the scheduling approach yielded a reduction in severe injuries and total days lost to injury. Rescheduling Part 2 post-training may thus provide an avenue to improve FIFA11+ uptake and support, as well as enhance the effectiveness of the program.
REFERENCES:
Bizzini et al., (2015) Br J Sports Med, 49(9): 577-579.
Fuller et al., (2006) Br J Sports Med, 40(3): 193-201.
Lovell et al., (2016) J Sports Sci 34(24): 1-9.
Silvers-Granelli et al., (2015) Am J Sports Med 25(3): 315-322.
Thorborg et al., (2007) Br J of Sports Med, 51(7): 562-571.

A DESCRIPTIVE ANALYSIS OF INCITING EVENTS AND MECHANISMS OF CALF MUSCLE INJURIES IN PROFESSIONAL GERMAN FOOTBALL.

STEENDAHL, I.1,2, TRÖß, T.1, AUS DER FÜNTEN, K.1, HAUSER, T.2, MEYER, T.1

1: SAARLAND UNIVERSITY, SAARBRÜCKEN, GERMANY. 2: GERMAN FOOTBALL ASSOCIATION , FRANKFURT, GERMANY.

INTRODUCTION: Understanding both, mechanisms and the inciting events of an injury, is considered a vital part of developing appropriate injury prevention strategies (Bahr & Krosshaug, 2005). Although calf muscle injuries (CMIs) constitute 13% of all muscle injuries in professional football (Ekstrand, Hägglund & Waldén, 2011), limited research has investigated their characteristics in detail. This study therefore aims to analyse injury circumstances and general lower limb biomechanics of CMIs sustained during match play in professional German male football.
METHODS: From a database of publicly available information, where match injuries in professional German football from the 2008/09 to the 2016/17 season have been recorded, 55 non-contact CMIs were identified. Fourteen of these injuries had acute onsets visible on video material of the matches obtained through the publicly available platform Wyscout.com and were included for initial analysis.
Using a standardised analysis form modified from previous research (Waldén et al., 2015; Grassi et al., 2017), the injuries were analysed in relation to the playing situation, player and opponent behaviour as well as to the biomechanical details of player movements while sustaining the injury.
RESULTS: Preliminary results indicate that seven of the 14 CMIs (50%) occurred while the injured player performed a movement transition, either by changing direction, accelerating or decelerating. Five (35%) of them occurred when the player seemed to be either out of balance or moving in one direction whilst focusing on the match play taking place in a different direction. Four (29%) of the injuries occurred when kicking the ball and three (21%) while closing-down an opponent.
CONCLUSION: Although only a limited number of injuries (n=14) were eligible for this analysis, CMIs seem to occur in various match situations. A further refined analysis of the inciting events of CMIs may reveal whether specific situations result in the sudden combination of knee extension and ankle dorsiflexion, a movement pattern, which has been considered the main mechanism of CMIs (Green & Pizzari, 2017). Therefore, a more detailed examination of a larger sample of CMIs may yield the potential to provide valuable information for appropriate development of future prevention strategies.
References: Bahr R, Krosshaug T. (2005). BJSM, 39(6), 324-329.
Ekstrand J, Hägglund M, Waldén M. (2011). AJSM, 39(6), 1226-1232.
Grassi A, Smiley SP, di Sarsina TR, Signoreli C, Muccioli GMM, Bondi A, Romagnoli M, Agostini A, Zaffagnini S. (2017). Eur J Ortho Surg Traumatol, 27, 967-981.
Green B, Pizzari T (2017). BJSM, 0, 1-6.
Waldén M, Krosshaug T, Bjørneboe J, Andersen TE, Faul O, Hägglund M. (2015). BJSM, 49, 1452-1460.
Contact: Ida.steendahl@uni-saarland.de

YOUNG AND SENIOR INTERNATIONAL ÉLITE ATHLETES ON-FIELD COMPARISON FOR TECHNIQUE ENHANCEMENT AND INJURY PREVENTION DURING RUGBY SIDE-ON TACKLE

PAVAN, D.1, CIBIN, F.1, GUIOTTO, A.1, SPOLAOR, F.1, SGORLON, A.2, PAVANELLO, A.2, CASAGRANDE, T.2, SBROCCO, G.2, SAWACHA, Z.1

UNIVERSITY OF PADUA

INTRODUCTION: During a Rugby match, the tackle has been recognized as the task leading to the higher number of injuries [1,2]. Despite injury rate has already been correlated with athletes' age [4], literature reports no information about technique comparison between young and experienced athletes. The present study aims to investigate the international élite young and senior athletes tackling technique, to highlight differences both in technique effectiveness and ACL injury risk.
METHODS: 5 athletes from Benetton Treviso (mean ± standard deviation (SD) BMI: 29.26±4.41, age: 24.20±4.49 years), and 5 athletes from the Italian Rugby Federation U18 Academy (BMI: 28.32±2.96, age: 17.13±0.64 years) participated in the study. All the athletes take regularly part in international fixtures. Participants, after signing informed consent, performed 4 repeating tackles in the rugby field. Video sequences and plantar pressure distribution were acquired by means of a Novel Pedar system and 4 synchronized cameras (GoPro Hero3); hence peak vertical ground reaction force (PV) was recognized, and specific features were tracked on the motion sequences [5,6]. Key instants were recognized as: left foot PV (LPV), right foot PV (RPV), contact between players (C).

At key instants, sagittal plane kinematics, along with sagittal and coronal plane joint moments at hip, knee and ankle joints were determined and their position, in the tackle task, evaluated (Matlab R2013a). Moments were hence normalized in percentage of the body weight times height (%BW*h).
Tackler's centre of mass acceleration have been calculated basing on 2D trajectory reconstruction; hence peaks have been recognized in specific task sections: start-contact (SC), contact-grounding (CG), and grounding-ball retrieve (GR).
Student's indipendent T-Test has been performed to highlight differences between the two groups.
RESULTS: Senior athletes shown a significantly earlier LPV and C, along with an earlier, higher acceleration during the SC cycle ($p<0.05$). Significant difference in hip flexion at C was underlined (Senior: 108°±24°; Young: 140°±40°), along with higher ankle eversion (Senior: -5,2±3,3 %BW*h; Young: -9,1±5,5 %BW*h), knee valgus (Senior:-6,8 3,8± %BW*h; Young: -12,5±9,8 %BW*h) and hip adduction (Senior: -6,9±4,6 %BW*h; Young: -17,0±10,4 %BW*h) moments at RPV.
CONCLUSION: The more experienced athletes displayed as expected a quicker, hence more confident, execution of the tackle, while keeping the valgus torque at low values. The lack in experience affected the tackling efficiency and posture in FIR U18 athletes, exposing some of them to ACL injury risk. This screening tool can be useful to coaching and clinical staff, to improve players safety and effectiveness.
1. Roberts SP, et al, BrJSportsMed,49:536,2015
2. Fuller CW, et al, BrJSportsMed,41:862,2007
3. Hendricks S, et al, SafetyScience,50:266,2012
4. Lee AJ, et al, BrJSportsMed,30:213,1996
5. Magalhães F, et al, JSportsSc&Med,12:660,2013
6. Sawacha Z, et al, JNeuroEng&Rehab,9:63,2012

Oral presentations

OP-PM56 Physiological characteristics of trained individuals

OVERLOAD IN TENNIS TRAINING; EFFECTS ON PHYSICAL PERFORMANCE AND PHYSIOLOGICAL AND PERCEPTUAL RESPONSES.

DUFFIELD, R.1, AUBRY, A.2, SUDOUR, W.3, MORIN, J.B.3, HAUSSWIRTH, C.2,3
1: UTS , 2: MOURATOGLOU TENNIS ACADEMY , 3: UCA-LAMHESS

INTRODUCTION: Weekly tennis schedules are typically represented by variable and uncontrolled training loads (TL) during tournament phases, punctuated by spikes in TL during periods of training [1]. Such spikes in TL are reported as potential precursors to injury or overreaching states in many athletic populations [2]. Given the effects of high TL have not been reported in tennis players, the current study determined the acute physiological, perceptual and performance responses to high TL in well-trained youth tennis players.
METHODS: Eleven male, national-level, youth tennis players (age: 16+/-1y and 8+/-1y training experience) undertook 1 week of normal training (CTRL) and a week with a 30% increase in TL (HiL). The 30% higher TL was delivered by increased training duration distributed equally to on-court tennis and gym-based conditioning. TL was monitored by stroke counts from wrist-mounted accelerometers, court-based movement from Global Positioning Satellite devices and session rating of perceived exertion (sRPE). At the start and end of both CTRL and HiL weeks, physical performance measures (counter-movement jump, drop jump, change of direction and internal/external shoulder rotation force) were recorded. Further, heart rate, heat rate recovery, (Masimo oximetry) and RPE responses to a standardised 5min sub-maximal cycle test were measured. Finally, perceived muscle soreness was also collected throughout each respective training week.
RESULTS: Effect size (ES) analysis showed training volume (30+/-3%), stroke counts (32+/-3%) and sRPE TL (50+/-10%) were all increased in HiL (ES>6.0). Trivial changes (ES<0.20) in jump height, change of direction speed or shoulder rotation force measures were evident during the HiL week or compared to CTRL week. However, perceived muscle soreness was increased during HiL week compared to CTRL (ES>1.30). Moderate effects for a decrease in heart rate and heart rate recovery (ES<0.50) and increase in RPE (ES>1.0) to a standardised 5min cycle test were evident following the HiL compared to CTRL week.
CONCLUSION: A 30% increase in weekly on-court and gym TL resulted in no clear short-term change in physical performance markers in trained youth tennis players. However, increased RPE to a submaximal cycle test and perceived muscle soreness following training show responsiveness to the higher TL. Despite suggestions of the negative consequences of spikes in TL and risk of overreaching, no negative short-term consequences of a large increase in TL were evident in the current tennis cohort.
References: 1. Murphy et al. (2015) IJSPP 10(8):986-993.
2. Windt et al. (2017) BJSM 51(13):993-994.

CHANGES IN MUSCLE VOLUME, SPRINT MECHANICAL PARAMETERS AND PERFORMANCE IN SPRINTERS DURING AN INDOOR TRACK AND FIELD MACROCYCLE.

NUELL, S., ILLERA-DOMINGUEZ, V., CARMONA, G., ALOMAR, X., PADULLÉS, J.M., LLORET, M., CADEFAU, J.A.
INEFC BARCELONA

INTRODUCTION: Many factors may influence the sprint performance, although force production seems to be the most critical. It has been recently shown that the ability to orientate the resultant ground reaction force (GRF) vector forward, in other words to produce higher horizontal component of GRF throughout the sprint is the strongest predictor of acceleration and sprint performance, as well it is the differential factor between recreational and top level sprinters. Muscle mass seems the major determinant of maximal force. In addition, joint torque and power generation capabilities are largely determined by the muscle volume rather than cross sectional area. Therefore, seems logical the belief that muscle mass and more specifically muscle volume, could play an important role regarding sprint performance.
METHODS: 12 Senior and Under-23 national level sprinters (23.5 ± 4.2 y.o.) were screened during an indoor macrocycle. They were tested before they started their training regime and before the main competition. Testing procedures included Magnetic Resonance Imaging of the thighs to compute volumes of quadriceps (vQUAD), hamstrings (vHAMS) and adductors (vADD) muscle groups; a 40m dash using a

radar gun to asses sprint mechanical parameters of the sprint such as: theoretical maximal horizontal force (F0) and theoretical maximal velocity (V0); and 40m, 80m and 150m sprint performance tests using photocells.
RESULTS: vQUAD increased 6.66 ± 4.58 % (P < 0.01), vHAMS increased 10.09 ± 5.1% (P < 0.01) and vADD increased 12.14 ± 4.34% (P < 0.01). V0 increased 5.25 ± 2.35% (P < 0.001), no significant changes were seen in F0 through the macrocycle. Time to run 40m, 80m and 150m was decreased by 4.88 ± 1.72% (P<0.001), 4.38 ± 1.63% (P < 0.001) and 4.55 ± 1.84% (P < 0.001).
CONCLUSION: Improvements of sprint performance were accompanied of increases in vQUAD, vHAMS, vADD and V0 showing the importance of this parameters in sprint performance. The relative higher increase of vHAMS and vADD compared with vQUAD could explain the role of the hip extensors and hip flexors, rather than knee extensors, in sprinting due to the role of hamstrings and adductor magnus in hip extension and the rest of the adductors in hip flexion. The increase in V0 and not in F0 give us some information about the importance of the "velocity-oriented" profile in sprinters, as shown before V0 is the most determinant variable when comparing elite vs. average sprinters.
From a practical point of view we strongly believe knee-extensors exercises are overused in sprinters strength training. We also want to encourage coaches to asses sprint mechanical parameters in order to individualise the training.

PHYSIOLOGICAL CHARACTERISTICS OF FIRST DIVISION FEMALE FOOTBALL PLAYERS IN GAUTENG, SOUTH AFRICA

COOPOO, Y., WILLIAMS, K., FORTUIN, C.

UNIVERSITY OF JOHANNESBURG

INTRODUCTION: In Africa, South Africa has been among the pioneers of womens football . However, successive teams have repeatedly missed continental success at various championships over the past 15 years . This study aimed to determine the profiles of first division female football players in Gauteng with specific reference to physiological characteristics.
METHODS: The research methods included both fieldwork and questionnaires. A questionnaire was used to gather descriptive information with regard to the demographics of players and various field tests were used to describe the physiological profile of the female football players. The stratification of the sample was 12 teams, comprising 148 players who completed the full testing procedures.
RESULTS: The outcomes of the study showed that the fitness levels for all playing positions were statistically not significant, however, differentiated according to playing position. Specific training should occur for various playing positions within female football players. These are the first set of norms available for female footballers in South Africa.
CONCLUSION: it would appear that the conditioning programmes for female football players are alike.The forwards, backs, midfielders and goalkeepers are all provided with the same conditioning programme with no differentiation for playing positions.

MAXIMAL JUMPING PERFORMANCE IN THE MAASAI PEOPLE OF EAST AFRICA

BOJSEN-MØLLER, J.1,2, SEYNNES, O.R.1, MAGNUSSON, S.P.3, HERNÆS, H.1, REFSDAL, A.1, CHRISTENSEN, D.L.4, AAGAARD, P.2

1: NORWEGIAN SCHOOL OF SPORT SCIENCES , 2: UNIVERSITY OF SOUTHERN DENMARK , 3: BISPEBJERG HOSPITAL, , 4:UNIVERSITY OF COPENHAGEN

INTRODUCTION: The Maasai of East Africa have an ancestral tradition of ritual jumping during which some individuals demonstrate quite extreme jumping ability as evidenced mainly by anecdote. The aim of the present study was therefore to (1) assess vertical jumping ability in detail, (2) examine anatomical and biomechanical lower limb characteristics in order to investigate the possibility of an acquired or inherited jumping capacity in male Maasai jumpers.
METHODS: A field study was carried out in Tanzania, where 22 male Maasai jumpers (172.0 ± 5.6 cm, 58.3 ± 5.4 kg) performed maximal counter-movement jumps (CMJ) and maximal repetitive jumps (RJ) on a force plate. Twelve Scandinavian males (177.7 ± 4.5 cm, 69.3 ± 4.4 kg) served as controls (CON). Anthropometrics of the body and legs were recorded, and kinematic and kinetic data were obtained during jumping. Achilles tendon stiffness during isometric MVC as well as tendon and muscle fascicle mechanics during RJ were measured using ultrasonography.
RESULTS: The Maasai jumpers had longer legs relative to body height, shorter and more proximal calf muscles, longer (23.2 ± 0.7 vs. 19.8 ± 0.6 cm, P<0.05) and more compliant (241 ± 15 vs. 311 ± 22 N/mm, P<0.05) Achilles tendons compared to CON. Maximal vertical jump height was similar between Maasai and CON (CMJ: 46.5 ± 4.3 vs 46.5 ± 6.1 cm, RJ: 30.4 ± 6.2 vs 29.7 ± 5.0 cm, respectively), but relative to body mass the Maasai jumped 20% higher in both conditions. Maximal CMJ execution was faster in Maasai vs CON: eccentric deceleration phase (114 ± 29 vs. 172 ± 22 ms, P<0.05), concentric phase (213 ± 38 vs. 286 ± 43 ms, P<0.05) accompanied by a more shallow counter movement amplitude with 24% greater peak vertical force (29.7 ± 5.3 vs. 24.0±1.4 N), 12% higher power exertion (55.2 ± 8.3 vs. 49.2 ± 5.8 W/kg), 148% higher rate of force development (219.9 ± 199.2 vs. 88.6 ± 28.24 N/kg/s), 156% greater lower limb stiffness (246 ± 135 vs. 96 ± 26 N/m) and 13% greater vertical jump efficiency (5.1 ± 0.5 vs. 4.5 ± 0.5 cm/J/kg). In RJ the Maasai had lower self-selected frequency, and greater joint range of motion. Fascicle behavior was generally isometric during RJ in both groups however, the tendon length change was greater for the Maasai during RJ (9 ± 2 vs. 3 ± 4 % (relative to resting MTU length), P<0.05).
CONCLUSION: Although some Maasai jumpers demonstrated outstanding vertical jump performance no differences in raw jump height was seen on a group basis. Notably however, force, power, limb stiffness and vertical jump efficiency were greater in the Maasai during maximal CMJ. The Achilles tendon was longer and more compliant in the Maasai, and during repetitive jumping the elongation/shortening of the series elastic element was greater in the Maasai. The present data show that the Maasai jumpers have an explosive-type CMJ execution, and a high mechanical efficiency during both CMJ and maximal RJ which may relate to the observed differences in anatomy and mechanical properties of the series elastic element.

PHYSICAL DEMANDS OF AIRPORT FIRE BRIGADE AND ITS EFFECTS ON PERFORMANCE

KLEINÖDER, H., DÖRMANN, U., DIETZSCH, M., RAPPELT, L., WIRTZ, N., MICKE, F., DONATH, L.

GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: In general, fire brigades have high physical demands such as working with heavy equipment or carrying injured people. Moreover, airport fire fighters have to fulfil these tasks wearing up to 70 kg additional load. A warm-up is not possible due to the extreme time restrictions to reach each place at the airport in emergency. Accordingly, the final question deals with best possible preparation for this profile to save health and secure work capability. Therefore the first aim of this study was to analyze typical physical specifications of airport fire brigades and its effects on performance.

METHODS: The analysis of typical physical demands of the Cologne airport fire brigade (n=10; av. 38y, 21-54y; av. 86.6kg , 66-115kg) consisted of dummy (personal rescue) and firehose pulling with and without protective clothing. The first issue were the force requirements during these tasks (measured with a force sensor, mechatronic 5kN) and the second the loss of essential strength parameters due to fatigue and equipment. After dummy (75kg, 66 m) or firehose pulling (mass constantly increasing, 40 m) maximal force and speed strength was measured at different time intervals at a leg press machine (gym 80, edition line) with force and distance sensors (mechatronic, 10kN).
RESULTS: Time for dummy pulling was av. 69.9s (56-86s) without pre-exhaustion and without protective equipment and increased significantly to av. 84.9s (76-100s) resulting in a loss of performance of around 20% (with HF av. 152bpm, range 122-172bpm, av. lactate 7.74mmol/l, range 5.78-10,2mmol/l). Force values decreased significantly from beginning to end from 418N+-30N to 369N+-41N with an increase of amplitude (144+-32N to 165+-66N, n.s.) and a simultaneous significant decrease of frequency (7 peaks/s +-1.7 to 4.4 peaks/s +-1.5) of measured force peaks. Maximal force directly after dummy pulling decreased significantly from 2897N+-490 (pre) to 2583N+-511 and recovered after 10 min (2809N +-560). In contrast to this, RFD did not recover significantly (12191N/s +-3821 pre; 8166N/s +-2981 post; 8856N/s +-3073 post 3min; 9415N/s +- 3265 post 10min). The results of firehose pulling were generally similar with recovery of maximal force not before ten minutes but no restoring of RFD. Force values increased with length of firehose.
CONCLUSION: Since physical demands are very high on airport fire fighters it is necessary to prepare them especially for these requirements during their professional career. This esp. includes an increase of maximal force (cp. Sharky/Davis 2008) and speed strength in order to cope with these repeated demands during exercise and emergency of airport fire brigades.
Sharky J, Davis P (2008). Hard Work – Defining Physical Work Performance Requirements.

Oral presentations

OP-BN41 Neuromuscular exciatability and motor control

EFFECTS OF CONTRACTION INTENSITY ON THE RESPONSES TO BRAIN AND CORTICOSPINAL TRACT STIMULATION AFTER A SINGLE SESSION OF RESISTANCE TRAINING

COLOMER-POVEDA, D.1, ROMERO-ARENAS, S.1, LUNDBY-JENSEN, J.2, HORTOBÁGYI, T.3, MÁRQUEZ, G.1

1. CATHOLIC UNIVERSITY OF MURCIA. 2. UNIVERSITY OF COPENHAGEN. 3. UNIVERSITY OF GRONINGEN.

INTRODUCTION: A single session of resistance training (RT) increases the excitability of the corticospinal tract probably due to increases in motoneuronal or cortical neuron excitability or a higher corticospinal synapse efficacy (Nuzzo et al. 2016; Selvanayagam et al. 2011). Such acute changes may precede chronic adaptations underlying strength gains after a period of RT. To explore neural adaptations to RT, most studies used loads near maximal voluntary contraction (MVC). Yet RT at lower intensities (<60% MVC) can also improve muscle strength (Schoenfeld et al. 2017). We hypothesized that neural adaptations to a single session of RT are proportional to contraction intensity. We thus determined the effects of acute RT on the responses to brain and corticospinal tract stimulation.
METHODS: In four experimental sessions, healthy young adults (n = 14) performed 12 sets of eight isometric contractions of the elbow flexors at 0 (control), 25, 50, and 75% of MVC. Before and after the acute exercise bouts, we measured motor and cervicomedullary evoked potentials (MEPs, CMEPs) in the biceps brachii every five minutes for 30 minutes (7 blocks).
RESULTS: Mean amplitude of all MEP obtained during the 30 minutes after training increased by 70% ($P<0.05$ vs. all other conditions) after muscle contractions at 75% intensity, and by 39% after 50% intensity bout ($P<0.05$ vs. CON and 25% intensity). MEP amplitude did not change after the 25% intensity bout (11%) and CON (-5%). CMEPs amplitudes increased by 28% ($p < 0.05$) but not differently after the 25, 50, and 75% intensity bouts, while it decreased by 16% ($p < 0.05$) in CON.
CONCLUSION: According to the hypothesis, corticospinal excitability increased after single bouts of RT in proportion to the intensity of muscle contraction used in the acute bouts of RT. Our data agree with the increases reported previously for the 75% condition (Nuzzo et al. 2016). In contrast, the increases in spinal excitability, indexed by CMEPs, were independent of contraction intensity. The data tentatively suggest that motor cortical compared with spinal motoneurons may be more sensitive to intensity of muscle contraction performed during acute bouts of RT. Future studies will examine if such changes in neuronal excitability are also proportional to the larger strength gains normally observed after high compared with low intensity RT.
References: Nuzzo, J. L., Barry, B. K., Gandevia, S. C., & Taylor, J. L (2016). Med Sci Sports Exerc, 48(1), 139-150.
Selvanayagam, V. S., Riek, S., & Carroll, T. J. (2011). J Appl Physiol (1985), 111(2), 367-375.
Schoenfeld, B. J., Grgic, J., Ogborn, D., & Krieger, J. W. (2017). J Strength Cond Res, 31(12):3508-3523.
Contact: dcolomer@ucam.edu

STRONG VOLUNTARY CONTRACTION BUT NOT A WEAK ONE ENHANCES MOTOR CORTICAL EXCITABILITY

DAI, W.1, KATO, K.2, KANOSUE, K.2, ZHANG, J.3

1: WASEDA UNIVERSITY, 2: WASEDA UNIVERSITY, 3: SHANGHAI UNIVERSITY OF SPORT

INTRODUCTION: Motor learning facilitates motor cortical excitability through long-term potentiation (LTP) (Ziemann et al., 2004). However, a single session of simple muscle contraction can also enhance motor cortical excitability (Rosenkranz et al., 2007). It is not yet clear whether mechanisms underlying the two phenomena are the same. This research explores whether changes in cortical excitability after a single session of simple muscle contraction are related to changes in LTP produced by paired associative stimulation (PAS).
METHODS: Eight healthy subjects were asked to perform two types of rapid voluntary thumb contraction 90 times at 0.2Hz. In the "comfortable" task, the subjects were only required to complete thumb flexion as quickly as possible, whereas in the "strong" task the subjects were required to complete a similar movement, but at 65% to 85% of the force level for a maximum voluntary contraction. The LTP induced with PAS involved the same numbers and frequency as with the contraction tasks. Motor cortical excitability was measured with a motor-evoked potential (MEP) using transcranial magnetic stimulation. We utilized a "1 mV MEP" intensity for each subject as the baseline and stimulated with the same intensity at 0, 5, 10, 15, 20, 25, 30, 45, and 60 min after intervention (the contraction tasks or PAS).
RESULTS: The average contraction level for the "comfortable" task was significantly lower than that of the "strong" task. For the "comfortable" task, MEP amplitude gradually decreased with time and was significantly lower than baseline at 25, 45 and 60 min. In contrast, MEP amplitude gradually increased and was significantly greater than baseline in the period of 15-25 min for the "strong" task. The MEP amplitude after PAS exhibited a facilitation with a time course similar to that of the "strong" task.

CONCLUSION: Over the one-hour MEP observation, thumb contractions at the two strengths produced opposite results, probably due to a difference in the degree of concentration during the tasks. In the "comfortable" task, the subjects did not need to control contraction strength. However, in the "strong" task they were required to perform rapid contraction and simultaneously control force level. This would require a greater level of concentration.
REFERENCES:
Ziemann, U. et al. (2004), J. Neurosci., 24, 1666.
Rosenkranz, K. et al. (2007) J. Neurosci., 27, 12058.

PRECONDITIONING TDCS FACILITATES EFFECTS OF SUBSEQUENT TDCS APPLIED DURING CYCLING EXERCISE ON CORTICOSPINAL EXCITABILITY AND WORKING MEMORY IN YOUNG ADULTS

SIDHU, S.K., POURMAJIDIAN, M.

THE UNIVERSITY OF ADELAIDE

INTRODUCTION: Transcranial direct current stimulation (tDCS), a non-invasive neuromodulation technique, can be used to deliver continuous low intensity electrical currents, causing significant modulation in cortical excitability that mimic long-term potentiation (LTP) and long-term depression-like synaptic processes in humans (2). A recent study using tDCS reveal that priming the corticospinal system by lowering the threshold using cathodal-tDCS (ctDCS) for the induction of LTP-like plasticity during subsequent skill learning, augments corticospinal excitability and improves motor skill performance (1). However, the effect of priming ctDCS and subsequent anodal-tDCS (atDCS) coupled with cycling exercise on corticospinal excitability and working memory in young healthy individuals remain unknown.
METHODS: 11 subjects (21 ± 1 years) participated in two sessions receiving either priming cathodal-tDCS or sham stimulation, followed by anodal-tDCS (ctDCS-atDCS, sham-atDCS) while cycling at 1.2 times body weight (84 ± 20 W) in a counterbalanced double-blind design. Corticospinal excitability was measured with motor evoked potentials (MEP) elicited via transcranial magnetic stimulation intensity set to produce an MEP amplitude of 1 mV (S1mV) in a resting hand muscle. Executive cognitive function was measured using percentage correct (PC; %) and reaction time (RT; ms) in a 2-back short-term memory test. Both corticospinal excitability and cognitive function were measured at baseline (PRE), following priming tDCS (POST-PRIMING) and post atDCS combined with cycling exercise (POST-TEST).
RESULTS: There was no difference in RMT (sham-atDCS: 42 ± 1.7, ctDCS-atDCS: 41 ± 1.6) and S1mV (sham-atDCS: 53 ± 2.5, ctDCS-atDCS: 51 ±2.4) between sessions (P>0.5). There was a significant interaction between time and intervention ($P < 0.01$) and significant main effect of time ($P < 0.01$) and intervention ($P < 0.001$) on MEP. MEP increased at POST-TEST (1.3 ± 0.06) from PRE (1.0 ± 0.06) during ctDCS-atDCS ($P < 0.001$) but did not change across time during sham-atDCS (1.0 ± 0.06, $P > 0.7$). Furthermore, MEP was higher at both POST-PRIMING (sham-atDCS: 1 ± 0.06, ctDCS-atDCS: 1.1 ± 0.06) and POST-TEST (sham-atDCS: 1 ±0.06, ctDCS-atDCS: 1.3 ±0.06) in ctDCS-atDCS compared to sham-atDCS ($P < 0.01$). There was no interaction effect on PC ($F2, 147 = 1.7$, $P > 0.1$) and RT ($F2, 146 = 0.3$, $P > 0.7$), and no main effect of time ($F2, 128 > 2$, $P > 0.06$) on PC and RT. There was however, a main effect of intervention on RT ($F1, 52 = 9$, $P < 0.01$). RT at POST-TEST was shorter in ctDCS-atDCS (530.6 ± 27.3; $P < 0.01$), compared to sham-atDCS (597.7 ± 27.3).
CONCLUSION: The results demonstrate that priming cathodal tDCS can enhance corticospinal excitability and improve some domains of executive function following anodal tDCS applied in combination with cycling exercise. The outcomes suggest that priming tDCS protocols may potentially be used in sporting, clinical and defence settings to improve exercise tolerance and cognitive function.

ACUTE EFFECTS OF STATIC AND DYNAMIC STRETCHING ON SPINAL AND CORTICOSPINAL EXCITABILITY OF PLANTAR FLEXOR MUSCLES

OPPLERT, J., PAIZIS, C., PAPITSA, A., BABAULT, N.

INSERM UMR1093 CAPS

INTRODUCTION: The aim of the present study was to determine the acute effects of static and dynamic stretching on spinal and corticospinal excitability.
METHODS: On separate days, fifteen males completed three testing sessions on an isokinetic dynamometer. A control condition (CON), 5×20-s of static stretching (SS) and 5×20-s of dynamic stretching (DS) were randomly completed. Neurostimulation was firstly applied to investigate spinal excitability by using the Hoffmann reflex (Hmax/Mmax). Transcranial magnetic stimulation was secondly applied to investigate corticospinal excitability by recording the amplitude of the motor-evoked potential (MEP/Mmax) and the duration of the silent period (SP). These different responses were obtained during submaximal isometric contractions. Finally, neuromuscular properties were assessed using (i) the amplitude of the maximal M-wave (Mmax) and the corresponding peak twitch torque (PTT), (ii) the maximal voluntary isometric torque (MVIT) and the corresponding electromyographic activity (RMS values), and (iii) the V-wave (V/Mmax) elicited from a supramaximal stimulation during the maximal voluntary isometric contraction. These parameters were recorded before and immediately after each condition in the soleus (SOL), gastrocnemius medialis (GM) and gastrocnemius lateralis (GL) muscles.
RESULTS: Given that similar results were obtained for all triceps surae (TS) muscles, values from SOL, GM and GL were averaged. Statistical analyzes revealed an increase in MEP amplitude after SS and DS conditions (+30.2 ± 8.3% and +19.3 ± 9.5%, respectively; $P<0.05$) and no change was recorded after CON condition. Similarly, MEP/Mmax ratio was enhanced after SS and DS conditions (+30.9 ± 7.8% and +18.3 ± 7.7%, respectively; $P<0.05$) and was unaffected by the CON condition. No difference was obtained between SS and DS conditions for MEP amplitude and MEP/Mmax ratio. Hmax, Mmax and V-wave amplitude, Hmax/Mmax and V/Mmax ratios and the SP duration were unchanged. RMS/Mmax was significantly decreased after the DS condition (-16.7 ± 4.3%; $P<0.05$) but did not change after CON and SS conditions. Finally, PTT and MVIT were unaffected after all conditions.
CONCLUSION: As previously demonstrated, Hmax/Mmax and V/Mmax ratios were not modified after stretching. While spinal excitability was not altered after static and dynamic stretching, corticospinal excitability did increase, suggesting that neural modulations originated at a cortical level. This could be explained by a larger amount of sensory information to the brain from musculotendinous lengthening. Finally, neuromuscular properties were not affected after both stretching modalities. Nevertheless, such duration of dynamic stretching seems to induce fatigue which may alter central activation of motor unit of triceps surae.

EFFECTS OF AN EIGHT-WEEK DYNAMIC WHOLE-BODY ELECTROMYOSTIMULATION TRAINING ON STRENGTH AND POWER PARAMETERS OF THE LEG MUSCLES: A RANDOMIZED CONTROLLED STUDY.

MICKE, F., KLEINÖDER, H., DÖRMANN, U., WIRTZ, N., DONATH, L.

GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: Whole-body electromyostimulation (WB-EMS) training is increasingly gaining importance in competitive sports. Despite a heterogeneous use of WB-EMS-specific stimulation patterns, a stimulation frequency of ≥60 Hz, a pulse width of 200-400 µs and a duty cycle of 50 % are recommended for improving strength and power parameters (Filipovic et al. 2012). However, in the context of WB-EMS, intervention studies have rarely been conducted so far. Therefore, the present study examined effects of dynamic WB-EMS training on maximal strength and power parameters of the leg muscles.
METHODS: Eighteen male sports students were randomly assigned to a WB-EMS intervention (INT; n=9; age: 22.8 ± 3.0 years; height: 179.4 ± 5.1 cm; body mass: 80.2 ± 6.6 kg; strength training experience: 4.6 ± 2.8 years) or traditional intervention (CON; n=9; age: 22.8 ± 2.5 years; height: 184.9 ± 9.1 cm; body mass: 77.6 ± 9.0 kg; strength training experience: 4.5 ± 2.9 years) group. Both training intervention programs had to be performed 2 times a week over a period of 8 weeks (adherence: INT & CON: 100%) with the only difference that INT performed all dynamic exercises (e.g. split squads, glute-ham raises, jumps, tappings) with superimposed WB-EMS. WB-EMS intensity was adjusted to 70% of individual pain threshold (RPE scale) to ensure dynamic movement. Before (PRE), after (POST) and two weeks after the intervention (FU), performance was assessed by maximal strength (Fmax) and maximal power (Pmax) tests on the leg extension (LE), leg curl (LC) and leg press (LP) machine. Additionally, squat jumps (SJ), counter movement jumps (CMJ), drop jumps (DJ), standing long jumps (SLJ), 30m linear sprint and 3x10m shuttle run tests were conducted as secondary endpoints.
RESULTS: Large within-group analysis showed significant improvements in all strength and power parameters (INT&CON: LE Fmax +5.0% , LC Fmax +5.1%, LP Fmax +17.9%, LE Pmax +12.8%, LC Pmax +13.5%, LP Pmax +7.8%; $p<0.05$; $0.13<\eta p^2<0.46$). A time x group interaction effect was merely observed for Fmax on the leg curl machine ($p=0.4$; $\eta p^2=0.18$) where post-hoc comparisons indicated higher improvements in the INT group from PRE to FU (INT: +9.1%, $p<0.01$; CON: +1.2%).
CONCLUSION: The findings of this study indicate that the combination of dynamic exercises and superimposed submaximal WB-EMS seems to be effective in order to improve leg strength and power, especially in hamstring muscles compared with dynamic training without WB-EMS. These EMS-specific improvements are relevant, because the knee flexor muscles play an important performance-determining role, not only in team and sprint sports with a high prevalence of hamstring injuries.
REFERENCES:
Filipovic, A., Kleinöder, H., Dörmann, U. & Mester, J. (2012). Electromyostimulation - A systematic review of the effects of different Electromyostimulation methods on selectet strength parameters in trained and elite athletes. Journal of Strength and Conditioning Research, 26 (9), 2600–2614.

EXPLORING POWER-ATHLETE CIRCUITRY THROUGH TRANSCRANIAL AND PERIPHERAL STIMULATIONS

GROSPRETRE, S., MARTIN, A.

C3S - EA4660, INSERM U1093

INTRODUCTION: Extensively practicing the same activity during several years does not shape only the muscular system (e.g. muscle mass) but also the nervous networks, from the brain to the spinal cord. Particularly, power-type athletes are known to have lower spinal excitability of the lower limb than non-trained participants (1). However, several parameters remain unknown regarding the modulation of cortico-spinal networks with the practice of a power-type activity. The aim of the present study was to analyze cortico-spinal and spinal excitabilities of several muscles of the upper and lower limb. These responses were compared between a group of non-trained individuals and a group of particularly powered athletes (2) who practice Parkour, a modern physical activity that consists of jumping over obstacles in an urban landscape.
METHODS: A group of 10 non-trained participants (NT group; age: 24.5 ± 2 years old) and a group of 10 Parkour athletes (PK group; age: 23.4 ± 3.4 years old) were involved in the experiments. Transcranial magnetic stimulation was used to evoke motor evoked potentials (MEP) and peripheral stimulations to evoke H-reflexes and M-waves of the soleus (SOL) and flexor carpi radialis (FCR). Spinal and cortico-spinal responses were normalized by the maximal M-wave of the corresponding muscle (MEP/Mmax and H/Mmax). SOL and FCR MEP/H ratios were compared to measure the relative contribution of spinal and cortico-spinal modulations (3).
RESULTS: FCR MEP/Mmax was statistically ($p=0.04$) greater in PK (0.12 ± 0.1) than in NT (0.05 ± 0.05). FCR H/Mmax, 0.20 ± 0.1 in PK and 0.28 ± 0.2 in NT, were not statistically different (P=0.07). Opposite statistical trends were observed in SOL muscle: H/Mmax was statistically lower (P=0.02) in PK (0.32 ± 0.1) than in NT (0.41 ± 0.1) while MEP/Mmax, 0.07 ± 0.04 for PK and 0.05 ± 0.03 for NT, was not statistically different among groups (P=0.11). MEP/H was statistically lower in NT (0.20) than in PK (0.60) for both muscles.
CONCLUSION: Overall, greater cortical excitability and lower spinal excitability are observed in power athletes. Both are not similarly balanced between upper and lower limbs but lead to the same MEP/H ratio among muscles. The present study raised that the reduction of spinal excitability in such power athletes is counterbalanced by an increase of cortico-spinal excitability.
References: 1) Maffiuletti NA, Martin A, et al. Electrical and mechanical H(max)-to-M(max) ratio in power- and endurance-trained athletes. J Appl Physiol. 2001;90(1):3-9.
2) Grosprêtre S, Lepers R. Performance characteristics of Parkour practitioners: Who are the traceurs? Eur J Sport Sci. 2015:1-10.
3) Duclay et al. (2014) Specific modulation of spinal and cortical excitabilities during lengthening and shortening submaximal and maximal contractions in plantar flexor muscles. J Appl Physiol 117: 1440–1450

Oral presentations

OP-SH02 Mental and Physical Health

"YOU'RE TRYING TO BE HONEST BUT YOU'RE NEVER TRYING TO BE AT A DISADVANTAGE": QUALITATIVE EXPLORATION OF ATHLETE SELF-REPORT MEASURES IN ELITE GAELIC GAMES.

DUIGNAN, C.1,2, SLEVIN, P.1,2, CAULFIELD, B.1,2

1. INSIGHT CENTRE FOR DATA ANALYTICS, UNIVERSITY COLLEGE DUBLIN; 2. UCD SCHOOL OF PUBLIC HEALTH, PHYSIOTHERAPY & SPORTS SCIENCE

INTRODUCTION: Gaelic games are the national sports of Ireland, described as high intensity, multidirectional contact field games which require speed, strength and skill. Although amateur games, it has been recognized that the level of commitment shown in terms of the number of hours of training suggests a professional attitude to the game at the elite inter-county level (Cromwell et al., 2000).
Athlete self-report measures (ASRM) reflect changes in athlete well-being and provide a practical method for athlete monitoring (Saw et al., 2016). Short customised and commercial measures have been adopted in practice by many in elite Gaelic games; favoured by coaches for the reduced burden on athletes and the ease of use. However, insights regarding player's perceptions of using ASRM in elite Gaelic games is yet unknown.
METHODS: Semi-structured interviews were conducted with a cohort of elite Gaelic games players (n=10) to understand their perceptions of using ASRM. Interviews were audio recorded and transcribed verbatim. Data was inductively coded and a thematic analysis was applied.
RESULTS: For the purposes of this paper, the results focus on the factors influencing the integrity of the self-report data entered by players. Four sub-themes emerged from thematic analysis: (1) system factors; (2) reporting non-physical stressors; (3) apathy; (4) response distortion.
CONCLUSION: This study found four factors which influence the integrity of self-reported data from elite Gaelic games players. Insights relating to system factors and apathy were similar to those described by Saw et al (2015). However, the practice of response distortion was highly evident in the reporting of physical stressors by players. Distortion was influenced by the belief that appearing favourably would provide a competitive advantage in an elite team environment and raises the question of the reliability of these systems particularly in the lead up to team selection in Gaelic games. Another interesting concern is player's perceptions of the relative importance of reporting non-physical stressors to their management teams. This opens the discussion regarding team management's ability to appropriately address and react to measures of wellness outside the sports specific context.
References: Cromwell, F., Walsh, J. and Gormley, J. (2000) A pilot study examining injuries in elite gaelic footballers, Br J Sports Med, 34(2), pp. 104-108.
Saw, A. E., Main, L. C. and Gastin, P. B. (2016) Monitoring the athlete training response: subjective self-reported measures trump commonly used objective measures: a systematic review, Br J Sports Med, 50(5), pp. 281-291.
Saw, A. E., Main, L. C. and Gastin, P. B. (2015) 'Monitoring athletes through self-report: Factors influencing implementation', Journal of Sports Science and Medicine, 14, pp. 137-146.
Contact:
ciara.duignan@insight-centre.org

SPORTS COACHES' MENTAL HEALTH LITERACY AND ROLE PERCEPTIONS FOR SUPPORTING YOUNG PEOPLE'S MENTAL HEALTH

MATTHEWS, J., DUFFY, J., ROONEY, B.

UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: Sports coaches are in a prominent position to support young people and their mental health. However, sport coaches' knowledge of mental ill-health and the way in which they perceive their roles as coaches are likely to be key influences on such helping behaviour. Therefore, the purpose of this study was to examine how coaches' mental health literacy and their role-related perceptions effect their engagement in promotion, prevention, and early intervention behaviours with young people in the sporting environment.
METHODS: A cross-sectional design was employed. A sample of 296 Gaelic Football coaches (Mean age = 41.97; SD = 9.78; 14% female) were recruited and completed an online survey. Participants completed measures of: depression literacy, two types of role perception (i.e., role breadth and role efficacy) and engagement in prevention, promotion and early intervention behaviours.
RESULTS: Sports coaches' knowledge of the signs and symptoms of depression was moderate, reported at 55.2% (M = 12.15/22; SD =3.90). Path analyses demonstrated that depression literacy did not significantly predict helping behaviours. However, depression literacy did significantly predict role breadth for each of the helping behaviours (promotion: $p < 0.01$; prevention: $p < 0.01$; early intervention: $p < 0.01$) and role efficacy for prevention ($p < 0.05$) and early intervention ($p < 0.05$). In turn, role breadth and role efficacy both significantly predicted each of the helping behaviours.
CONCLUSION: This study revealed that role perceptions are influential in predicting coaches' involvement in supporting young people's mental health through promotion, prevention, and early intervention behaviours. Mental health literacy appears to strengthen coaches' beliefs and efficacy for these helping behaviours. Assisting coaches to engage in these helping behaviours, by developing their competence and clearly aligning these behaviours to the coaching role, may help reduce the burden of mental health problems among young people in Ireland.
Contact:
James Matthews [james.matthews@ucd.ie]

HEALTH BEHAVIOURS OF POLISH AND CZECH AMATEUR LONG-DISTANCE RUNNERS

NOWAK, P.F.

OPOLE UNIVERSITY OF TECHNOLOGY

Organizing mass street running competitions is fashionable in Central and Eastern Europe and is still developing in the last decade. Especially in Poland, an increase in the number of organized competitions (marathons and other running events at different distances) is

being noted in recent years. The idea of these events is popularizing running as pro-health form of exercise for everyone and promoting a healthy lifestyle.
Determining the level of health behaviours of runners from Poland and Czechia was the aim of this study – in the context of their age, gender, training experience, a frequency of starting in running competitions and training load (number of trainings and number of kilometres running weekly).
The study included 765 amateur runners from Poland and 111 from Czechia, who have been training regularly at least for a year and have been participating in running events. The standardized research tool – Z. Juczyńskis adaptation of the Health Behaviour Inventory, was used to evaluate health behaviours of runners. In addition to the general indicator of health behaviours also four categories of behaviour were calculated to the test procedure: Proper Nutrition Habits, Prophylactic Behaviours, Positive Psychological Attitudes (PPA) and Health Practices (HP).
Researched runners from Czechia are characterized by a much longer training experience than Polish runners, but they train less than Poles (on average, run fewer kilometres during a week). As many as 48.6% of Czech runners received a low level of health behaviours (29,2% of Polish runners) and only 15,3% received high level (runners from Poland – 27%).
Runners from Poland obtained the slightly higher level of the general indicator of health behaviours than runners from Czechia. In the case of such categories of health behaviours as PPA and HP, Poles also obtained a higher level of indicators, statistically significant.
Gender is not a factor differentiating runners statistically significant – in context of the general indicator of the level of health behaviours. The number of kilometres covered each week, an average number of trainings a week and age positively correlate with health behaviours in the group of Polish runners. But in the group of Czech runners a statistically significant correlation was calculated only between indicator of health behaviours and number of kilometres running per week.
The organizers of running competitions should focus more on health education and popularize healthy lifestyle. It would be worth to examine what kind of values that organizers of sports and recreational events really popularize – if training experience and frequency of starting in running competitions do not affect the growth of healthy behaviours.

ASSOCIATIONS BETWEEN PHYSICAL ACTIVITY, SEDENTARY BEHAVIOR, DEPRESSION TENDENCY, AND SENSE OF COHERENCE IN EARLY ADOLESCENTS

SAKI, K.1,2, KOKUDO, S.1, KASANAMI, R.3, NAGANO, M.4, ISHII, K.5

1 KOBE UNIVERSITY,2 JSPS RESEARCH FELLOW ,3 NARA UNIVERSITY OF EDUCATION,4 FUKUOKA WOMENS UNIVERSITY,5 DOSHISHA UNIVERSITY

INTRODUCTION: To date, the appropriate intensities, amount and details of physical activity (PA) and sedentary behaviour for mental health remain partially elucidated for adolescents.This study aims to assess the structure of PA [intensity, time and activity details (ADs)]; sedentary behaviour (SB); depression tendency and sense of coherence (SOC) among early adolescents.
METHODS: We conducted a questionnaire survey with the International Physical Activity Questionnaire, including ADs, Birleson Depression Self-Rating Scale (DSRS) and Sense of Coherence Scale (SOC-13) for children, among 6481 adolescents (grades 5-8) in Japan. We log-transformed PA time/week, including vigorous intensity physical activity (VPA), moderate intensity physical activity (MPA) and walking (Walk), as well as sedentary behaviour on the weekdays (SBwd) and weekend (SBwe) for analysis. According to the characteristics of ADs and the degree of effect on the DSRS and SOC-13 factors, the classification of ADs was ranked in nine levels. We applied categorical exploratory factor analysis (categorical EFA; weighted least square mean and variance (WLSMV) estimation; oblimin rotation) to extract factors of both the DSRS and SOC-13. Furthermore, we performed structural equation modelling based on the correlation coefficients in the DSRS factors, SOC-13 factors, PA and SB variables.
RESULTS: We created a model comprising PA variables and four factors extracted by the EFA, including decline in activity and enjoyment (FDAE) and depression mood (FDM) from the DSRS and comprehensibility & manageability (FCO-MA) and meaningfulness (FME) from the SOC-13, based on the hypothesis that PA affects the four factors respectively. Considering the order of time, the path from the two DSRS factors to both the SOC factors was subtracted, respectively. Our model fitted the data significantly [χ 2(489), 5766.7; CFI, 0.902; RMSEA, 0.041]. In addition, the FDAE, FDM, FCO-MA and FME were mutually dependent, as expected. Although the estimates revealed a significant correlation, it was small in size as follows. ADs (-0.107), VPA (-0.093), MPA (-0.042), Walk (-0.089), SBwd (-0.036) and SBwe (0.072) affected the FDAE. In addition, ADs (-0.065), VPA (-0.039), SBwd (-0.056) and SBwe (0.085) affected the FDM. While ADs (-0.038) affected only the FME, ADs (-0.030) and SBwe (-0.040) affected the FCO-MA. Both the SOC factors were significantly affected by PA and SB mediate by the DSRS factors as follows: FDAE to FME (-0.729), FDM to FCO-MA (-0.673).
CONCLUSION: This study suggests that ADs, VPA and SBwe affect the FDAE in the early adolescence. In contrast, SBwe affects the FDM rather than PA. Furthermore, the SOC factors are affected by the mediation of the DSRS factors.
Birleson, P. (1981) The validity of depression disorders in childhood and the development of a self-rating scale: A research report, Journal of Child Psychology and Psychiatry and Allied Disciplines, 22(1), 73-88
This work was supported by KAKENHI 15H03108, 17J02587.

DRUG AND ALCOHOL USE AMONG CANADIAN RECREATIONAL SKIING AND SNOWBOARDING YOUTH

RUSSELL, K., SELCI, E., GOULET, C., MORRONGIELLO, B.

UNIVERSITY OF MANITOBA

Background: Skiing and snowboarding are popular activities among Canadian youth and are often done in the absence of parental supervision. While alcohol and drugs are suspected to contribute to injury risk among skiers and snowboarders, the prevalence and risk factors for drug and alcohol use among youth while skiing and snowboarding is unknown.
Methods: Using focus group methodology, a questionnaire examining high-risk behaviors while skiing and snowboarding was developed and rooted within the Theory of Planned Behavior. The questionnaire was assessed for validity and reliability. The questionnaire was administered to youth aged 14-18 during two winter seasons at a ski hill in Manitoba, Canada. No identifying data were collected. Logistic regression was used to determine factors that increased or decreased the use of drugs or alcohol while skiing or snowboarding.
Results: Overall, 735 youth completed the questionnaire. The mean age was 14.9 years , 82.1% were male, 83.0% were snowboarding that day, 11.5% self-identified as beginners, 40.2% as intermediate, 33.8% as advanced, and 14.6% as experts. The majority of youth were wearing a helmet <88.1%>. There were 101 <13.8%> youth who reported using drugs that day, 7.0% reported drinking alcohol, and 5.7% reported using both drug and alcohol. The most commonly used drugs were marijuana , amphetamines , and cocaine . Risk factors for drug or alcohol use were male , snowboarding instead of skiing , friends using drugs or alcohol when skiing or snowboarding , or sib-

lings using drugs or alcohol when skiing or snowboarding . Wearing a helmet and believing that using drugs or alcohol while skiing and snowboarding put their life at risk protected against drugs or alcohol use. Age or ability did not predict drug or alcohol use.
Conclusions: A notable proportion of skiing and snowboarding youth do so under the influence of drugs or alcohol. Prevention programs not only need to target the youth but also their friends and siblings. Promoting other safety behaviors like helmet use may also decrease drug and alcohol use.

PREVALENCE OF EATING DISORDERS AND RISK FACTORS IN THE SPORT ENVIRONMENT

TEIXIDOR-BATLLE, C., VENTURA VALL-LLOVERA, C., ANDRÉS, A.

GRUP DINVESTIGACIÓ SOCIAL I EDUCATIVA DE LACTIVITAT FÍSICA I LESPORT , INSTITUT NACIONAL DEDUCACIO FÍSICA DE CATALUNYA , UNIVERSITAT DE BARCELONA

INTRODUCTION: Due to the seriousness of eating disorders, and their frequent appearance in sports, it is important to examine and understand why athletes seems to be more at risk compared to non-athletes (Chapman & Woodman, 2015), and If there are agents that might explain the development of eating disorders (ED). Although physical activity provides great health benefits, when taken to an extreme, exercise can be a maladaptive behaviour associated with physical and psychological risks. Among the sport-specific weight pressures related with ED development, coach concerns about weight or strength, comments by coaches or teammates, revealing uniforms or performance expectations could contribute to body image disturbances. The aim of the present study was to examine the prevalence of ED symptomatology and risk factors for its development in elite athletes.
METHODS: Participants are 686 athletes, 332 male [Mage= 16.96; SD= 4.74] and 354 female [Mage= 16.29; SD= 4.15], competing in 34 different sports from Catalonia, Spain. Subjects were recruited from four sources: the Center of Training and High Performance (CEARE), the Sports Program for Catalonia (Pla de Tecnificació Esportiva), the Center of High Performance (CAR) or clubs playing in top-level competition. They were asked to complete an online self-reported questionnaire containing several sociodemographic items, the Weight Pressures in Sport (WPS) for Male or Female athletes' version and the Eating Attitudes Test (EAT-26).
RESULTS: Results from this study describe the prevalence of EDs among male and female athletes. A description of male and female weight pressure scores, such as coaches, peers, and team uniform, are described and compared between different sport groups. Moreover, the relationship between the sport-related weight pressures and disordered eating behaviours are examined in order to evaluate risk factors within the sport environment.
CONCLUSION: The present study findings are in the line of identifying possible sources of weight pressure within the sports setting as to prevent the vulnerability of developing a further eating disorder. These results must be considered in the designing of an educational program aiming to educate sport professionals and to prevent and cope body image and body weight pressures in athletes.

Oral presentations

OP-SH20 Applications of self determination theory to sport and exercise

PERCEIVED DISEMPOWERING COACH-CREATED MOTIVATIONAL CLIMATE AND PERCEIVED EXERTION OF YOUNG FOOTBALL PLAYERS: THE MEDIATOR ROLE OF THE MALADAPTIVE INDIVIDUAL PSYCHOLOGICAL VARIABLES

PÉREZ-XIMÉNEZ, M.1, PARDO, A.1, TOMÁS, I.1, XIMÉNEZ-DE-EMBÚN, D.P.2, BALAGUER, I.1

UNIVERSITY OF VALENCIA <1>; UNIVERSITY OF ZARAGOZA <2>

INTRODUCTION: Based on the theoretical frameworks of Self-determination theory (Ryan & Deci, 2017) and Achievement Goals Theory (Ames, 1992; Nichols, 1989) the objective of this work is to analyse the mediation role of maladaptive individual psychological variables (external regulation, amotivation, and physical-emotional exhaustion) in the relationship between disempowering dimensions of coach-created motivational climate (controlling interpersonal style and ego-involving climate) and perceived exertion in young football players' legs when completing interval running training tasks.
METHODS: The participants were 77 male young football players (M = 15.17 years old; SD = 0.53), belonging to four different teams, with a relatively large competitive experience for their age (M = 6.39; SD = 2.04) and practising three or four times per week apart from the official game during the weekend.
Regarding the psychological variables, players completed the Spanish versions of a questionnaire package tapping the variables of interest. With respect to perceived exertion, players' RPE-legs was recorded in interval running training tasks at different intensity: aerobic capacity (A-Cap; 75%-84% HR) and aerobic power (A-Pow; 86%-92% HR). Players of the total sample who met the established criteria to be included in further statistical analysis for A-Cap and A-Pow running trainings were 36 and 30, respectively.
RESULTS: It was found that maladaptive individual psychological variables had a mediational role in A-Pow interval running training in the following four mediational models: (1) Controlling style – Amotivation – RPE (IE=.32; CI Bootstrap 95% [.01 to .77]); (2) Ego-involving climate – External regulation – RPE (IE=.38; CI Bootstrap 95% [.02 to 1.05]); (3) Controlling style – Exhaustion– RPE (IE=.54; CI Bootstrap 95% [.09 to 1.03]); (4) Ego-involving climate – Exhaustion – RPE (IE=.43; CI Bootstrap 95% [.06 to 1.09]).
CONCLUSION: The disempowering dimensions of coach-created motivational climate (controlling interpersonal style and ego-involving climate) lead to maladaptive individual psychological responses in young footballers (including lack of motivation, increment of external regulation and physical-emotional exhaustion). This causes a maladaptive response, with a rising perceived exertion in young football players' legs when completing interval training at aerobic power intensity (86%-92% HR).
REFERENCES:
1. Ames, C. (1992). Achievement goals, motivational climate, and motivational processes. In G. C. Roberts (Ed.), Motivation in sport and exercise (pp. 161–176). Champaign, IL: Human Kinetics.
2. Nicholls, J. G. (1989). The Competitive Ethos and Democratic Education. Cambridge, MA: Harvard University Press. Retrieved from http://www.hup.harvard.edu/catalog.php?isbn=9780674154179
3. Ryan, R. M., & Deci, E. L. (2017). Self-Determination Theory. Basic Psychological Needs in Motivation, Development, and Wellness. Guilford Publishing.

INTRAPERSONAL GOALS, UNDERLYING REASONS AND EMOTIONAL WELL-BEING AMONG PARKRUNNERS: A PROSPECTIVE DESIGN

MULVENNA, M., ADIE, J.W., SAGE, L.

COVENTRY UNIVERSITY

INTRODUCTION: Integrating tenets of self-determination theory and the hierarchical model of achievement motivation (see Delrue et al., 2016; Vansteenkiste et al., 2014), the current study tested a temporal sequence of hypothesized relationships between intrapersonal goals and their underlying reasons > stress appraisals > emotional well-being among parkrunners. The mediational role of stress appraisals in the hypothesized model was also ascertained.
METHODS: Following ethical approval, 176 male and female runners (Mage=45.02; SD=10.76 years) responded to a series of online questionnaires 5 days prior to (T1), 24 hours before (T2) and immediately following (T3), a parkrun event in the UK. Data were collected for intrapersonal (i.e., self-approach/-avoidance) goals and their underlying (i.e., autonomous/controlling) reasons at T1, pre-parkrun challenge and threat appraisals were then captured at T2, and emotional well-being (indexed by pride) was measured at T3.
RESULTS: Multiple regression analyses confirmed autonomous reasons for intrapersonal goal adoption positively predicted self-approach and –avoidance goals. In turn, self-approach goals were positively associated with challenge appraisals. Additionally, autonomous reasons underlying self-approach goals and challenge appraisals both positively related to pride. Finally, self-avoidance goal adoption for controlling reasons was positively related to threat appraisals. Intrapersonal goal adoption and their underlying autonomous reasons were indirectly associated with pride via challenge appraisals.
CONCLUSION: The findings suggest the value of runners adopting self-approach goals for autonomous reasons if they are to view parkrun as a challenge and experience positive emotions. Further analyses aims to examine potential goal complexes (see Elliot, 1999) in moderating the prediction of intrapersonal goals on stress appraisals and subsequent emotional well-being among parkrun participants.

FEASIBILITY OF TRAINING EXERCISE CLASS INSTRUCTORS TO ADOPT A MOTIVATIONALLY SUPPORTIVE COMMUNICATION STYLE

NTOUMANIS, N.

CURTIN UNIVERSITY

This study examined the feasibility of a 10-week self-determination theory-based training programme delivered to 24 group exercise instructors. Feasibility of implementing the programme was explored in terms of 1> recruitment, 2> rates of adherence and retention, and 3> acceptability. Results revealed modest uptake <51%> and excellent workshop attendance and retention rates <96%>. Coding of the interview data revealed 9 main themes with regard to the acceptability of the training programme: satisfaction with content, challenging current motivational practices, perceived relevance of the motivational strategies, social support, mix of theory and practice, usefulness of learning resources, need-supportive delivery, multi-stage structure, and value for professional development. The findings can inform the development, design, and implementation of future research with the target population.

EXAMINING DECISION-MAKING AND CRITICAL THINKING IN A PHYSICAL-ACTIVITY-BASED POSITIVE YOUTH DEVELOPMENT PROGRAM FOR YOUTH FROM LOW-INCOME FAMILIES

KNISEL, E.1, MCDONOUGH, M.H.2, RUIZ, Y.3, SNYDER, F.J.4, MCDAVID, M.L.3

1: UNIVERSITY OF MAGDEBURG , 2: UNIVERSITY OF CALGARY , 3: PURDUE UNIVERSITY , 4: CENTRAL MICHIGAN UNIVERSITY

Introduction: The purpose of study was to analyze the associations between autonomy support from program staff and decision making and critical thinking among participants in a physical activity-based program for low-income youth. Additionally, demographic variables were examined. Self-determination theory offers a theoretical framework to explain how program staff behavior may be associated with youth decision making and critical thinking. SDT suggests that social contexts that are more autonomy supportive are more effective at meeting an individual's needs for competence, autonomy, and relatedness, which may be more conducive conditions for developing thoughtful decision-making skills and purposeful judgment .
Methods: 110 girls and 121 boys aged 7-14 participated in a physical activity-based positive youth development summer program providing opportunities in sports, health and fitness, and life skills development. Participants self-reported their decision making skills and critical thinking skills on the second and 17th day of the 20-day program, and rated their staff leader's autonomy supportive behavior on the 17th day
Results: There were significant increases in self-reported decision making =15.44, p=.000, η2=.063> and critical thinking =23.75, p=.000, η2=.094> over time. Results showed that the degree of change in decision making =10.59, p=.001, η2=.046> and critical thinking =7.71; p=.006, η2=.034> was associated with age. The younger group <7-10 years; n=141> increased their decision making skills compared with the older group < 11-14 years; n=83> . The younger group improved their critical thinking skills more than the older group . The enhancement of decision making skills and critical thinking skills was not associated with perceived autonomy-support or gender.
Discussion: The results suggest that the physical activity-based educational program has the potential to improve life skills such as decision making and critical thinking. There may be greater potential for change in these skills among children versus pre- and early adolescents, although whether these age differences are due to the program or are attributable to development needs to be examined in a controlled study. Furthermore, future interventions studies identifying the effects of an autonomy-supportive social context on youth life skills development is required.

MOTIVATION AND INTEREST: THE MEDIATORS OF THE RELATION BETWEEN SOCIAL SUPPORT AND PHYSICAL ACTIVITY AMONG ADOLESCENTS IN CHINA

FUBAIHUI, W.

CHINA INSTITUTE OF SPORT SCIENCE

Introduction: Most of the Chinese adolescent do not meet the moderate and vigorous physical activity (MVPA) 5 hours per week recommendation. The purpose of this study was to determine how motivation and interest mediate the relationship of social support with

physical activity by integrating available measures of personal characteristic including internal/external motivations for MVPA, MVPA interest, peer MVPA, parental support, and school support to better understand adolescent MVPA.
Methods: The data used in this paper came from the Survey on Physical Activity of Chinese adolescents in 2016, which investigated by General Administration of Sport of China. The structural equation model was used to verify the hypothesis model of the relationship among motivation, interest, social support and physical activity, which based on Self-Determination Theory (SDT).
Results: Adolescent MVPA was directly, significantly associated with MVPA interest (β= 0.209), peer MVPA (β= 0.213),and internal motivation (β= 0.079). Internal motivation was associated with peer MVPA (β= 0.264), parental support for MVPA (β= 0.748), and external motivation (β= 0.186). The indirect relationship between internal motivation and adolescent MVPA through MVPA interest as an intermediary (0.209, $p<0.01$) is stronger than the direct relationship between internal motivation and adolescent MVPA (0.0.079, $p<0.01$). The school support was not directly related to adolescent MVPA, but indirectly through mediation of internal/external motivation. It was verified that the importance of MVPA interest and intrinsic motivation in motivating adolescent MVPA behavior.
Discussion: Adolescents with MVPA interest are more likely to engage in MVPA, have greater internal motivation, and more active friends are more likely to engage in MVPA. Adolescents with higher MVPA interest are more likely to convert MVPA motivation into MVPA behavior. The rationality of Self-Determination Theory to explain adolescent physical activity behavior was verified. It is demonstrated the importance of MVPA interest and internal motivation for promoting adolescent MVPA.

09:45 - 11:15

Invited symposia

IS-PM01 Dietary Nitrate as an Ergogenic Aid in Clinical Populations. What is it good for?

THE EFFECTS OF NITRATE SUPPLEMENTATION ON EXERCISE CAPACITY IN HEART FAILURE. HFPEF V HFREF: AN UPDATE FROM THE LITERATURE

WOESSNER, M.
VICTORIA UNIVERSITY

Low exercise tolerance is associated with increased morbidity and decreased quality of life in patients with chronic heart failure (CHF). Given this strong prognostic value, interventions targeting improvements in exercise tolerance have a significant clinical utility in this population.
Nitric oxide (NO) is essential for vascular health and function and has been implicated in exercise performance in humans. Patients with CHF display endothelial dysfunction and a have a diminished ability to endogenously produce NO. Recently, oral supplementation with inorganic nitrate has emerged as a novel intervention to exogenously increase vascular NO bioavailability and potentially improve exercise performance in patients with CHF.
There are relatively few published studies examining the effects of inorganic nitrate supplementation in patients with CHF, and the results are conflicting. One potential explanation for the discrepancies is that despite similar symptomology, there are two distinct classes of CHF, each with unique pathologies, differentiated by the cardiac ejection fraction (EF). Heart failure with reduced ejection fraction (HFrEF) is characterized by significant reductions in central systolic function (EF<40%) and pronounced chronotropic incompetence. In contrast those with preserved ejection fraction (HFpEF, EF>50%) are potentially more limited by peripheral tissue under-perfusion and a lower arteriovenous oxygen difference during exercise.
This talk will present new original data from the largest-to-date exercise study of inorganic nitrate supplementation in patients with HFrEF, including central and peripheral physiological parameters. There will also be a review of the current literature to compare and contrast the findings in patients with HFrEF and HFpEF.

WHAT'S DIFFERENT ABOUT DIETARY NITRATE AND DIABETES?

GILCHRIST, M.
UNIVERSITY OF EXETER

Type 2 diabetes has a limiting effect on VO2 at both maximal and sub-maximal exercise and endurance. Poorer cardio-respiratory fitness and inactivity are independent predictors of mortality in type 2 diabetes. The cause of the limitation on exercise tolerance in T2DM has been attributed to several potential factors during the transport of oxygen from the lung to its site of utilization in the muscles. These include impairments in cardiac function, peripheral blood flow, microcirculatory dysfunction, skeletal muscle glucose uptake, and mitochondrial dysfunction. Each of these physiological processes has a nitric oxide dependent component. People with type 2 diabetes have reduced bioavailability of nitric oxide. Strategies to enhance nitric oxide bioavailability would appear to be an attractive target to improve exercise tolerance and potentially the hallmark of type 2 diabetes, insulin resistance itself. Dietary nitrate supplementation has been shown to have beneficial effects on exercise tolerance and metabolic function in human studies in health and disease as well as in a range of animal models. We will review data from nitrate supplementation studies in subjects with diabetes. These data will be used to explore why people with type 2 diabetes do not appear to derive the same benefit from inorganic nitrate supplementation as healthy subjects and cohorts with a range of other pathologies. Reasons for discordant results between human trials and animal models will be examined.

CAN WE BEET THE BEST? - INORGANIC NITRATE, EXERCISE AND PERIPHERAL ARTERIAL DISEASE

ALLEN, J.D.
UNIVERSITY OF VIRGINIA

PAD is a form of cardiovascular disease caused by atherosclerotic occlusions that impair blood flow to the lower extremities. The most frequent clinical symptomatic manifestation of PAD is intermittent claudication defined as, pain in 1 or both legs during exercise that is

relieved with rest. This inability to match oxygen delivery to tissue demands during physical activity severely debilitates subjects. A primary goal of therapy for PAD+IC is increased ambulatory function.
Although the pathophysiologic mechanisms contributing to the functional impairment and functional decline in PAD are not fully delineated, current evidence suggests numerous peripheral tissue maladaptations in response to chronic under perfusion. These include vascular endothelial dysfunction, reduced NO bioavailability, capillary density rarefaction, increased reactive oxygen species, mitochondrial dysfunction, reduced aerobic enzyme activity, and a preferential loss of type I oxidative fibres. Overall this results in the uncoupling of skeletal muscle cellular metabolism from tissue perfusion and the exhibition of a glycolytic phenotype; which promotes the early onset of fatigue and exercise intolerance.
Nitric oxide (NO) is an important signalling molecule and essential for vascular function/health. In human exercise studies, increased vascular NO is associated with improved skeletal muscle perfusion, contractile efficiency and mitochondrial function. Unfortunately, in vascular pathologies, including PAD, a dysfunctional endothelium limits the ability to endogenously upregulate NO bioavailability and restricts the utility of eNOS-dependant therapeutics.
We will present data from the last 10 years of work outlining…
a) the discovery of the relationship between plasma nitrite concentrations and walking performance in PAD+IC
b) the role of exercise training in PAD+IC and its effects on nitric oxide metabolism
c) the effects of acute oral inorganic nitrate supplementation on walking performance in PAD+IC
d) The results of a double blind RCT of 3 months of exercise training plus chronic dietary provision of inorganic nitrate (EX+BR) or EX and placebo (EX+PL) on exercise performance in PAD+IC subjects.
Data will highlight changes in vascular function, gastrocnemius muscle tissue perfusion, muscle metabolism, and nitric oxide species signaling.

Invited symposia

IS-PM11 Muscle protein turnover – influencing factors

PHYSICAL (IN)ACTIVITY - INFLUENCE ON THE REGULATION OF MUSCLE MASS MAINTENANCE

VAN LOON, L.

MAASTRICHT UNIVERSITY MEDICAL CENTRE

INTRODUCTION: A period of muscle disuse due to sickness or injury can lead to substantial loss of skeletal muscle mass and strength in otherwise healthy individuals. The resulting health consequences, such as impaired functional capacity, decreased muscle strength, onset of peripheral insulin resistance, and a decline in basal metabolic rate, are of particular concern to older individuals, who are already functionally and/or metabolically compromised. Even a few days of disuse can already results in substantial loss of muscle mass and strength. These findings are of particular clinical relevance because hospitalization of (older) individuals with acute illness generally results in a mean hospital stay of 5–7 days. Such short successive periods of muscle disuse occurring throughout the lifespan may be instrumental in the progressive loss of muscle mass with aging. Loss of skeletal muscle mass due to disuse must be attributed to an imbalance between muscle protein synthesis and breakdown rates. A decline in basal (post-absorptive) muscle protein synthesis rates has been reported following both bed rest as well as limb immobilization. Furthermore, more recent work has shown that the muscle protein synthetic response to protein or amino acid administration becomes blunted following a period of disuse. Though declines in both post-absorptive and postprandial muscle protein synthesis rates seem to play the biggest causal role in the loss of muscle mass during a period of disuse, there is also some indirect evidence that increases in muscle protein breakdown rates occur during the first few days of muscle disuse.

METHODS: RESULTS: CONCLUSION: ENDOGENOUS AND EXOGENOUS DRIVERS OF MUSCLE HYPERTROPHY IN HUMANS

PHILLIPS, S.M.

MCMASTER UNIVERSITY

INTRODUCTION: Skeletal muscle growth and atrophy are the result, in part, of imbalances between the rates of muscle protein synthesis (MPS) and breakdown (MPB). Of the two, unless someone is pathologic, MPS predominates as the process that is stimulated to lead to accretion of muscle mass. Factors that we know stimulate MPS include: loaded contraction, ingestion of dietary protein (especially proteins rich in leucine), and some supplements. In this presentation, I will discuss the role of these anabolic factors and present the most recent data.
METHODS: The focus will range from short-term acute measurements of MPS, to longer-term measurements based on deuterated water ingestion, to training studies.
CONCLUSIONS
While there are claims for anabolic proteins, the leucine content of protein is still a driving factor. Supplements such as creatine appear to augment hypertrophy but this is through allowing greater work. Supplements to purport to suppress proteolysis are not likely to be beneficial. And despite our best efforts, endogenous factors that are muscle-derived supplant any known role of systemic hormones and exogenous supplements in determining hypertrophy.

INFLUENCE OF GENDER AND FEMALE SEX HORMONES ON MUSCLE PROTEIN TURNOVER

HANSEN, M.

AARHUS UNIVERSITY

INTRODUCTION: Women are characterized by a lower absolute and relative muscle mass than men. Differences in sex hormones coupled with localization of androgen and estrogen receptors in the skeletal muscle suggest a regulatory role of sex hormones on muscle mass.
METHODS: This presentation will specifically focus on the effect of endogenous and synthetic female hormones on the regulation on muscle protein turnover.

RESULTS: Estrogen deficiency is associated with changes in muscle protein turnover and the responsiveness to anabolic stimuli. In addition, an accelerated reduction in specific force is observed when women turn into the postmenopausal state. Young women experience comparable changes in muscle protein synthesis in response to anabolic stimuli. Nevertheless, use of oral contraceptives seems to influence muscle protein synthesis, but effect seems to depend on the type of oral contraceptives.
CONCLUSION: An enhanced knowledge is of importance since use of oral contraceptives use is widespread among young women and many elderly postmenopausal women are in great risk of losing independence due to sarcopenic fragility.

Oral presentations

OP-PM17 Cardiovascular Physiology 2

EFFECTS OF ACUTE EXERCISE ON SKIN MICROVASCULAR FUNCTION

THOMAS, S.D., JONES, H., THIJSSEN, D., LOW, D.A.

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Chronic exercise induces systemic vascular adaptations, yet less is known about acute changes to vascular function after exercise; the accumulation of which may provide the basis for long-term adaptations (1). After acute exercise conduit artery function may or may not be decreased, with potential changes seeming intensity-dependent (2). Skin microvasculature is a critical site for thermoregulation, blood pressure regulation and sensory function. Changes to skin microvascular function (SkMF) following acute-exercise, the repetition of which likely contribute to improved skin microvessel function with chronic exercise, are relatively unknown. The aim of this study was to examine effects of acute exercise on SkMF.
METHODS: Healthy participants (n=12, 1 female) had SkMF assessed via skin blood flux (perfusion units, PU) responses to fast local heating (0.1ºC/sec to 42ºC for 30 mins, 44ºC for 15 mins) using laser Doppler flowmetry before (PRE), immediately after (IMM) and 1-hour (1HR) after 30 minutes low (50% heart rate maximum, HRmax) or high (75% HRmax) intensity cycling (LOW, HIGH). Skin blood flow was indexed as cutaneous vascular conductance (CVC=flux/mean arterial pressure MAP, PU/mmHg) and percent maximal CVC (CVC%max, obtained from 44ºC response). Initial axon reflex peak/ nadir responses (sensory-nerve mediated) and plateau phase (endothelium-dependent) responses to local heating were analysed.
RESULTS: Exercise increased (PRE vs exercise) HR (LOW, 54±8 vs 104±6 BPM, p<0.001; HIGH, 55±9 vs 147±6 BPM, p<0.001), MAP (LOW, 82±8 vs 93±9 mmHg, p=0.001; HIGH, 81±5 vs 105±17 mmHg, p<0.001) and baseline skin blood flow (LOW, 6±1 vs 16±12 CVC%max, p<0.001; HIGH, 7±1 vs 47±17 CVC%max, p<0.001).
Local heating axon reflex peak increased after HIGH (PRE 56±10 vs IMM 73±17 CVC%max, p=0.001; PRE vs 1HR 74±15 CVC%max, p=0.003) and trended towards being increased after LOW (PRE 64±11 vs IMM 72±8 CVC%max, p=0.057). Axon response nadir increased after LOW (PRE 46±13 vs IMM 61±11 CVC%max, p=0.002; PRE vs 1HR 62±14 CVC%max, p=0.007) and HIGH (PRE 48±13 vs IMM 67±18 CVC%max, p<0.001). Neither exercise nor time affected endothelium-dependent plateau responses (LOW: PRE 85±9 vs IMM 92±7 CVC%max, p>0.05; PRE vs 1HR 90±11 CVC%max, p>0.05. HIGH: PRE 86±9 vs IMM 88±11 CVC%max, p>0.05; PRE vs 1HR 88±8 CVC%max, p>0.05).
CONCLUSION: Exercise increases cutaneous microvascular axonal response to local heating for up to 1-hour, suggesting an augmented sensory afferent function post-exercise. Acute exercise doesnt affect endothelial function in cutaneous jmicrocirculation, contrasting some findings in macrovessels.
1.Birk GK, Dawson EA, Batterham AM, Atkinson G, Cable T, Thijssen DH, et al. Effects of exercise intensity on flow mediated dilation in healthy humans. Int J Sports Med. 2013;34(5):409-14.
2.Dawson EA, Green DJ, Cable NT, Thijssen DH. Effects of acute exercise on flow-mediated dilatation in healthy humans. J Appl Physiol (1985). 2013;115(11):1589-98.
Contact:Dr David Low, d.a.low@ljmu.ac.uk

CARDIOVASCULAR EFFECTS OF ISOMETRIC HANDGRIP TRAINING FOR PATIENTS WITH PERIPHERAL ARTERY DISEASE

CORREIA, M.1, OLIVEIRA, P.2, GERMANO-SOARES, A.1, WOLOSKER, N.2, CUCATO, G.G.2, RITTI-DIAS, R.3

1. UNIVERSITY OF PERNAMBUCO, RECIFE, BRAZIL; 2. HOSPITAL ISRAELITA ALBERT EINSTEIN, SÃO PAULO, BRAZIL; 3. UNIVERSITY NINE OF JULY, SÃO PAULO, BRAZIL.

INTRODUCTION: Patients with peripheral artery disease (PAD) have a high prevalence of hypertension, which contributes to a high mortality risk. Meta-analysis studies have demonstrated that isometric handgrip training (IHT) promotes reductions in blood pressure in normotensive, pre-hypertensive, and hypertensive individuals. However, the effect of this modality of training in individuals with significant impairment in cardiovascular function and regulation, such as patients with PAD, is unknown. Thus, the aim of the study was to analyze the effects of IHT on cardiovascular function of PAD patients.
METHODS: In this randomized clinical trial, 86 patients (66 ± 9 years) of both genders were randomized into two experimental groups: IHT and control (CG). The IHT group underwent three weekly sessions (four two-minute series of isometric of unilateral contraction at 30% of maximal voluntary contraction, with a four-minutes interval between sets). The CG patients received a compression ball to perform sham training, also three times a week, but without any isometric component. Before the beginning and after eight weeks of intervention, the following indicators of the cardiovascular function were obtained: brachial arterial pressure (OMRON, Japan) and central (pulse wave analysis, Sphygmocor, Australia), arterial stiffness (pulse wave velocity, Sphygmocor, Australia), heart rate variability (Polar, Finland) and vascular function (flow-mediated dilatation, Philips Healthcare, The Netherlands). For statistical analysis, models of generalized estimation equations were used, considering the group (IHT and CG) and time (pre and post intervention) as factors.
RESULTS: No effects on central and brachial artery pressure (P> 0.05), arterial stiffness (P> 0.05) and heart rate variability (P> 0.05) were observed. There was interaction effect group vs. time on flow-mediated dilation with significant increases of this parameter only in the IHT group (GC – pre: 8.4 ± 5.7 vs. post: 8.2 ± 5.2; IHT – pre: 5.8 ± 5.1 vs. post: 9.9 ± 5.4, P <0.05).
CONCLUSION: Despite the improvement in local vascular function, IHT did not alter blood pressure, heart rate variability and arterial stiffness in PAD patients.

BLOOD PRESSURE RESPONSES DURING AND AFTER HEAVY RESISTANCE TRAINING IN HEALTHY MALES

HEITMANN, K.A.1, DALEN, H.2,3,4, INGVALDSEN, R.P.5, WELDE, B.1

1. UIT , 2. NTNU , 3. LEVANGER HOSPITAL , 4. ST. OLAVS UNIVERSITY HOSPITAL , 5. NORD UNIVERSITY

INTRODUCTION: Most recommendations are careful in advising heavy resistance training (HRT, 85-90% 1RM) for hypertensive individuals, due to earlier reports of acute excessive elevated blood pressure (BP) during resistance training (RT). In this population, RT with lighter weights (≤75% 1RM) have been recommended as a supplement to aerobic exercises. However, no association has been reported between the percent 1RM weight lifted and acute excessive elevated BT during HRT, if the Valsalva's manoeuvre is avoided. Therefore, the aim of this study was to examine the BP response during HRT with 3 and 5 repetitions (rep.), where both sessions were carried out at the 5RM load (i.e., 85% 1RM) and the Valsalva's manoeuvre was avoided. Also, we studied the BP response for 90 min resting post-exercise. We hypothesized that 3 rep. induced lower acute BP during training than 5 rep. and that both training sessions induced post-exercise hypotension (PEH).
METHODS: Seven healthy male students (23.8±1.4 years (mean and SD)) volunteered to seated leg press exercise for examination of their BP response to HRT in two different exercise sessions: 1) 10 x 5 rep. exercise session (5RES) and 2) 10 x 3 rep. exercise session (3RES), both at 5RM load and in a randomized, crossover within-subjects-design. Intra-arterial BP were measured before and during RT, as well as 15-90 min post-exercise.
RESULTS: At baseline there was no difference of the systolic and diastolic BP (SBP, DBP) between the exercise sessions (P=0.42). Mean (SD) SBP (3RES: 167.2 (13.8) mmHg; 5RES: 176.9 (17.4) mmHg, P=0.08), and peak SBP (3RES: 177.7 (15.5) mmHg; 5RES: 184.3 (16.8) mmHg; P=0.29), measured at the end of each training sets, did not significantly differ between 3RES and 5RES. Mean DBP (3RES: 79.2 (8.4) mmHg, 5RES: 88.4 (8.2) mmHg, P=0.01) and peak DBP (3RES: 88.1 (8.2) mmHg, 5RES: 95.3 (9.7) mmHg, P=0.02) were higher during training for 5RES vs. 3RES. In the rest periods during training, the mean and peak SBP and DBP did not differ between 3RES and 5RES (0.24≤P≤0.58). When compared to resting values before training, a significant PEH was found for SBP 30 min post exercise (mean difference: -11.8 (7.3) mmHg, P=0.01), with no difference between 3RES and 5RES and no hypotensive response for DBP.
CONCLUSION: The major findings in the present study were: 1) HRT could be performed without acute excessive elevated BP during training; 2) BP increased more during training for 5RES than for 3RES, however not significantly for SBP; 3) Ten sets of HRT induced systolic PEH.

SIMULTANEOUS ASSESSMENT OF INTRA- AND EXTRACRANIAL ARTERIAL RESPONSES TO SYMPATHETIC STIMULATION: IMPAIRED REACTIVITY IN HEALTHY OLDER SUBJECTS COMPARED TO YOUNGER PEERS.

SHKREDOVA, D.1, CLAASSEN, J.A.H.R.1, THIJSSEN, D.H.J.1,2

<1> RADBOUD UNIVERSITY MEDICAL CENTER <2> LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Impaired vascular health contributes importantly to the development of cardio- and cerebrovascular disease. Recent work found that common carotid artery (CCA) reactivity to the cold pressor test (CPT; a strong sympathetic stimulus) is closely related to coronary responses to the CPT and is impaired in older subjects. Given its close proximity to the brain, CCA reactivity to the CPT may also show similarity with blood flow velocity of the middle cerebral artery (MCA). Furthermore, in line with the CCA, MCA reactivity may be impaired in older humans. Therefore, the objectives of this study were to 1. Explore responses of extra- (CCA) and intra-cranial arteries (MCA, cortical) to the CPT, and 2. Examine the impact of age on these responses.
METHODS: Two groups were recruited for this cross-sectional study: healthy younger adults (YA; 18-30yrs) and healthy older adults (OA; ≥65yrs). Participants were free from cardiovascular and cerebrovascular disease, with no cognitive impairment (MoCA≥26). CPT consisted of a 3-min submersion of the left hand into cold water (<1°C), with continuous simultaneous assessment of CCA diameter (CCAd) and blood flow velocity (CCAv) by duplex ultrasound, MCA blood flow velocity (MCAv) by Transcranial Doppler, and cortical oxygenation (O2Hb) by Near Infrared Spectroscopy. Statistical analysis involved characterization of the vascular responses using 4th degree polynomial modelling. Between-group differences regarding the magnitude of vascular responses were assessed with unpaired t-Test (YA versus OA).
RESULTS: In n=15 YA (23.0±1.5yrs; 40% male), CPT produced a significant increase in CCA velocity (+8.9%, 74s), diameter (+5.2%, 89s) and blood flow (+67.7±16%). These responses in the CCA coincide with increased MCAv (+6.0%, 78s), subsequently followed by an increase in cortical oxygenation (O2Hb: +3.6µmol, 126s). Despite similarity in the magnitude of these responses, no significant correlations were observed between CCA versus MCA or cortical oxygenation (all P>0.05).
Compared to YA, the OA group (n=13, 71.8±4.6yrs, 62% male) showed an abolished dilator response in CCAd (0.8±4%, P=.002), whilst no differences were found in CCAv (P=.910) or blood flow (P=.601). OA subjects exhibited reversed MCAv responses to CPT (-13.2±28%, P=.005), whilst a trend for attenuated response was found for cortical oxygenation in OA compared to YA (P=.056). Time to reach peak was not different between YA and OA for CCAd, CCAv or O2Hb, although OA reached peak MCAv earlier than YA (P=.023).
CONCLUSION: In agreement with the extra-cranial CCA, we found that sympathetic stimulation leads to marked vascular reactivity of intra-cranial larger (i.e. MCA) and smaller vessels (i.e. cortical oxygenation). Furthermore, older age is associated with impaired and even reversed vascular responses in extra- and intracranial arteries, despite similar blood flow. Future research is warranted to better understand these responses and explore if physical activity interventions may be beneficial.

Oral presentations

OP-PM20 Hydration / Dehydration

HYDRATION KNOWLEDGE, ATTITUDES AND PRACTICES OF OCEANIA ATHLETES PREPARING FOR THE 2018 GOLD COAST COMMONWEALTH GAMES: AN OBSERVATIONAL STUDY

IRWIN, C., DESBROW, B., BELLINGER, P., MINAHAN, C.

GRIFFITH UNIVERSITY

INTRODUCTION: Fluid and electrolyte balance are important considerations for athletes, particularly when undertaking regular training sessions separated by short recovery times (<24h). In these situations, rehydration between sessions is important, as hypohydration can increase physiological strain, decrease performance and contribute to heat illness. Relatively little is known about the hydration practices

of regional Oceania athletes (outside Australia and New Zealand), who typically train in hot environments and have variable access to sports science/nutrition advice and support. The aim of this study was to: (1) determine hydration knowledge and attitudes of Oceania region athletes; and (2) assess hydration status and fluid consumption practices of these athletes during a training camp based in Gold Coast, Australia for the 2018 Commonwealth Games.
METHODS: Fourty-six athletes (n = 29 male, age: 22.2±5.7 y) from different sports [Field (n = 3), Track (n = 8), Boxing (n = 8), Lawn Bowls (n = 2), Swimming (n = 9), Volleyball (n = 16)] attended the training camp. Nutrition knowledge and attitudes regarding hydration practices were assessed at commencement of the camp using a questionnaire. Hydration assessment (n = 33) involved urine measures of specific gravity (Usg), osmolality (Uosm) and colour (Ucol) at three times throughout a training day (upon waking and immediately pre- and post-training). Body mass (BM) was also measured and fluid intake during training was estimated.
RESULTS: The mean assessment score of nutrition knowledge was 43±13% correct responses. Females (45±12%) and field athletes (54±13%) scored slightly better than males (42±14%) and other groups (≤46%). However, no athlete obtained a pass score (≥80%), indicating a low level of hydration/fluid replacement knowledge. Most athletes agreed with statements suggesting positive attitudes towards personal hydration practices, with the exception of relying on thirst as an indicator of dehydration; where the majority of athletes indicated belief they could employ this strategy (n = 22, 51%). Most athletes were hypohydrated upon waking (Usg = 1.020±0.007; Uosm = 697±267; Ucol = 5.2±1.4) and commenced training sessions in a hypohydrated state (Usg = 1.022±0.009; Uosm = 795±261; Ucol = 5.4±1.3). Fluid intake during training was not sufficient to prevent further fluid losses (1.4±0.9% BM loss), irrespective of athlete group.
CONCLUSION: Results indicate that Oceania athletes have limited understanding of fluid replacement concepts and that this likely contributes to their poor hydration practices. Targeted information regarding pre-exercise hydration status and appropriate hydration practices during and between training sessions is required to support these athletes, particularly in preparation for major competition.

THE EFFECT OF SLOW, MODERATE AND FAST WATER DRINKING ON FLUID RETENTION FOLLOWING EXERCISE-INDUCED HYPOHYDRATION.

RODRIGUEZ-SANCHEZ, N.1, RODRIGUEZ-GIUSTINIANI, P.1, SAYER, L.2, IRWIN, C.2, MCCARTNEY, D.2, COX, G.R.3, DESBROW, B.2, GALLOWAY, S.D.1

1. UNIVERSITY OF STIRLING, 2. GRIFFITH UNIVERSITY, 3. AUSTRALIAN INSTITUTE OF SPORT

INTRODUCTION: Changing drinking rate has the potential to alter the fluid retention profile of a beverage (Jones et al 2010 & Kovacs et al 2002), but only slow or very slow ingestion rates have been examined. This study examined the influence of fast, moderate and slow drinking rates on fluid retention following exercise-induced hypohydration.
METHODS: Twelve active participants (9 males and 3 females: age: 28.3±6.3 y, height: 1.76±0.11 m, body mass: 74.0±10.2 kg, (Mean±SD)) undertook four exercise trials conducted 5-7 days apart to induce a body mass loss of 2.0±0.3%. After exercise, in a crossover randomised design participants ingested water in a volume equivalent to 100% of their body mass loss over either 15 min (DR15), 45 min (DR45) or 90 min (DR90), with a repeat trial of either DR15 or DR45 to assess test-retest reliability. Subjective sensations (thirst, nausea, fullness, bloating) and urine output were measured hourly for a total of 3-h after the onset of drinking.
RESULTS: Body mass loss was similar on all trials resulting in a total fluid intake of 1490±288 ml. Total fluid retention was significantly greater in DR90 (57.1±12.8%) compared to DR15 (49.7±10.9%, p=0.046), but not different to DR45 (51.5±21.8%). Thirst sensation peaked post exercise and decreased after water ingestion to similar levels regardless of the drinking rate. Perceived bloating and fullness was higher on DR15 trial ($p<0.05$) immediately after ingesting water, but not thereafter. Test-retest reliability assessment revealed that day to day variation in fluid retention was 7.3±8.8% (CV 17%).
CONCLUSION: Ingesting fluid at a fast drinking rate (DR15) reduced fluid retention compared to a slow drinking rate (DR90), however, this was just outside the range of normal day to day variation noted on repeated trials. Practically, there is no real difference between rapid or metered ingestion strategies on hydration, but a key benefit of staggering fluid intake during recovery would be to improve gastrointestinal symptoms compared to rapid ingestion.

EFFECT OF DRINKING RATE ON RETENTION OF MILK AND WATER FOLLOWING EXERCISE-INDUCED DEHYDRATION.

SAYER, L.1, RODRIGUEZ-SANCHEZ, N.2, RODRIGUEZ GIUSTINIANI, P.2, IRWIN, C.1, MCCARTNEY, D.1, COX, G.R.3, GALLOWAY, S.D.2, DESBROW, B.1

1: GRIFFITH UNIVERSITY , 2: UNIVERSITY OF STIRLING , 3: AUSTRALIAN INSTITUTE OF SPORT

INTRODUCTION: Changing drinking rate (Jones et al 2010) and altering nutrient composition (Maughan et al 2016) have independently been shown to change the fluid retention profile of a beverage, yet no study has examined the interaction of these factors. This study investigated the effect of drinking rate on the fluid retention properties of milk and water following exercise-induced sweat loss.
METHODS: Twelve male participants (23.5 y (SD 5.3), 178cm (SD 6), 77.3kg (SD 9.6)) lost 1.9% (SD 0.3) body mass (BM) through moderate intensity cycle exercise on 4 separate occasions. Following exercise, plain water or low fat milk equal to the volume of sweat lost during exercise was provided. Beverages were ingested at different rates (30 min or 90 min), resulting in the following four beverage treatments: (1) Water 30 mins (W30); (2) Water 90 mins (W90); (3) Milk 30 mins (M30); and (4) Milk 90 mins (M90). Nude BM, urine volume, urine specific gravity (USG), plasma osmolality (POSM) and ratings of gastro-intestinal (GI) tolerance were obtained pre-exercise and every hour for 3h after the onset of drinking.
RESULTS: Total fluid retention (%) was significantly greater when milk was consumed, as opposed to water (Water (both trials) 58.1% (SD 17.7) vs. Milk (both trials) 83.8% (SD 6.5), $p<0.001$). No significant effect of drinking rate was observed (W30 = 56.5% (SD 16.1); W90 = 59.7% (SD 19.7); M30 = 82.9% (SD 6.1); M90 = 84.9% (SD 7.1) at the end of the recovery period. Rapid drinking resulted in a peak in subjective bloating 30 mins post exercise and was not influenced by the type of beverage (p=0.28). Perceived fullness was higher at 90 mins following the M90 compared to W90 ($p<0.001$).
CONCLUSION: The nutrient composition of a beverage had a more pronounced impact on fluid retention than the beverage ingestion rate. Practically, total fluid intake and beverage choice are more influential than fluid ingestion rate in determining post-exercise rehydration. Personal preference, gastro-intestinal tolerance and post-exercise commitments can be considered when recommending drinking rates to athletes.
References:
Jones EJ, Bishop PA, Green JM, Richardson MT (2010). IJSNEM, 20(2), 139-144.
Maughan RJ, Watson P, Cordery PA, Walsh NP et al (2016). AJCN, 103(3), 717-723.
Contact: liam.sayer@griffithuni.edu.au

FLUID, ENERGY AND NUTRIENT RECOVERY VIA AD LIBITUM CONSUMPTION OF DIFFERENT COMMERCIAL BEVERAGES AND FOOD IN FEMALE ATHLETES

MCCARTNEY, D.1, IRWIN, C.1, COX, G.R.2, DESBROW, B.1

1: GRIFFITH UNIVERSITY, GOLD COAST, AUSTRALIA. 2: AUSTRALIAN INSTITUTE OF SPORT, GOLD COAST, AUSTRALIA.

INTRODUCTION: Recent evidence suggests that different commercial beverages promote similar levels of fluid recovery in men when consumed voluntarily with access to food during exercise recovery (Campagnolo et al., 2017). However, it is unclear if this effect persists in trained females, who may exhibit contrasting dietary behaviors. This study investigated the effect of consuming different commercial beverages with food ad libitum post-exercise on fluid, energy and nutrient recovery in females.
METHODS: On 4 separate occasions, 8 trained females (body mass [BM]: 61.8±10.7 kg; VO2max: 46.3±7.5 mL·kg-1·min-1) lost 2.0±0.3% BM cycling (24.2±0.9°C) at 75% VO2max before commencing a 4 h recovery period with ad libitum access to one of four beverages: (1) Water, (2) Powerade® Isotonic (Coca Cola Ltd.) (Sports Drink, 103 kJ·dL-1), (3) Up & Go Sugar FreeTM (Sanitarium®, Australia) (SF-MILK, 279 kJ·dL-1), and (4) Up & Go EnergizeTM (Sanitarium®, Australia) (HP-MILK, 344 kJ·dL-1). In addition, participants had 2 × 15 min opportunities to access food during the recovery period. Beverage intake; total fluid/nutrient intake (from food and beverage); and indicators of fluid recovery (BM, urine output, urine specific gravity [USG] and plasma osmolality [POSM]), gastrointestinal (GI) tolerance and palatability were assessed periodically.
RESULTS: Whilst total fluid intake (Water: 1918±580 mL; Sports Drink: 1809±338 mL; SF-MILK: 1458±431 mL; HP-MILK: 1523±472 mL; p=0.010) and total urine output (Water: 566±314 mL; Sports Drink: 459±290 mL; SF-MILK: 220±53 mL; HP-MILK: 230±117 mL; p=0.009) differed significantly by beverage, the overall quantity of ingested fluid retained was similar across treatments (Water: 1352±462 mL; Sports Drink: 1349±407 mL; SF-MILK: 1238±400 mL; HP-MILK: 1293±453 mL; p=0.691). Total energy intake increased in proportion to the energy-density of the beverage (Water: 4129±1080 kJ; Sports Drink: 5167±643 kJ; SF-MILK: 6019±1925 kJ; HP-MILK: 7096±2058 kJ; p=0.014). Carbohydrate, protein and sodium intakes also differed across treatments (p's<0.05).
CONCLUSION: When consumed voluntarily and with access to food, different commercial beverages promote similar levels of fluid recovery, but alter energy/nutrient intakes during a 4 h recovery period. Providing access to food and understanding the longer-term dietary goals of female athletes are important considerations when providing recovery beverage recommendations.
Campagnolo, N. Iudakhina, E. Irwin, C. Schubert, M. Cox, G.R. Leveritt, M. Desbrow, B. (2017) Physiology & Behavior 171, 228-235.

THE INFLUENCE OF WATER, SPORTS DRINK OR LOW-ALCOHOL BEER ON VOLUNTARY FLUID AND NUTRIENT INTAKE FOLLOWING EXERCISE.

DESBROW, B.1, BARNES, K.1, COX, G.R.2, IUDAKHINA, E.1, MCCARTNEY, D.1, SKEPPER, S.1, YOUNG, C.1, IRWIN, C.1

GRIFFITH UNIVERSITY, GOLD COAST

INTRODUCTION: Availability of different beverages immediately after exercise has the potential to influence fluid and nutrient intake, ultimately influencing acute recovery (Desbrow et al, 2017). This study assessed voluntarily fluid consumption and subsequent nutrient intake when different beverages were provided in a post-exercise recovery area.
METHODS: Participants (n=132) completed two 10km afternoon runs (repeated measures design) separated by 1 week. Immediately after the first run, participants were randomly assigned to a recovery area providing access to one beverage (based on personal preference). "Beer Drinkers" (n=54 (41 male) ((mean±SD) age=23.9±5.8y, body mass (BM)=76±13kg)) received Beer (low-alcohol beer (Hahn Ultra®, (LionCo), 0.9% ABV) or sports drink (SD) (Gatorade® (PepsiCo), orange flavour). "Non-Beer Drinkers" (n=78 (38 male) (age=21.8±2.2y, BM=71±13kg)) received Water or SD (lemon-lime flavour). Participants remained in the recovery area for 30-60 min and consumed the alternate recovery beverage under the same conditions the following week. All fluid was consumed ad libitum and was measured by trained observers (i.e. acute fluid intake). Participants recorded all food and fluid consumed for the remainder of both trial days via food diary and photographs, which were subsequently analysed (energy and macronutrients) by a dietitian. Fluid balance was assessed via nude body mass (BM) before and after exercise and Urine Specific Gravity (USG) before running and the next morning. Paired-samples t-tests assessed differences in hydration and dietary outcome variables.
RESULTS: No differences were observed in pre-exercise USG (~1.01), run time (~65min) or change in BM (~1.5%) between any intervention groups (p's>0.05). Water vs SD: No difference in acute fluid intake between beverages was noted (Water=751±259 ml, SD=805±304 mL, p=0.157). However, the contrast in beverage nutrient profiles influenced total energy and CHO intakes (Water=5691±2491 kJ and 151±77 g, SD=6497±2724 kJ and 187±87 g, Energy p=0.002, CHO p<0.001). SD vs Beer: Access to SD resulted in greater acute fluid intake (SD =1047±393 ml, Beer=850±630 mL, p=0.004). However, differences were not evident when fluid intake was considered at the end of the trial days (SD=2235±1015mL, Beer=2175±835 mL, p=0.581). No differences in dietary variables were evident. Next day mean USG values were not different between any groups (p's>0.05).
CONCLUSION: Provision of a calorie containing drink immediately following exercise influences subsequent dietary intake, whereas beverage choice does not influence markers of rehydration in recreational runners.
Desbrow et al (2017) IJSNEM, 27(6), 487-490.

INGESTION OF HYDROGEN-RICH WATER REDUCES SERUM CREATINE KINASE ACTIVITY AND MUSCLE SORENESS FOLLOWING DOWNHILL RUNNING

ABDULLAH, R.A., NG, S.K., OMAR, E.A., OOI, C.H.

UNIVERSITI SAINS MALAYSIA

INTRODUCTION: The effects of molecular hydrogen by means of oral administration of hydrogen-rich water, have been reported to be effective in reducing exercise-induced metabolic acidosis (Aoki et al., 2012; Ostojic, 2012; Ostojic and Stojannovic, 2014), muscular fatigue (Aoki et al., 2012), sports-related soft tissue injuries (Ostojic et al., 2014), and ischemia-reperfusion injury in skeletal muscle (Huang et al., 2015). However, we are not aware of any experimental studies that are specifically investigating the effects of hydrogen-rich water ingestion on eccentric exercise-induced muscle damage (EIMD). Therefore, this study aimed to examine the protective effect of hydrogen-rich water during recovery from EIMD.
METHODS: Eleven healthy and physically active male adults were randomly assigned into the double-blind, placebo-controlled, cross-over experimental trials to receive a 14-day treatment of either hydrogen-rich water (H2-water, ~1.0 ppm, -500 mV, 1.8 L/day) or a similar amount of pure water (placebo). On the day 7 of the treatment, subjects undertook a 30-minute continuous downhill run (DHR) on a motorized treadmill at a speed corresponding to 65% of their VO2max and a slope of –15% in a controlled environmental condition (22°C,

40% relative humidity). Serum CK and HSP70 levels, muscle tenderness and soreness, and one-repetition maximum knee extension strength were measured before and after (0, 24, 48, 96, and 168 h) the DHR. Changes in these physiological measures and biomarkers of EIMD were compared between the trials by two-way repeated measures ANOVA. The area under the curve and the maximal responses of these indices for the seven days post-DHR were computed and compared between the trials by the paired t-test.
RESULTS: Serum CK and HSP70 increased at 24 to 48 h after the DHR, but the changes were unaffected by H2-water treatment. DHR also resulted in increased muscle tenderness and soreness within 48 h, and the reduction in muscle strength was observed up to 96 h following the DHR. However, there were no treatment effects on these indices of EIMD between the trials. When the data were expressed as area under the curve, serum CK response and muscle soreness during the seven days post-DHR were attenuated ($P = 0.033$ and $P = 0.022$, respectively) in the H2-water trial. The peak serum CK response following DHR was also lower in H2-water than in placebo trial ($P = 0.029$).
CONCLUSION: Ingestion of hydrogen-rich water seven days before and after a 30-minute eccentric exercise bout may attenuate the serum CK activity and self-perceived muscle soreness. However, it does not seem to ameliorate eccentric exercise-induced increases in circulating stress protein response or strength loss.

DEHYDRATION REDUCES CARDIAC OUTPUT AND STROKE VOLUME DURING PROLONGED EXERCISE LARGELY THROUGH REDUCTIONS IN VENOUS RETURN AND LEFT VENTRICULAR FILLING

WATANABE, K.1,2, STÖHR, E.J.3, WATANABE, S.1, GONZÁLEZ-ALONSO, J.1

1: BRUNEL UNIVERSITY LONDON , 2: UNIVERSITY OF TSUKUBA , 3: COLUMBIA UNIVERSITY

INTRODUCTION: Dehydration accrued during prolonged, whole body exercise in the heat reduces stroke volume (SV), cardiac output (CO), mean arterial pressure (MAP) and blood flow to the brain, skin and active muscles in parallel to concomitant increases in heart rate (HR), core temperature and total peripheral resistance (TPR) (1). The fall in SV is a key feature of the global cardiovascular strain induced by dehydration and hyperthermia, but the extrinsic and intrinsic cardiac factors underlying this multifarious phenomenon remain elusive. The diminished dehydration-induced SV during single leg knee-extensor exercise with stable CO is closely coupled to a blunted left ventricular (LV) filling (2). Whether extrinsic cardiac mechanisms dominate during whole body exercise causing a greater homeostatic challenge has never been investigated. We therefore manipulated hydration status to test this hypothesis during prolonged exercise inducing significant systemic and peripheral circulatory strain compared to exercise with physiological stability.
METHODS: Eight cyclists (3 females) performed 2 h of submaximal semi-recumbent cycling in the heat without (dehydration, DE; 4.0 ± 0.2% body mass loss) and with full fluid replacement (euhydration, EU). LV volumes (Echocardiography), systemic, arm and head haemodynamics, core temperature and haematological parameters were assessed at rest and during the exercise.
RESULTS: DE reduced blood volume (0.4 ± 0.04 L) and increased core temperature (0.6 ± 0.1°C) compared to EU at 2 h (both $P < 0.05$). At this time point, SV and CO were reduced by 27 ± 3 mL and 2.1 ± 0.3 L/min and HR and TPR were increased by 19 ± 3 beats/min and 0.6 ± 0.1 mmHg/L/min in DE compared to EU (all $P < 0.05$), whereas MAP was no different ($P = 0.187$). The lower SV in DE was solely due to reduced LV end-diastolic volume (31 ± 4 mL), as LV end-systolic volume was decreased (3 ± 1 mL; both $P < 0.05$) indicative of enhanced myocardial contractility. Lower bilateral brachial and carotid beat volumes (1.4 ± 0.3 and 1.8 ± 0.5 mL; both $P < 0.05$) suggestive of reduced venous return accompanied the blunted cardiac SV.
CONCLUSION: The SV decline with dehydration and hyperthermia during prolonged exercise is intimately related to the lowering in LV filling secondary to compromised venous return. The decreased venous return and preload of the heart is in turn mechanistically associated with concomitant dehydration-induced hypovolemia, enhanced peripheral vasoconstriction and diminished cardiac filling time accompanying hyperthermia-mediated tachycardia, rather than impaired intrinsic myocardial contractility. These findings advance our fundamental understanding of how heat and hydration impact human cardiovascular function during exercise.
REFERENCES:
(1) Trangmar & González-Alonso (2017). Exerc Sport Sci Rev 45, 146-153.
(2) Stöhr et al. (2011). J Appl Physiol 111, 891-897.

Invited symposia

IS-BN05 Effects of aging and training on fatigability and motor control

AGING OF THE NEUROMUSCULAR SYSTEM AND FATIGABILITY

HUNTER, S.K.

MARQUETTE UNIVERSITY

INTRODUCTION: Age-related changes to the motor unit and its neural inputs result in impaired neuromuscular function and functional performance in older adults <>65 years>. Changes in function with advanced age include reduced maximal strength and power, slower contractile velocity, increased variability of motor tasks, and increased fatigability of limb muscles. Fatigability is the acute reduction in force or power of a muscle in response to exercise and can temporarily exacerbate the age-related loss of strength and power in older adults, although this can differ with the task involved. There is minimal understanding of the mechanisms for age-related increases in fatigability particularly in very old adults <>80 years>, and the relevance of laboratory-based assessments of fatigability to functional performances in daily living.
METHODS: This presentation will highlight studies that have tested power and force of the knee extensor and elbow flexor muscles before and after dynamic fatiguing tasks in young <<35 years>, old <65-79 years> and very old men and women <≥80 years>. Techniques used to understand the neural and muscular mechanisms of fatigability of the limb include electrically evoked contractions of the agonist muscle, transcranial magnetic stimulation over the motor cortex, and analysis of muscle fibres from muscle biopsies. Older adults also performed whole-body functional performance tasks to determine their association with fatiguing tasks of a single limb.
RESULTS: The collective results of several studies show that 1> reductions in power during repeated high-velocity dynamic contractions were significantly larger in old adults <65-79 years> and very old adults <≥80 years> than young adults <<35 years>, and these reductions were similar for men and women; 2> this age-related fatigability was greater in the lower limb than the upper limb muscles ; 3> the mechanisms for the age-related fatigability of the lower limb were associated with both neural and contractile mechanisms, but most

strongly correlated with the contractile function; and 4> the greater fatigability of the knee extensor muscles was associated with a slower walking speed and reduced balance among the older adults.
CONCLUSION: Age-related increases in fatigability induced with high-velocity dynamic contractions in healthy community dwelling men and women were greater for the lower limb than upper limb muscles, and for the lower limb was associated with functional performance tasks. The mechanisms for the age-related fatigability were both neural and contractile in origin but their contribution depended on the muscle group involved. Optimal and efficient strategies to offset this age-related fatigability especially in very old who suffer the greatest fatigability, can potentially offset large age-related declines in functional performance.

AGING AND THE AGONIST –ANTAGONIST MUSCLES CO-ACTIVATION: A REVISITED MECHANISM

DE VITO, G.

UNIVERSITY COLLEGE DUBLIN

Introduction: The age-related deterioration in the neuromuscular system not only reduces the ability to generate maximal force and power but also to control force production. These deficits are manifested as a decreased capability of older adults to perform the tasks of everyday living. In this regard an appropriate coordination of agonist and antagonist muscles is essential for the correct execution of movements and normally some degree of agonist–antagonist coactivation is observable during a voluntary muscle contraction. It has been proposed that during voluntary contraction of the knee extensors (KE), the hamstrings (i.e. antagonist muscles) could provide opposing mechanical movement of the agonist muscles in response to variations in joint angular displacement and ligamentous loading, thus contributing to maintain joint stability. Several previous studies reported an increased antagonist co-activation in elderly participants compared to young individuals, whilst some other studies have observed that the level of coactivation remains unchanged with aging.
Methods: This speech will, therefore, focus on recent studies conducted in our laboratory presenting new insights into the age-related modifications in agonist antagonist muscles co-activation and how these can be influenced by mechanical factors (i.e. muscle length and contraction intensity) and gender. In addition, specific attention will be paid to discuss the potential risk of crosstalk contamination related to the use of surface electromyography (sEMG) for the assessment of co-activation. To this purpose, we will describe the effects that adipose tissue, covering the muscle of interest, can have on the level of antagonist coactivation measured by sEMG. Most of the results presented here were obtained in studies involving healthy young (20-30 yr) and older (65-75 yr) participants of both genders who performed isometric KE contractions of different durations, and intensities at distinct muscle lengths.
Results: Taken together our findings suggest that during KE contractions the level of antagonist co-activation: 1) correlates with subcutaneous adipose tissue; 2) it is dependent on knee joint angle (muscle length); 3) tends to increase with agonist contraction intensity. In relation to aging we found that antagonist coactivation was higher in the older at the longer muscle length (60° knee angle) but only after controlling for adiposity. In relation to gender, the higher antagonist co-activation observed in women compared to men, at all level of contractions, disappeared after controlling for adiposity.
Conclusions
In conclusion, fat can be a confounding factor when assessing coactivation using sEMG and this point deserves more attention especially when groups with different level of adiposity are investigated. In addition, it is important to stress that although these results can be of some values they were limited just to healthy participants in their seventies.

EFFECTS OF EXERCISE TRAINING ON NEUROMUSCULAR FUNCTION IN OLD AGE

AAGAARD, P.

UNIVERSITY OF SOUTHERN DENMARK

INTRODUCTION: Mechanical muscle function in terms of maximal muscle strength, power, and rate of force development is negatively affected by progressive aging, which is evident even in lifelong trained master athletes. The impairment in muscle function is accompanied, and in part, caused by age-related impairments in neuromuscular function that includes a loss of spinal motor neurons , a reduction in maximal MN firing frequency, altered agonist and antagonist muscle activation, reduced fine motor control , reduced excitability in descending corticospinal pathways as well as altered spinal circuitry function. Notably, however, these age-related changes in neuromuscular function may be effectively delayed and/or compensated by means of resistance exercise training, with improvements in neuromuscular function demonstrated to occur even into very old age <+80 years>. Thus, experimental evidence will be presented to illustrate that substantial adaptive plasticity in motorneuronal function exists at old age, which can be translated into improved function in various activities of daily living such as chair rising, stair walking and postural balance.

Invited symposia

IS-MI03 Mind over muscle? A psychophysiological approach to pacing and exercise behaviour - FEPSAC Symposium

UNDERSTANDING AND OPTIMIZING PACING BEHAVIOR AND PERFORMANCE

HETTINGA, F.

UNIVERSITY OF ESSEX

To start, dr. FJ Hettinga (FECSS) will begin with describing her recent studies concerning the manipulation of athletes exercise behaviour and pacing strategies during middle-distance and endurance trials.
She will demonstrate the effects of modifying athletes' feedback, fatigue and external environmental cues such as opponents on pacing behavior and performance.
Do these manipulations influence athletic drive or motivation to exercise?
Do they impact on pacing behavior and performance?

THE NEUROPHYSIOLOGICAL DRIVE TO EXERCISE.

ROELANDS, B.

VRIJE UNIVERSITEIT BRUSSEL

In the last decades part of the research on the mechanisms of fatigue during prolonged exercise has focused on the role of the brain. Studies applied pharmacological or nutritional manipulations to affect the serotonergic, noradrenergic and dopaminergic neurotransmitter systems and look at how this influenced fatigue. The outcomes are however not that straightforward. It seems that in human subjects the manipulation of the noradrenergic neurotransmitter system has profound negative effects on performance in a normal ambient setting, while no significant changes were observed after the manipulation of dopamine or serotonin.
Nevertheless, when an additional external stressor was added to the equation, changes in catecholamine levels induced by pharmacological manipulations exerted significant effects on performance. Identical to the outcomes in normal ambient temperature, noradrenergic reuptake inhibition had vast negative effects on performance. The manipulation of dopamine, through methylphenidate or bupropion, significantly improved performance. Subjects pushed harder and became much warmer without perceiving this. This line of work strongly suggests a role for the central nervous system in the onset of fatigue, but obviously fatigue during prolonged exercise remains a complex interplay between both central and peripheral aspects.
The central nervous system is also largely involved in another aspect of fatigue, i.e. mental fatigue. Mental fatigue is a psychobiological state that has already shown to be detrimental for physical and technical performance. Strong links have been made between the occurrence of mental fatigue and changes in brain neurotransmitter concentrations. One of the most mentioned hypothesis is that neural activity increases the extracellular concentration of adenosine , and that brain adenosine accumulation reduces endurance performance. It is speculated that adenosine accumulation in the pre supplementary motor area and anterior cingulate cortex could also partly explain the higher than normal perceived exertion during an endurance exercise in a mentally fatigued state. Finally, very few other studies have looked into the effects of brain chemistry on the development or consequences of mental fatigue, creating an urge for scientists to further unravel the mechanisms behind this phenomenon.

PSYCHOLOGY AND THE DRIVE TO EXERCISE

SCHIPHOF-GODART, L.

THE HAGUE UNIVERSITY OF APPLIED SCIENCES

Middle-distance and endurance sports are booming, both in the general population and at elite level. The investments required for participating and performing in endurance exercise are considerable for all participants, and the lucidity of this behaviour may escape more than one bystander.
In psychology, this complex subject has been addressed by examining athletes' motivation to exercise and passion for sports. The drive to exercise can nevertheless also be approached from a neurophysiological point of view.
Attempts to influence athletes' performance through the manipulation of internal factors such as brain neurotransmitters or pain perception, or by modifying external factors such as athletes' environments, have been made, providing novel insights in the regulation of exercise behavior and pacing.
Although interesting patterns appear, neither psychological nor physiological approaches separately seem sufficient in predicting athletes' exercise behaviour such as pacing during endurance exercise.
It therefore is our belief that both psychological and physiological factors should be examined in combination, in order to study the short and long term effects and outcomes of manipulation of athletes' drive to exercise. In this multi-disciplinary session, we will present different expert views on both internal as well as external factors related to the concepts of drive and motivation that might affect endurance exercise behavior and performance, and we will conclude by providing practical applications and future recommendations that have come forward based on these views.
Dr. L. Schiphof-Godart will provide an overview of psychological research concerning the determinants of motivation and the drive to exercise in elite athletes. Concepts such as passion and perfectionism are important character traits impacting on athletic motivation, and might serve to explain excessive exercise behaviour and the effect on sport performance from a psychological point of view. She will focus in particular on the short and long term effects that an enhanced drive to exercise might have on training, pacing and performance behavior, and provides insight in potential negative consequences in the context of overtraining and athlete drop out.

Oral presentations

OP-BN06 ACL injury: Prevention and rehabilitation

A COMPARISON OF THE EFFECTS OF ANTICIPATION BETWEEN LEGS ON THE BIOMECHANICS OF A NOVEL ONE-LEG DOUBLE-HOP TEST INVOLVING MEDIAL DIAGONAL HOPS IN PERSONS WITH ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

ARUMUGAM, A., MARKSTRÖM, J., HÄGER, C.

UMEÅ UNIVERSITY

INTRODUCTION: Recent evidence on one-leg cutting tasks reports increased knee abduction and internal rotation angles and moments, associated with a risk of anterior cruciate ligament (ACL) (re-)injury, during unanticipated compared to anticipated cutting maneuvers. We proposed a novel one-leg double-hop test (a forward hop followed by a medial diagonal hop (45°)) carried out under unanticipated and anticipated conditions. We compared the effects of anticipation between legs on lower limb biomechanics of the novel test in persons with a unilateral ACL reconstruction (ACLR).
METHODS: Twenty-three persons (age: 24.0±4.2 years, Tegner activity level: 7 (4-9) (median (range)), 18 women) with a unilateral ACLR (37.3±34.5 months after surgery) performed 3 successful unanticipated (UMDH) and anticipated medial diagonal hops (MDH). An 8-camera 3-D motion analysis system (Qualisys, 240 Hz) and 2 force plates (Kistler, 1680 Hz) were used. Participants did medial/lateral diagonal hops (only medial was analyzed) based on a visual cue randomly indicating hopping direction presented about 300 ms before the land-and-cut maneuver for UMDH and about 2 s before MDH. Hip, knee, and ankle peak angles and external joint moments were

calculated during the deceleration phase of the land-and-cut maneuver (initial foot contact to peak knee flexion) for ACLR and non-affected (NA) legs. We conducted 2*2 (leg*condition) repeated measures ANOVAs (post hoc comparisons: paired t-tests) ($p < 0.05$).
RESULTS: Participants demonstrated an overall pattern of hip flexion, abduction, and internal rotation, knee flexion, adduction, and external rotation, and ankle/foot dorsiflexion, supination and internal rotation across conditions and legs. There was a significant interaction between leg and condition for peak knee external rotation (ACLR leg: UMDH > MDH) and ankle plantar flexion angles (NA > ACLR leg in MDH), and hip abduction (NA leg: MDH > UMDH) and external rotation moments (NA leg: MDH > UMDH). Significant main effects were found for condition, regardless of leg, for most angles of the hip (flexion, abduction, int. rotation), knee (flexion, abduction), and ankle (dorsi- and plantarflexion) that were higher while moments of the hip (adduction, ext. rotation), knee (flexion, adduction, ext. rotation), and ankle/foot (dorsiflexion, int. rotation) that were lower during UMDH than MDH. Significant main effects of leg, regardless of condition, were found for hip flexion and adduction angles (ACLR > NA leg), hip abduction angles (NA > ACLR leg), and ankle dorsiflexion moments (NA > ACLR leg).
CONCLUSION: In a sporting context, unanticipated hops might challenge dynamic knee control more than anticipated hops owing to high peak angles in almost all three planes (UMDH > MDH) for ACLR and NA legs. Especially, greater sagittal plane angles for the hip, knee, and ankle reflect a strategy to lower the center of mass during UMDH. However, the higher moments during MDH than UMDH might occur due to pre-planning and rapid execution of MDH.

RETURN TO PLAY, PERFORMANCE AND CAREER DURATION AFTER ANTERIOR CRUCIATE LIGAMENT RUPTURE: A 5-YEAR CASE-CONTROL AND COHORT-STUDY IN TOP LEAGUE FOOTBALL ATHLETES

NIEDERER, D., ENGEROFF, T., WILKE, J., VOGT, L., BANZER, W.

GOETHE-UNIVERSITY FRANKFURT/MAIN

INTRODUCTION: Initial evidence suggests a high return to play (RTP) rate of top-level football players undergoing anterior cruciate ligament (ACL) reconstruction but a lower rate for RTP to the same performance level. As an exclusive look on absolute rates is biased by – inter alia – ageing effects, a comparison with the underlying population, in particular a cohort of matched unimpaired players is needed. A media-based collection and further analysis of the RTP rates and the corresponding quality of play was the aim of our study.
METHODS: We adopted a 5-year cohort and case-control study design. All male players from the first two leagues of five European countries top leagues (England, France, Germany, Italy, and Spain), which sustained an ACL rupture during the season 2010/11 and/or 2011/12, were included. For them and a matched control sample (ratio 1:2; age, market value, playing position, league, and country as matching variables), all data on anthropometrics, injury history, time point of RTP, quantity, and game performance were retrieved by a structured search from the publicly available and validated media-based platforms (transfermarkt.de & whoscored.com; interrater-reliability) 90 %; Cohen's Kappa = .82) until the end of season 2016/17. Injury and return to play-specific data were calculated as absolute incidences, and as rate ratios (RR) to compare the injured and matched control athletes rates and as a survival analysis (log-rank-test; career duration). Factors potentially affecting the RTP duration were further analysed.
RESULTS: Overall, 148 ACL-injuries were documented in 141 players (season prevalence: 1.32 %). RTP-duration was 202±94 days. The RTP rate was 96 % (RR = 100 %), the RTP to same level was 61.5 % (RR = 91.0 %). The RTP duration differed between playing positions ($p < .05$). Five years post RTP, 62.8 % of the ACL group were still engaged in football (RR = 79 %), 40.9 % at the same level (RR = 79.7 %). Survival analysis revealed a systematic group difference in career duration compared to controls (Cox-Mantels $Chi^2 = 12.7$; $p < 0.001$). Game performance (rates/number of completed passes, dribblings, and minutes played) was lower in the ACL athletes than in the matching group during the RTP and post RTP seasons.
CONCLUSION: Although absolute and relative RTP rates after ACL reconstruction are high in professional football, career duration and performance are lower than in the reference group. This calls for a re-rupture and long-term consequences prevention in football players after RTP after an ACL reconstruction.

PATELLAR AND HAMSTRING TENDON AUTOGRAFTS ARE ASSOCIATED WITH DIFFERENT LOADING PATTERN ASYMMETRIES IN A BILATERAL VERTICAL JUMP AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

MILES-COPPARD, J., DANIELS, K.

THE SPORTS SURGERY CLINIC, DUBLIN, IRELAND. THE UNIVERSITY OF BATH, BATH, ENGLAND.

INTRODUCTION: There is a high incidence of anterior cruciate ligament (ACL) injury in many field sports. The gold standard treatment is surgical reconstruction (ACLR), often using a bone-patellar-tendon-bone (BPTB) or hamstring tendon (HT) autograft. Although graft type has been found to affect inter-limb asymmetries in single-leg discrete-point strength (Xergia et al., 2011) and kinetic measures (Webster et al., 2004), its effect on phase-specific loading patterns in bilateral movements has not previously been investigated. Large asymmetries can be associated with poorer knee function and can increase the risk of sustaining a second ACL injury. The aim of this study was to assess counter-movement jump (CMJ) phase-specific impulses and isokinetic strength asymmetries in athletes with a BPTB or HT autograft after ACLR.
METHODS: Male field sport ACLR athletes with a BPTB (n=22) or HT (n=22) autograft completed two testing sessions at approximately 6 and 9 months post-ACLR. An uninjured control group (n=22) completed a single testing session. Vertical ground reaction force during a CMJ was assessed using a dual force plate system. Concentric peak knee extensor torque was measured using an isokinetic dynamometer at 60°/s. Absolute bilateral asymmetry indices (AAIs) were calculated for kinetic impulse during the eccentric deceleration, concentric and landing phases of the CMJ. A repeated-measures ANOVA and post-hoc testing were used to compare jump heights and impulse AAIs amongst all groups over time during all phases. A linear regression model was used to assess the relationship between concentric impulse asymmetry index (AI) and knee extensor strength AI in all groups.
RESULTS: BPTB had a greater impulse AAI than both HT and controls in the eccentric deceleration ($p<0.001$;$p=0.01$) and concentric ($p=0.002$;$p<0.001$) phases, and a greater impulse AAI than controls in the landing phase ($p=0.007$).There were no significant differences in jump height between BPTB and HT ($p=0.95$). The only significant decrease in AAI from 6 to 9 months post-ACLR was in HT during the CMJ concentric impulse phase ($p=0.006$). Isokinetic knee extensor strength AI and CMJ concentric impulse AI were positively correlated in BPTB ($r=0.66$) and HT ($r=0.36$).
CONCLUSION: Graft donor site significantly affected loading patterns during a CMJ in athletes up to nine months post-ACLR, although no differences in jump height performance were identified. BPTB demonstrated greater kinetic asymmetries in all take-off phases than both the HT group and the control group. This group also had greater asymmetries than the control group during the landing phase. Concen-

tric impulse asymmetry was more strongly correlated with isokinetic extensor strength asymmetry in BPTB than HT. Due to these differences in loading patterns, rehabilitation practitioners should consider graft type when evaluating asymmetry post-surgery.
Xergia SA et al.(2011).Knee.Surg.Sport.Traumatol.Arthros.19,768-780
Webster et al.(2004).Knee.Surg.Sport.Traumatol.Arthros.12,15-21

LOWER LIMB ISOKINETIC STRENGTH AND SINGLE LEG DROP JUMP PERFORMANCE IN MALE ATHLETES RETURNING FROM ACL INJURY.

CAFFERKEY, N.

SPORTS SURGERY CLINIC

INTRODUCTION: The anterior cruciate ligament (ACL) is frequently injured in field sports. Symmetrical lower limb strength and jumping ability is important for both injury prevention and sports performance (Menzel et al. 2012). The high rates of ACL injuries during field based activity suggest the need for a better understanding of how strength asymmetries influence single leg jump performance in specific injured populations. The aim of the study was to identify how asymmetries in knee flexor and extensor strength influence bilateral differences in single leg drop jump (SLDJ) performance.
METHODS: Eighty six field sports male athletes, approximately 9 months after unilateral ACL reconstruction (ACLR) from a patellar tendon graft, took part in this study. A 3D biomechanical assessment of 3 maximal single leg drop jumps, on both the injured and non-injured limb, was recorded at 200 Hz using 10 Vicon Bonita cameras and AMTI force plates. Strength of the knee flexors and extensors was assessed by isokinetic dynamometry. Concentric knee extension and flexion strength was assessed at an angular velocity of 60°/s using a Cybex Norm Isokinetic Dynamometer. Inter limb asymmetries in strength and SLDJ performance measures were quantified by a limb symmetry index equation (Schlitz et al. 2009). Linear regression models were defined and fitted between the strength measures (peak torque normalised to body mass and the following SLDJ performance measures: Jump height, contact time, Reactive strength index (RSI) impulse, peak vertical Ground reaction force (GRF) and GRF at lowest vertical position of each subjects centre of mass during the contact phase.
RESULTS: Linear regression analysis examining how the variance between bilateral asymmetries in knee extensor strength predicted the variance in jump height, revealed a significant ($p < 0.001$) moderate relationship ($R2 = 0.25$). A Significant regression value ($p < 0.001$) was also evident between asymmetries in knee extensor strength and RSI scores ($R2 = 0.17$). Lower values of variance were defined ($p < 0.001$) between asymmetries in knee flexor strength and RSI ($R2 = 0.05$), Impulse ($R2 = 0.07$), peak force ($R2 = 0.07$).
CONCLUSION: The results demonstrate that asymmetries in peak torque of knee extensor strength influence jump height and RSI scores during SLDJ. The regression analysis indicates that knee extensor strength was a better predictor of SLDJ performance than knee flexor strength for males returning to field sports after a patellar tendon graft ACLR.

SCREENING AND PREVENTION TOOL FOR ACL INJURY IN BASKETBALL PLAYERS BASED ON KINEMATICS, PLANTAR PRESSURE AND EMG ANALYSIS

DAINESE, M., PAVAN, D., CIBIN, F., GUIOTTO, A., SAWACHA, Z.

UNIVERSITY OF PADUA

INTRODUCTION: Due to the peculiar requirements of a basketball game, jumping-landing is a recurring tasks executed by athletes. The correlations between landing biomechanics and ACL injury risk have been widely demonstrated, along with protocols to assess the landing task execution to predict ACL injuries. The aim of the present study is to develop a landing assessment protocol that can be execute directly in the training court, through plantar pressure insoles, surface electromyography and video based analysis.
METHODS: 10 subjects participated in the study (mean standard deviation (SD) BMI 24,59 ±2,83, age 23,40 ±3,04 years). Subjects, after signing informed consent, performed 9 repeating drop jumps from a 32 cm height, according to previous literature, with 3 different landing approaches: double leg (DL), single leg left (LSL) and right (RSL). Video sequences and plantar pressure (PP) distribution were acquired by means of a Novel Pedar system and 4 synchronized cameras (GoPro Hero3+), with bilateral EMG signals (BTS FreeEMG1000, 8 channels) from: Rectus Femoris (RF), Biceps Femoris Caput Longum (BF), Tibialis Anterior (TA), Gastrocnemius Lateralis (GL). EMG signals were normalized to their peak value during maximum voluntary contraction; EMG peak of envelope and peak of envelope position within the drop jump task cycle were extracted. Hip, knee and ankle joints kinematics were determined on the sagittal plane and their position with respect to the drop jump task evaluated with a purposely developed Matlab code. Specific features were tracked bilaterally on the motion sequences through an automatic tracking of feature software: anterior iliac spine, posterior iliac spine, greater trochanter, lateral femoral epicondyle, calcaneus, two points on the shoes corresponding to the 1st and the 5th metatarsal head. The center of pressure position and the vertical component of the ground reaction forces were extracted from the plantar pressure system. A Matlab code was then developed to calculate and evaluate the knee torque evolution during the performed task, and its association with the joint angle
RESULTS: From kinematic analysis, an imbalance is observed on the right leg. Both in bipodal and monopodal tasks, it can be observed a pre-activation of left Biceps Femoris Caput Longum ($p<0,05$) and left Gastrocnemius Lateralis ($p<0,05$) compared to the right side. This informations supported by the results of the joint torques may be an indication of weakness in the left limb.
CONCLUSION: Differences between left and right leg, along with different approaches to the movements performed by the subjects have been highlighted in terms of EMG data, joint torques and kinematics. The association between maximum joint torque and muscle strategy can be useful in planning ACL injury prevention programs.

FIBRE TYPE TRANSFORMATION IN KNEE EXTENSOR MUSCLE WITH INSUFFICIENCY OF THE ANTERIOR CRUCIATE LIGAMENT IS REVERSIBLE WITH POST-OPERATIVE REHABILITATION AND GRADED TO FOCAL ADHESION KINASE ACTIVATION

FLÜCK, M.

UNIVERSITY OF ZURICH

INTRODUCTION: Transformation of skeletal muscle's contractile and metabolic characteristics has been shown to occur upon reductions and elevations in load-bearing contractile activity (reviewed by Flück and Hoppeler 2003). Whether bona fide fast-to-slow transformation of muscle fibre types takes place in humans, as reported for rodents, is debated (reviewed by Flück and Hoppeler 2003; Wilson et al 2012). We tested whether slow-to-fast transformation of muscle fibres occurs with insufficiency of the anterior cruciate ligament (ACL) and whether this would be reversed with rehabilitation after reconstruction of the ACL in relationship with the molecular index of load-bearing

muscle activity, tyrosine 397 phosphorylation of FAK (pY397-FAK), which governs the slow-oxidative muscle phenotype in rodents (Durieux et al. 2009).
METHODS: 9 patients (29 years, 8 males, 1 female) with unilateral insufficiency of the ACL were included in the investigation. Biopsies were collected from vastus lateralis (VL) muscle of the ACL insufficient and sufficient leg during reconstructive surgery, after 9 weeks of ambulant physio-therapy, following four months of subsequent rehabilitation training and 260 weeks after self-motivated exercise. Slow (I), and fast (IIA and IIB) type muscle fibers, volume density of mitochondria, the expression levels of markers of mitochondrial respiration complexes (I-V), FAK and pY397-FAK, were assessed. Effects were verified with a repeated measures ANOVA or Pearson correlations at a threshold of 5% (SPSS, IBM).
RESULTS: The percentage of type IIB muscle fibres was increased by 115% after 9 weeks of physiotherapy in VL of the ACL- insufficient leg when the percentage of type I muscle fibres (-30%), mitochondrial volume density (-35%) and levels of mitochondrial respiration complex I-III markers (-45-70%) were reduced. Qualitatively similar adaptations were seen in VL from the sufficient leg. All parameters of the slow-oxidate muscle phenotype, including the percentage of type I muscle fibres, recovered 260 weeks after reconstructive surgery. Mitochondrial parameters and percentages of IIB muscle fibres correlated positively (r=0.3-0.6) and negatively (-0.3), respectively, to FAK and pY397-FAK levels.
CONCLUSION: Reversible transformation of the contractile and metabolic fibre phenotype is detectable in human knee extensor muscle after extended durations of altered physical activity. Quantitative linear relationships between slow oxidative characteristics, pY397-FAK levels and time-under tension (Rahnert and Burkholder 2013), suggest that the summed impact of load bearing muscle activity drives plasticity of the metabolic and contractile muscle fibre phenotype.
References: Rahnert JA, Burkholder TJ. J Exp Biol 216(Pt 14): 2619-31, 2013.
Durieux AC, DAntona G, Desplanches D, Freyssenet D, J Physiol 587(Pt 14): 3703-17, 2009.
Flück M, Hoppeler H. Rev Physiol Biochem Pharmacol 146:159-216, 2003.
Wilson JM, Loenneke JP, Jo E, Wilson GJ, J Strength Cond Res 26(6): 1724-9, 2012.

Oral presentations

OP-BN07 Relative age effect and talent selection

THE ROLE OF RELATIVE AGE AND BIOLOGICAL AGE ON TALENT SELECTION IN SWISS YOUTH SOCCER

JAVET, M.1, BORN, D.P.1, MOSER, H.2, FUCHSLOCHER, J.1, ROMANN, M.1
1: SWISS FEDERAL INSTITUTE OF SPORT MAGGLINGEN SFISM , 2: SWISS FOOTBALL ASSOCIATION

INTRODUCTION: In youth soccer, the chronological age is used to group and select the athletes for training and competition. Within these age groups, individuals can differ by as much as 1 year in relative age, which might affect the talent selection process and benefit the athletes born early in the year. Moreover, the biological age varying by 4 years among athletes of the same age group further challenges the homogeneity of training and competition groups (R Malina, Coelho e Silva, & Figueiredo, 2012). The aim of the study was to investigate the effect of relative and biological age on the coaches` performance rating and the talent selection process for the national U15 team players.
METHODS: Within a three year period 185 players (age 14.0 ± 0.3) were recruited from the U15 Swiss national selection days. Players were grouped by birth quarter (Q1: Jan. to Mar.; Q4: Oct. to Dec.) for relative age. The players DXA hand scan (skeletal age) and the Tanner-Whitehouse 3 classification was used to determine the biological age, as an indicator for maturity. Players were classified as early, on time and late developed (R Malina, et al., 2012). Odds ratios (ORs) and 95% confidence intervals (CI) were calculated for birth quarters (relative age) and biological age. Secondly, the effects of relative and biological age were analyzed on the coaches' subjective performance rating evaluated technical skills, game intelligence, personality, and playing speed.
RESULTS: The average skeletal age of the soccer players was 14.1 ± 1.5 years, and did not differ significantly from chronological age. Early maturing players born in Q1 were 4.6 times (95% CI 1.7, 12.0) more likely to be selected for the national team than early matures born in Q4. Late maturing players born in Q1 in turn showed higher ORs (17.9 (95% CI 2.4, 135.0)) than their counterparts born in Q4. The coaches' subjective performance rating showed significantly higher rating in playing speed (3.5 ± 0.5) for early matures than on time (3.2 ± 0.6) and late matures (2.8 ± 0.4). However regarding technical skills and game intelligence, late maturing players (3.7 ± 0.5; 3.6 ± 0.5) were rated significantly higher than early matures (3.3 ± 0.6; 3.3 ± 0.5, respectively).
CONCLUSION: In conclusion, there is an overrepresentation of players with high relative age (born in Q1) that are selected for the national team. Players born late in the year (Q4) need to be early or on time developed to be selected. Players of Q4 with late maturity might have been deselected in previous selection levels. Secondly, the analysis showed that the coaches` subjective performance rating is highly affected by the maturity. Athletes with early maturity are more likely to have good ratings regarding playing speed, while late developed athletes will have high ratings regarding their technical skills and game intelligence.

EVALUATING THE RELATIVE AGE EFFECT IN A MULTI-SPORT ENVIRONMENT: THE FC BARCELONA PARADIGM

DONCASTER, G., MEDINA, D., DROBNIC, F., UNNITHAN, V.
EDGE HILL UNIVERSITY

INTRODUCTION: The relative age effect (RAE) is present when there is a distinct over-representation of players born earlier in the selection year for a given cohort. While there is a plethora of literature examining the presence and implications of the RAE on talent identification within a given sport, there is limited research investigating the presence of the RAE across a range of team sports, within the same club environment. Consequently, the aim of the study was to evaluate the RAE in a team, multi-sport environment within the same club; with a view to identifying RAE commonalities/differences between disparate team sports.
METHODS: The birth-dates of all players (n = 6542) affiliated to each sport (Basketball [n = 1013], male [n = 3012] and female [n = 449] Soccer, Futsal [n = 761], Handball [n = 999] and Indoor Roller Hockey [n = 308]) within the multi-sport professional club (FC Barcelona) and across all age groups (U10, U12, U14, U16, U18 & Senior) were recorded. These were then categorised into relative age quartiles from the start of the selection year (Q1=Jan-Mar; Q2=Apr-Jun; Q3=Jul-Sep; Q4=Oct-Dec). Birth-date distributions across quartiles were then analysed for; a) each sport, b) each age group, irrespective of the sport and c) each age group within each sport, using the Chi-square statistic and odds ratio's (OR) with 95% confidence intervals.

RESULTS: Birthdates across the entire club (all sports and ages) revealed a RAE (Q1= 46.1%, Q2= 27.1%, Q3=17.1% & Q4 = 9.7%, X2 = 29.8, P < 0.01). Odds ratio analysis, for the entire club, revealed players with birthdates in Q1, Q2 and Q3 were represented 4.76 (95% CI's:1.96-11.57), 2.80 (1.12-7.03) and 1.77 (0.67-4.63) more, when compared to Q4, respectively. Odds ratio's between birth quartiles (Q1 v Q4, Q2 v Q4 and Q3 v Q4) were larger in Basketball and male Soccer, when compared to female Soccer, Futsal, Handball and Roller Hockey. With respect to age group comparisons, OR between birth quartiles, became smaller as age increased, with the smallest OR evident in senior age groups.
CONCLUSION: Despite an over-arching club philosophy for psychological and perceptual-cognitive markers being the major drivers for talent identification at FC Barcelona, the RAE was still present within youth age groups (<18 yrs old). Yet, there was no presence of the RAE within senior squads (both within a sport and across all sports). In addition, when there was a reduced number of players within the sport (i.e. a reduced selection pool) the extent of the RAE was less evident between birth quartiles. The findings from this investigation may suggest that while the RAE is normally linked to physical precocity, within the FC Barcelona model, RAE may be coupled to enhanced psychological and percerptual-cognitive attributes, in those born earlier in the selection year.

SPORT PARTICIPATION AND PHYSICAL ACTIVITY LEVELS OF SCHOOL CHILDREN ARE NOT AFFECTED BY RELATIVE AGE

RÖSSLER, R.1,2, ROMMERS, N.3,4, FAUDE, O.2, VERHAGEN, E.1

1VU UNIVERSITY AMSTERDAM, THE NETHERLANDS; 2UNIVERSITY OF BASEL, SWITZERLAND; 3VRIJE UNIVERSITEIT BRUSSEL, BELGIUM; 4GHENT UNIVERSITY, BELGIUM

INTRODUCTION: The "relative age effect" is specifically known from high-level competitive sport, and is responsible for dropout of children disadvantaged by their chronological age (Lemez et al. 2014). If the relative age effect would also be present in the general population of children, this would result in decreased physical activity (PA) levels in children who dropped out of sport. This could have a negative impact on public health. It could be assumed that these disadvantaged children might also be demotivated to play sport in their leisure-time. Therefore, the present study aimed at investigating whether relative age negatively influences leisure-time PA levels and participation in organised sport in a large sample of Dutch school children.
METHODS: Datasets of three large-scale studies (iPlay, Krajicek Playgrounds, and StuntKids) have been used for secondary analysis. The data were collected in a sample of Dutch school children between 8 and 18 years of age using standardised questionnaires. To analyse the influence of relative age, children were grouped according to four birth quarters (Quarter 1: January-March; Quarter 2: April-June; Quarter 3: July-September; Quarter 4: October-December). Analysis of variance was used to test differences in leisure-time PA levels and participation in organised sport between the four birth quarters and between girls and boys.
RESULTS: Data of 5,864 Dutch school children (57.1% boys) with a mean age of 12.4 (SD 1.9) years were analysed. There was no interaction between birth quarter and sex. Leisure-time PA was lower in girls (4.0 hours per week [95%-CI 3.8, 4.2]) compared to boys (4.5 hours per week [95%-CI 4.3, 4.7]). Also participation in organised sport was lower in girls (2.9 hours per week [95%-CI 2.8, 3.0]) than in boys (3.6 hours per week [95%-CI 3.5, 3.7]). There were no statistical differences between the four birth-quarters regarding participation in leisure-time PA and organised sport.
CONCLUSION: These data show lower leisure-time PA and sport participation levels for girls compared to boys. The results suggest that there is no influence of relative age (i.e. birth quarter) on leisure-time PA or participation in organised sport. From a societal perspective, this is a positive and important finding.

THE INFLUENCE OF BIRTH DATE ON PROFESSIONAL FOOTBALL CLUB ENTRY AND CAREER ATTAINMENT: A 20-YEAR RETROSPECTIVE ANALYSIS

GIL, S.M.1, BIDAURRAZAGA-LETONA, I.1, MARTIN-GARETXANA, I.1,2, LEKUE, J.A.1,2, RODRIGUEZ-LARRAD, A.1, LARRUSKAIN, J.1,2

1: UNIVERSITY OF THE BASQUE COUNTRY , DEPARTMENT OF PHYSIOLOGY, FACULTY OF MEDICINE AND NURSING, BASQUE COUNTRY, SPAIN. 2: MEDICAL SERVICES, ATHLETIC CLUB BILBAO, BASQUE COUNTRY, SPAIN

INTRODUCTION: An overrepresentation of athletes born soon after the cut-off date has been observed in many sports, which is known as the Relative Age Effect (RAE)(1). This phenomenon has primarily been investigated in a cross-sectional fashion; however, longitudinal studies are scarce. Thus, the aim of this longitudinal retrospective study was to ascertain the influence of relative age on entry to a professional football club and also its influence on the long-term career attainment.
METHODS: We analysed the birth dates and the career attainment of 1071 footballers who entered the Athletic Club of Bilbao in the under (U) 12, U14, U16, U19, Reserves and 1st Team groups. A player obtained 1st Team status after playing 10 official matches with that team. The year was divided in 4 birth quarters (BQ): BQ1: January-March, BQ2: April-June, BQ3: July-September and BQ4: October-December. The $\chi 2$ goodness-of-fit test, w effect size and odds ratios (OR) with 95% confidence intervals (CI) were calculated.
RESULTS: There was an overrepresentation ($p<0.001$) of players born in BQ1 in the U12 (BQ1:45.4%, w=0.39), U14 (BQ1: 29.7%, w=0.48), U16 (53.8%, w=0.51) and U19 (38%, $p<0.01$, w=0.23) groups and the total (45.1%, $p<0.001$, w=0.37); but not in the Reserves and 1st Team. The OR (95% CI) for BQ1 vs BQ4 in the U12 was 4.28 (2.86-6.40), U14: 8.88 (3.94-20.03), U16: 10.61 (4.77-23.60), U19: 2.24 (1.08-4.66), Reserves: 1.71 (0.73-3.98), 1st Team: 2.73 (0.68-10.98) and Total: 4.36 (3.33-5.71).
Forty players (4.7%) became professional, 18 born in BQ1 and 9 in BQ4. A larger proportion of players born in BQ4 who had entered the club in the U12 and U14 groups became professional (9.5% and 33.3%, respectively), compared to players born in the rest of the quarters. Once the players were within the club, the odds for a player born in BQ4 to become professional were 3 times larger (95% CI: 1.38-6.56) than players born in the rest of the BQs.
CONCLUSION: Birth date has a relevant influence on recruitment of footballers by a professional club, particularly at young ages. As such, players born in the first BQ of the year have greater chances to play in a professional club and to attain the professional level than those born in the last birth quarter, which confirms the deleterious impact of the RAE for the relatively younger. Interestingly, once a relatively younger player has overcome the selection process and is within the club, the chances of becoming professional are larger than that of relatively older players (2), probably due to their genuine talent and/or mental toughness.
References:
1. Cobley et al. Annual age-grouping and athlete development (…). Sports Med 2009;39:235-56.
2. Skorski et al. The Relative Age Effect in German Elite Youth Soccer (…). Int J Sports Physiol Perform 2016;11(3):370-6.
Contact: susana.gil@ehu.eus

Acknowledgements: This study was supported The University of the Basque Country (UPV/EHU) (PPG17/34 and Euskara Errektoreordetza) and the Basque Government (IT922-16).

CAN MOTOR TALENT FACTORS HELP TO PREDICT ELITE FEMALE YOUTH SOCCER PLAYERS' LIKELIHOOD OF TURNING PRO IN ADULTHOOD?

LEYHR, D.1, RAABE, J.2, SCHULTZ, F.1, HÖNER, O.1

1: UNIVERSITY OF TUEBINGEN, GERMANY; 2: PENN STATE ALTOONA, USA

INTRODUCTION: In order to promote the players with the highest potential for success as soon as possible, the process of talent identification and selection in soccer has become increasingly important. As a result, various talent promotion programs have implemented motor diagnostics to complement the subjective assessments of coaches with objective data. While researchers have investigated the prognostic relevance of motor talent factors for adult success in youth soccer (e.g., Höner, Leyhr, & Kelava, 2017), to date no such studies have been conducted with female participants. Therefore, the purpose of the current research was to: (I) analyze the long-term prognostic relevance of motor talent factors for female youth soccer players and (II) compare the motor performance of girls and boys.
METHODS: Participants were N = 807 female U12 soccer players born between 1993 and 2000 who participated in motor diagnostics within the German Soccer Association's talent development program. The test battery comprised five individual tests (sprint, agility, dribbling, ball control, and shooting) and a total motor score. Subsequently, girls' U12 motor performance was used to predict their success in adulthood (i.e., whether an athlete played for a club in the first German women division). Independent sample t-tests were used to determine the significance of mean differences in participants' performance at U12 based on their future selection level. In addition, these results were compared to the motor performance of N = 13,666 male U12 players within the German talent development program using one-way ANOVAs.
RESULTS: Except for shooting, all motor variables significantly discriminated between the selection levels (each $p < .05$). Girls who reached a first division soccer club performed significantly better at U12 than non-selected players ($0.40 \leq d \leq 0.81$). When comparing the average performance of all girls and boys, male players were significantly better in sprint, agility, dribbling, ball control, and the total motor score (each $p < .01$). However, no significant difference with regard to the individual tests was found when comparing the performance of girls selected for a first division soccer club and the average performance across all boys.
CONCLUSION
The current findings indicate that assessing motor performance can assist in predicting female U12 players' future success in adulthood. While it seems that boys, in general, already outperform their female counterparts with regard to the assessed motor variables at an early age (U12), the future professional female athletes perform comparably to average boys.
REFERENCES: Höner O, Leyhr D, Kelava A (2017). PLoS One.
CONTACT: daniel.leyhr@uni-tuebingen.de

DEVELOPMENT OF TALENTED YOUTH FOR TOP PERFORMANCE – CHALLENGES, ETHICAL AND SOCIAL ISSUES ALONG THE WAY

PILZ-BURSTEIN, R., BETZER-TAYAR, M., LEV, A.

GIVAT WASHINGTON ACADEMIC COLLEGE OF EDUCATION

DEVELOPMENT OF TALENTED YOUTH FOR TOP PERFORMANCE – CHALLENGES, ETHICAL AND SOCIAL ISSUES ALONG THE WAY
Pilz-Burstein, R.1, Betzer-Tayar, M. 2, Lev, A. 3,4. 1: Givat Washington Academic College of Education , 2: Ruppin Academic Center, School for Business and Economy , 3: Sammy Ofer School of Communications Interdisciplinary Center , 4: The Academic College at Wingate, Wingate Institute
Introduction: Optimizing the development of young talented athletes has gained a wide spectrum of scientific and professional attention. Yet, raising young athletes in the framework of a boarding school, away from home and family, involves ethical and managerial dilemmas that the professional team has to face on a daily basis. A case study of the Wingate Academy of Sports Excellence in Israel is reviewed.
Methods: We present firsthand experience for a period of over 12 years, from a professional view of key role positions at the WASE. The first two authors played a significant role in the strategy and decision making of the organization, and also as important figures in the personal and social lives of the young athletes. Using qualitative methods, we analyzed semi-structured and unstructured interviews and also informal conversations with the athletes, as well as organizational memos that were documented. All these provided a fertile ground for discussing the three main conflictual themes, seen as follows, that the athletes and managerial staff confront on a daily basis.
Results: a. High athletic performance versus academic achievements: The main requirement of the Ministry of Education and the athletes parents, i.e., academic achievements, sometimes contradicts with the target of the Ministry of Sport and the coaches, who strive for athletic achievements. Yet it is the Academys responsibility to optimize and provide a balance between the two for developing a well-rounded person and a valuable citizen; b. Athletic career versus a meaningful military service: This is a significant dilemma quite unique to Israeli society. Military service not only is compulsory in Israel, but it also represents a strong national awareness and a sense of commitment to the Israeli social ethos. However, it sometimes means giving up the athletes sport career and his or her life's dream; c. No pain, no gain – A double message? Fulfillment of the athletic expectations causes a professional conflict between the medical staff and the national federations that expect the coaches deliver top results. But "no pain, no gain" refers not only to physical pain, but also to the mental-psychological stress that plays a dramatic role in the wellness and security of the young athlete.
Discussion: All of these dilemmas have more than one single solution, and are solved in various ways in sport academies world-wide. Therefore, this presentation does not claim what is right or wrong, rather it points to the importance of our awareness of the existing complexities in the case of the WASE. Although each of these questions relates to a specific domain – educational, social, mental or medical, they all reflect an ethical-philosophical dilemma: While being committed to values of excellence and to "best practice", is our primary commitment to the sport bodies that aim for national achievements? Or, are we primarily bound to the young talented athletes and their families, who rely on our professional and ethical judgment in taking responsibility for a well-rounded development process of these young athletes.
Contact: rutipb@gmail.com

Oral presentations

OP-PM39 Interval training 2

INVESTIGATING THE INFLUENCE OF 6 MONTHS HIGH-INTENSITY INTERVAL TRAINING ON ARTERIAL STIFFNESS IN ADOLESCENTS: COMMANDO JOES' X4A TRIAL

MCNARRY, M.A., ELLINS, E.A., WINN, C.O.N., EDDOLLS, W.T.B., STRATTON, G.S., HALCOX, J.P.J., DAVIES, G.A., MACKINTOSH, K.A.

SWANSEA UNIVERSITY

INTRODUCTION: Cardiovascular disease is one of the leading causes of mortality in Western societies, with deterioration in endothelial function and arterial stiffness early indicators of cardiovascular damage. Whilst the beneficial effects of regular exercise training on cardiovascular performance have been documented in adults, little is known regarding the applicability of such findings to adolescents, despite evidence that arteriosclerosis begins in childhood. The purpose of the present study was therefore to investigate the influence of high-intensity interval training on arterial stiffness in adolescents.
METHODS: Thirty-four children (Int; 12.1 ± 0.9 yrs; 20 boys) were recruited to a six-month, three times a week, high-intensity interval training (HIIT) intervention (30 min sessions, 10-30 s exercise bouts at >90% age-predicted max heart rate, 1:1 exercise-to-rest ratio) with thirty-two children in a separate school acting as a control group (Con; 12.2 ± 1.0 yrs; 18 boys). Augmentation index and pulse wave velocity were measured with applanation tonometry and cardiorespiratory fitness was measured by an incremental ramp cycle ergometer test to determine peak oxygen uptake (O2). A repeated mixed measures analysis of variance was used to investigate the influence of the intervention and time, with Pearson correlations to assess the relationship between parameters.
RESULTS: Despite a significant increase in cardiorespiratory fitness over the six-month intervention irrespective of exercise group (Con: 2.19 ± 0.51 vs. 2.33 ± 0.56; Int: 2.04 ± 0.50 vs. 2.40 ± 0.63 l·min-1; P < 0.05), HIIT did not elicit any significant changes in pulse wave velocity (Con: 5.6 ± 0.51 vs. 5.7 ± 0.5; Int: 5.6 ± 0.6 vs. 5.5 ± 0.6 m·s-1; P > 0.05), augmentation index (Con: 8.8 ± 7.5 vs. 9.3 ± 6.5; Int: 9.2 ± 6.0 vs. 7.4 ± 4.5 %; P > 0.05), central (Con: 52 ± 7 vs. 52 ± 7; Int: 50 ± 6 vs. 50 ± 7 b·min-1; P < 0.05) or peripheral pulse pressure (Con: 62 ± 9 vs. 61 ± 8; Int: 59 ± 7 vs. 60 ± 7 b·min-1; P > 0.05). There was no relationship between cardiorespiratory fitness and arterial stiffness at baseline or in response to the HIIT intervention.
CONCLUSION: The current study demonstrates that despite significant improvements in cardiorespiratory fitness, HIIT does not improve parameters of arterial stiffness in youth. These findings may be related to the healthy baseline arterial compliance, minimising the capacity, or indeed need, for improvement. Future studies should consider the role of HIIT in ameliorating the deleterious changes in arterial stiffness observed in obese youth.

MITOCHONDRIAL RESPIRATION IS REDUCED IN ABDOMINAL ADIPOSE TISSUE IN WOMEN WITH POLYCYSTIC OVARY SYNDROME, AND UNALTERED FOLLOWING 16 WEEKS OF HIGH INTENSITY INTERVAL TRAINING

LIONETT, S., KIEL, I., VANKY, E., MOHOLDT, T.

NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

INTRODUCTION: Polycystic ovary syndrome (PCOS) is an endocrine disorder affecting ≥20% of reproductive-aged women. Beyond causing infertility, PCOS is associated with metabolic disorders such as insulin resistance. The mechanisms underlying the insulin resistance in PCOS are unclear, but are suggested to be related to abnormal adipose tissue function and morphology. Exercise training improves insulin resistance in PCOS, yet the underlying mechanisms for improved whole-body and tissue-specific metabolism in women with PCOS after training are unknown. The aims of the study were to investigate adipose tissue function in sedentary women with and without PCOS as well as the effect of high intensity interval training (HIT) on adipose tissue function in women with PCOS.
METHODS: Adipose tissue biopsies were obtained from abdominal and gluteal subcutaneous regions of sedentary women with PCOS (n=16; 28 ± 5 y, 32.0 ± 7.5 kg/m2) and without PCOS (n=11; 30 ± 5 y, 29.3 ± 6.1 kg/m2). The women with PCOS were randomized to two different HIT groups (3 × per week, either 10 × 1 min "all-out" intervals (n=4) or 4 × 4 min reaching 90-95% of HRmax (n=6)) for 16 weeks, or control (n=6). Following the 16 weeks of HIT, a second set of abdominal and gluteal subcutaneous adipose tissue biopsies were obtained. Currently, pre and post data from 10 × 1 min (n=1) and 4 × 4 min (n=3) are complete, therefore, data from the HIT groups are pooled. Adipose tissue function was measured as mitochondrial respiration using high-resolution respirometry (Oxygraph-2K, Oroboros).
RESULTS: At baseline, a lower uncoupled respiration (P=0.02), as well as reduced electron transfer system capacity through complex II (P=0.03), in abdominal adipose tissue of women with PCOS compared to women without PCOS was observed. Furthermore, a tendency towards a lower maximal mitochondrial oxidative phosphorylation capacity using fat + Complex I and II substrates (P=0.08) and electron transfer system capacity through Complex IV (P=0.06) was observed in abdominal adipose tissue of women with PCOS compared to women without PCOS. There were no between-group differences in mitochondrial respiration of the gluteal adipose tissue at baseline. There was no effect of HIT on mitochondrial respiration.
CONCLUSION: The lower mitochondrial respiration in abdominal adipose tissue in women with PCOS compared to women without PCOS suggests mitochondrial dysfunction may play a role in the pathophysiology of the metabolic disorders observed in PCOS. HIT does not improve the impaired adipose tissue function (i.e. mitochondrial respiration) in women with PCOS.

EXTREMELY SHORT DURATION REDUCED-EXERTION HIGH-INTENSITY INTERVAL EXERCISE IMPROVES 24 H FREE-LIVING GLYCAEMIC CONTROL IN MEN WITH TYPE 2 DIABETES

METCALFE, R., FITZPATRICK, B., FITZPATRICK, S., MCDERMOTT, G., BRICK, N., MCCLEAN, C., DAVISON, G.

SWANSEA UNIVERSITY

INTRODUCTION: High-intensity interval training (HIT) has been proposed as an alternative exercise strategy to improve glycaemic control in people with type 2 diabetes. However, the assertion that HIT is time-efficient is often misleading, with the protocols studied to date requiring 25-60 mins to complete. A genuinely time efficient HIT intervention (reduced-exertion HIT; REHIT) has been shown to improve aerobic capacity and blood pressure in men with type 2 diabetes over 6-weeks of training. However, the acute effects of REHIT on 24 h glycaemic control in type 2 diabetes have not previously been determined.

METHODS: Eleven men with type 2 diabetes (mean ± SD: age, 52±6 years; BMI, 29.7±3.1 kg/m2; HbA1c, 52±9 mmol/mol [7.0±0.8 %]) participated in a randomised, four-trial crossover study, with continual interstitial glucose measurements captured during a 24 h period including either: (1) no exercise (CON); (2) 30 min of continuous exercise (MICT); (3) 10 x 1 min at ~90 HRmax (HIIT; time commitment, ~25 min); and (4) 2 x 20 s 'all-out' sprints (REHIT; time commitment, 10 min). Dietary intake and exercise timing (30-min post breakfast) were standardised across experimental conditions. Magnitude-based inferences were used to interpret mean differences between the experimental conditions expressed with 90% confidence limits. Inferences were made using standardised effect size (Cohens d) thresholds of 0.2 (smallest worthwhile effect), 0.6 (moderate effect) and 1.2 (large effect).
RESULTS: Compared with CON, there were possibly moderate beneficial decreases in mean 24-h glucose with REHIT (mean difference; ±90%CI: -0.58±0.27 mmol/L) and HIIT (-0.36; ±0.37 mmol/L), and a likely small beneficial decrease with MICT (-0.37; ±0.26 mmol/L). Similarly, there was a possibly moderate decrease in the prevalence of hyperglycemia following both REHIT (-110; ±44 min/day) and HIT (-125; ±77 min/day), and a likely small decrease following MICT (-110; ±81 min/day) compared with CON. 24-h incremental area under the curve (iAUC) was also lower following REHIT (-296; ±250 mmol/L/24h; possibly moderate decrease), HIIT (-364; ±310 mmol/L/24h; possibly moderate decrease) and MICT (-494; ±270 mmol/L/24h, likely moderate decrease) compared with CON. Differences between exercise conditions for mean 24-h glucose and the prevalence of hyperglycaemia were all unclear or trivial, but MICT was associated with additional clear beneficial decreases in iAUC compared with REHIT (-198; ±230 mmol/L/24h, likely small decrease) and HIIT (-130; ±160 mmol/L/24h, possibly small decrease).
CONCLUSION: We conclude that acute bouts of submaximal HIIT, supramaximal REHIT and 30 mins of MICT are beneficial for 24-h glycaemic control in men with type 2 diabetes. REHIT may offer a genuinely time-efficient alternative exercise option for men with type 2 diabetes.

JUMPS AS A FORM OF HIGH INTENSITY INTERVAL TRAINING: EFFECT OF REST DURATION ON OXYGEN UPTAKE, HEART RATE AND LACTATE ACCUMULATION

KRAMER, A., POPPENDIEKER, T., GRUBER, M.

UNIVERSITY OF KONSTANZ

INTRODUCTION: High intensity interval training (HIT) has been shown to elicit similar adaptations as high volume moderate intensity endurance training. However, most HIT research has been conducted on running and cycling. The aim of this study was to assess suitability of jumps as a type of intermittent HIT by analyzing the metabolic load during different jump sessions.
METHODS: Respiratory gases, heart rate and ground reaction forces were recorded for 21 healthy young participants during five distinct jump sessions that differed with respect to the rest durations in between series (0, 15 or 30s) and in between jumps (0, 1 or 2s). The following rest combinations were used: 0-0, 30-0, 15-1, 30-1 and 30-2. After each series of jumps, the participants' perceived exertion was documented, and blood lactate was determined three minutes after the last series. The five jump sessions were completed on five different days, separated by at least two days of rest. Prior to the first session, maximal countermovement jump height as well as maximal oxygen uptake during a ramp cycle test was recorded.
RESULTS: Maximal heart rate for all five jump sessions reached at least 96±4% of the maximal heart rate in the ramp test. Perceived exertion on the 6-20 BORG scale reached 17±2 to 19±1 after the last series. VO2peak, time at ≥90%VO2, lactate and average jump height differed between jump sessions, with the 0-0 session eliciting the highest responses and the 30-2 session eliciting the lowest responses.
CONCLUSION: Metabolic load during the intermittent jump HIT training was high. The duration of rest periods in between jumps and in between jump series had a pronounced effect on metabolic load. The results of this study can help to program intermittent HIT that uses specific exercises instead of cycling or running.

EFFECTS OF MODIFIED SPRINT INTERVAL TRAINING ON PHYSIOLOGICAL RESPONSES IN MODERATELY TRAINED FEMALES

KAVIANI, M., TAHERI, M., HEMMATINAFAR, M., NEMATI, J.

ACADIA UNIVERSITY

INTRODUCTION: Sprint interval training (SIT) is a form of high intensity interval training (HIIT) when shorter work bouts performed at peak power intensity. The usage of sprint interval training (SIT) has been on the rise in athletes, recreational, and clinical populations. However, whether there is any potential sex-based differences in the acute and adaptive responses to SIT when controlling for various factors, such as menstrual cycle phase and relative fitness yet to be fully understood. Therefore, this study investigated effects of modified SIT protocols on physiological responses in moderately trained females.
METHODS: Ten moderately trained females (age, 23.8 ± 2.82 years; height, 164.8 ± 7.19 cm; weight, 57.2 ± 6.97 kg; Vo2max, 40.5 ± 3.1) voluntarily completed two SIT sessions in a randomized cross-over design separated by four weeks: (i) 30:240 (4 × 30-s bouts, 240-s recovery); (ii) (3) 5:40 (24 × 5-s bouts, 40-s recovery). Protocols were matched for the total duration of work (2 min) and recovery (16 min), as well as the work-to-recovery ratio (1:8 s). EE and fat oxidation rates, excess post exercise oxygen consumption (EPOC), and respiratory exchange rate (RER) were calculated from gas analyzer collected before, during, and for 90 min post exercise.
RESULTS: Results showed that EE during exercise in 5:40 was significantly higher (p =0.000) than 30:240 protocol. Also, EE post exercise was greater (p = 0.036) in 5:40 versus 30:240. Post exercise fat oxidation was higher (p=0.000) after 30:240 (0.098 g/m) than 5:40 protocol (0.082 g/m). RER in 5:40 (0.78) was greater than 30:240 (0.75) (p=0.000).
CONCLUSION: In conclusion, 5:40 SIT protocol increased EE during exercise thorough targeting peak power generation, while 30:240 SIT protocol promoted greater post exercise fat oxidation. It has been suggested that women tend to have a higher contribution (approximately 25%) of aerobic metabolism to a 30-s compared with men , which could explain in part the greater fat oxidation in 30:240 protocol versus 5:40 protocol.
Hill DW, Smith JC, Texas N. Gender difference in anaerobic capacity: role of aerobic contribution. Br J Sports Med. 1993;27:45–8
Tarnopolsky MA. Sex differences in exercise metabolism and the role of 17-beta estradiol. Med Sci Sports Exerc. 2008;40:648–54
Lloyd Jones MC, Morris MG, Jakeman JR. Impact of time and work:rest ratio matched sprint interval training programmes on performance: A randomised controlled trial. J Sci Med Sport. 2017 Nov;20(11):1034-1038.

Tarnopolsky MA. Sex differences in exercise metabolism and the role of 17-beta estradiol. Med Sci Sports Exerc. 2008;40:648–54
Lloyd Jones MC, Morris MG, Jakeman JR. Impact of time and work:rest ratio matched sprint interval training programmes on performance: A randomised controlled trial. J Sci Med Sport. 2017 Nov;20(11):1034-1038

THE EFFECT OF 8 WEEKS OF HIGH INTENSITY INTERVAL RESISTANCE TRAINING ON E-SELECTIN AND WHITE BLOOD CELL INDICES IN HEALTHY MEN

MORADI, L.

ISLAMIC AZAD UNIVERSITY, NORTH TEHRAN BRANCH

INTRODUCTION: Exercise has positive and negative effects on athlete's immune system and sometime can be increased risk of infection (Del Giacco SR, 2014). The aim of this study was to investigate the effects of 8 weeks of high intensity interval resistance training on E-selectin and White blood cell indices in healthy men.
METHODS: Twenty four active healthy men were selected and randomly divided into two groups: training (n=11) and control (n=12). Training group was performing high intensity interval resistance training for 8 weeks while control group continued their normal daily life styles. Dependent and independent t-test was used for statistically analyses. Level of significance was p=0.05.
RESULTS: Results were shown that 8 weeks of interval resistance exercise significantly decreased level of E-selectin (p=0.001), but differences between control and training groups in monocytes, lymphocytes, basophiles and eosinophils was not significant (p>0.05), also there was significant relation between body weight and E-selectin changes (r=.67, p= 0.001).
CONCLUSION: High intensity interval resistance training did not result in white blood cells indices excitation because of enough recovery between sets and repetitions, but E-Selectin were sensitive to exercise pressure (Ogawa, Sanada, Machida, Okutsu, & Suzuki, 2010)and load imposed on body by training and showing higher adaptation to high intensity interval resistance training.
References:
Del Giacco SR, S. M., Argiolas F, Firinu D, Del Giacco GS. (2014). Exercise training, lymphocyte subsets and their cytokines production: experience of an Italian professional football team and their impact on allergy. BioMed Research International, 2014.
Ogawa, K., Sanada, K., Machida, S., Okutsu, M., & Suzuki, K. (2010). Resistance exercise training-induced muscle hypertrophy was associated with reduction of inflammatory markers in elderly women. Mediators Inflamm, 2010, 171023. doi:10.1155/2010/171023
Sakr SA, Ramadan MM, El-Gamal A. The inflammatory response to percutaneous coronary intervention is related to the technique of stenting and not the type of stent. The Egyptian Heart Journal. 2015.
Croymans D, Krell S, Oh C, Katiraie M, Lam C, Harris RA, et al. Effects of resistance training on central blood pressure in obese young men. Journal of human hypertension. 2014;28(3):157-64
Contact: moradi.lida@gmail.com

Invited symposia

IS-SH05 An app for everyone?!

DEVELOPMENT OF A SPORTS APP DECISION TOOL FOR PROFESSIONALS AND END-USERS

VOS, S.1,2, HOES, K.1, JANSSEN, M.1,2, DALLINGA, J.M.3,4, LAURIJSSENS, S.1, DEUTEKOM, M.3,4, NEDERSTIGT, J.1

1: FONTYS UNIVERSITY OF APPLIED SCIENCES , 2:EINDHOVEN UNIVERSITY OF TECHNOLOGY , 3: AMSTERDAM UNIVERSITY OF APPLIED SCIENCES , 4:INHOLLAND UNIVERSIT

Vos, S. 1&2, Hoes, K. 1, Janssen, M. 1&2, Dallinga, J.M. 3&4, Laurijssens, S. 1 , Deutekom, M. 3,4, Nederstigt, J. 1 ,
1: Fontys University of Applied Sciences (The Netherlands), 2:Eindhoven University of Technology (The Netherlands), 3: Amsterdam University of Applied Sciences (The Netherlands), 4:Inholland University of Applied Sciences (The Netherlands)
Introduction: In recent years, there has been an exponential increase in the availability and use of sports-related smartphone applications (apps) (Janssen et al., 2017). Although these apps are mostly used by unorganized sports participants, professionals such as such as lifestyle professionals and personal trainers are confronted with sports apps in their everyday work. For both end-users and professionals, it is difficult to determine which app fits their (clients') needs and wishes. The aim of this study was to develop a decision tool which supports professionals and end-users in their selection of sports apps.
Methods: The development of the decision tool consisted of four phases. First, a screenings protocol for apps was developed based on a literature review and two expert meetings. This protocol was used to evaluate and select sports apps. Second, we conducted online Delphi panels with four expert groups and participatory action research (Koshy et al., 2010) with 20 professionals and their clients to discuss and test the usability of these apps. Third, the decision tool was developed following an iterative design approach to incorporate user feedback in the earliest possible prototypes. Fourth, the logic of the decision tool was tested and validated against baseline measurements in decision-making behavior within app stores to measure the translation from user-specific goals to mobile app specifications.
Results: An online web-based decision tool was developed within six prototyping stages, using paper prototyping, visual mockups, three stages of rapid development and releasing one final production version of the web-based decision tool. The tests with both professionals and end-users revealed basic must-have criteria to assure minimal usability to facilitate the decision process.
Discussion: At the conference, the development process of the decision/selection tool for sports apps will be presented, and the results of the different sub-studies will be discussed.
Acknowledgements
This work was supported by SIA RAAK, part of the Netherlands Organization for Scientific Research (Grant 2015-02-32P).
References: Janssen M, Scheerder J, Thibaut E, Brombacher A, Vos S. Who uses running apps and sports watches? Determinants and consumer profiles of event runners' usage of running-related smartphone applications and sports watches. PLoS ONE; 2017; 12(7): e0181167. doi.org/10.1371/journal.pone.0181167
Koshy, E, Koshy, V, Waterman, H. (2010) Action research in health care. London: SAGE
Contact: steven.vos@fontys.nl

APP PREFERENCES AND EXPERIENCES OF RECREATIONAL RUNNERS, CYCLISTS AND WALKERS

DALLINGA, J.M., VAN DER WERF, J., JANSSEN, M., LAURIJSSENS, S., VOS, S., DEUTEKOM, M.

AMSTERDAM UNIVERSITY OF APPLIED SCIENCE

APP PREFERENCES AND EXPERIENCES OF RECREATIONAL RUNNERS, CYCLISTS AND WALKERS

Dallinga J.M.1&2, van der Werf J.1, Janssen M.3&4, Laurijssens S.3, Vos S.3&4, Deutekom M.1&2, 1: Amsterdam University of Applied Sciences (Amsterdam, the Netherlands), 2: Inholland University of Applied Sciences (Haarlem, the Netherlands), 3: Fontys University of Applied Sciences (Eindhoven, the Netherlands), 4: Eindhoven University of Technology (Eindhoven, the Netherlands)
Introduction: A huge amount of applications (apps) for running, cycling and walking is available in the App Stores. As recreational athlete, it is hard to choose the best app that matches personal wishes and goals. In the development of a decision tool for sport-app choice, it is important to understand the opinion of individual, recreational athletes about apps. Therefore, the aim of this study is to gain insight in app preferences and experiences of recreational runners, cyclists and walkers.
Methods: First, online surveys were sent to participants of a recreational running, cycling and walking event 2-3 days after the events. The following issues were addressed: frequency and goal of app use, satisfaction and preference for app functions. Frequency analyses were performed. Cluster analyses were performed as well to determine profiles of app and function preferences. Second, the mostly used sport-apps were tested by recreational athletes by means of a participatory action research (Koshy, 2005). In focus groups, their experiences were evaluated. A thematic analysis was conducted.
Results: A large amount of data was collected about app preferences in recreational runners (n=6.019, 14%), cyclists (n=939, 23%) and walkers (n=2.876, 25%). First results show that use of sport-apps ranged from 44% in walkers to 63% in cyclists and 75% in runners ($p<0.001$). Mostly used apps were Runkeeper for running (23%) and walking (26%) and Strava (61%) for cycling. For all athletes the most important goal of app use was monitoring and gaining insight in performance, however cyclists (93%) indicated this more often than walkers and runners (85%; 64%, respectively, $p<0.001$). A large group of athletes was (very) satisfied about the app they used (93% cyclists, 92% runners, 82% walkers).
Discussion: We will elaborate on the distinctive athlete profiles based on the cluster analysis. Additionally, based on the focus groups, experiences with sport-apps such as Runkeeper and Nike+ Run Club will be discussed. The outcomes are relevant for recreational athletes to choose the best app matching their personal wishes and goals, sport professionals to gain insight in what their clients prefer, and developers of sport-apps to fit the wishes and needs of recreational athletes.
This work was supported by SIA RAAK, part of the Netherlands Organization for Scientific Research (Grant 2015-02-32P).
References: Koshy, V. (2005). Action research for improving practice: A practical guide. London: Sage.
Contact m.deutekom@hva.nl

A SMARTPHONE-BASED TECHNOLOGY PLATFORM FOR PEOPLE WITH HEART DISEASE

RAWSTORN, J.

THE UNIVERSITY OF AUCKLAND

Maddison R1 2, Rawstorn JC1 2, Stewart RAH3, Benatar J3, Whittaker R2, Rolleston A4, Jiang Y2, Gao L5, Moodie M5, Warren I6, Meads A6, Gant N7.
1 Institute for Physical Activity and Nutrition, Australia
2 National Institute for Health Innovation, Auckland, New Zealand
3 Auckland City Hospital, New Zealand
4 The Centre for Health, Tauranga, New Zealand
5 Deakin Health Economics, Australia
6 Computer Science, Auckland, New Zealand
7 Exercise Sciences, Auckland, New Zealand
Introduction: Accessibility barriers constrain utilisation of traditional supervised exercise-based cardiac rehabilitation. Home-based interventions improve access but relinquish supervision and coaching from clinical exercise specialists during exercise training. Mobile health technologies can bridge these gaps by distributing clinical expertise to remotely located individuals during exercise; however, such an approach has yet to be evaluated.
Methods: A two arm, parallel non-inferiority design randomised controlled trial was conducted. 162 participants (61±12.7y, 86% men) were randomised to receive 12 weeks of tele- or centre-based exercise rehabilitation (CBexCR; control). REMOTE-CR provided individualised exercise prescription, real-time exercise monitoring/coaching, and theory-based behavioural strategies via a bespoke telerehabilitation platform; CBexCR provided individualised exercise prescription and coaching via established rehabilitation clinics. Outcomes assessed at baseline, 12 and 24 weeks included maximal oxygen uptake (VO2max, primary) modifiable cardiovascular risk factors, exercise adherence, motivation, health-related quality of life, and economic outcomes (programme delivery, hospital service utilisation and medication costs).
Results: VO2max was comparable in both groups at 12 weeks and REMOTE-CR was non-inferior to CBexCR (adjusted mean difference [95% CI]=0.51 [-0.97 to 1.98] ml·kg-1·min-1, P=.48). REMOTE-CR participants were less sedentary at 12 weeks (-61.5 [-117.8 to -5.3] min·day-1, P=.03), while CBexCR participants had smaller waist (1.71 [0.09–3.34] cm, P=.04) and hip circumferences (1.16 [0.06¬–2.27] cm, P=.04) at 12 weeks. No other between-group differences were detected. Per capita programme delivery (NZD1000/EUR627 vs NZD3336/EUR2091) and medication costs (NZD331/EUR207 vs NZD605/EUR379, P=.02) were lower for REMOTE-CR but hospital service utilisation costs were comparable (NZD3459/EUR2168 vs NZD5464/3425, P=.20).
Discussion: REMOTE-CR is an effective alternative exCR delivery model that can increase reach, reduce delivery costs, and satisfy unique participant preferences. REMOTE-CR could enhance overall exCR utilisation if implemented alongside existing services, particularly among those who are unwilling or unable to attend centre-based programmes. Opportunities for future research will be presented and discussed.
Contact: ralph.maddison@deakin.edu.au

Oral presentations

OP-PM18 Micronutrients

PROPER NUTRIENT INTAKE AND TRAINING INTENSITY DECREASE MUSCLE DAMAGE DURING COMPETITIVE SEASON IN PENTATHLON ATHLETES.

LOUREIRO, L., VIANA-GOMES, D., AZEREDO, D., SALERNO, V.P., PIERUCCI, A.P.T.R.

FEDERAL UNIVERSITY OF RIO DE JANEIRO

INTRODUCTION: It is well known that exercise training and healthy eating habits can affect redox homeostasis by enhancing antioxidant defenses. However, exhaustive exercise can induce excessive reactive oxygen species production, leading to oxidative stress related tissue injury and performance decrease. Professional athletes may be at high risk for oxidative stress, and consequent muscle injury or decreased performance. In this context, we investigated cell damage, antioxidant capacity, oxidative damage and food intake during pentathlon competitive season in professional athletes.
METHODS: Ten athletes were investigated for three weeks before competition. Blood samples were collected at the beginning and at the end of the last training session of the each week. The athletes' intake was evaluated with 24 hours dietary recall performed three times a week. Training sessions were performed for 2h in the morning and 2h in the evening. Each session consisted on three of the five modalities that comprise pentathlon (running, shooting, swimming, equestrian and fencing). During the first and second weeks the training sessions were conducted in high intensity. The week before the competition, technical training was prioritized with maximum speed 20% lower than previous weeks for running and swimming sessions, and mean heart rate ~7% lower compared with first week (Week 1=90%, Week 3=83%).
RESULTS: Alanine aminotransferase (ALT) decreases significantly (approximately 65%) in the last week compared to previous weeks. Lipid peroxidation, measured by TBARs remained unchanged during 3 weeks. Total glutathione (GSHt) reduced after two weeks of intense training but was recovered in the third week. Another important result was the correlation between nutrient intake and ALT variation. Athletes who ingested more pantothenic acid, copper and manganese presented lower cellular damage, r= -0.85; -0.78; -0.75, respectively.
CONCLUSION: Our data suggest that a 7% decrease in training intensity reduces cell injury the week before the competition and that adequate ingestion of nutrients that are cofactors of antioxidant enzymes is directly correlated to athletes' recovery.

CALCIUM, VITAMIN D AND IRON STATUS OF ELITE RUGBY PLAYERS DURING A COMPETITIVE SEASON.

SMITH, D.R., DUCKWORTH, L.C., KING, R.F.G.J., JONES, B.

LEEDS BECKETT UNIVERSITY

INTRODUCTION: Low calcium, vitamin D and iron concentrations are frequently observed in athletes, particularly adolescents, and are therefore key to monitor. Evaluating micronutrient adequacy from diet diaries can be erroneous given athletes typically under-report dietary intakes, and the duration of recording periods required to capture the variability in micronutrient intake is >20 days. Therefore, to accurately measure the micronutrient status of athletes, biomarker assessments are required, which allow comparisons to reference data. This study aimed to measure iron, calcium and vitamin D serum concentrations in elite English rugby league and union players, and determine their adequacy.
METHODS: A total of 39 elite male rugby players (18.0 ± 2.8, range 14.0 – 25.0 years old) completed the study during their respective competitive playing seasons. Fasted total serum calcium, 25-hydroxy vitamin D [25(OH)D] and ferritin were analysed, and compared to reference values where adequacy was assessed as 2.2 to 2.6 mmol.l-1, 50-100 nmol.l-1 and 15-200 mcg.l-1, respectively.
RESULTS: Serum calcium, 25(OH)D and ferritin concentrations were 2.3 (± 0.2, range; 1.9 to 2.6) mmol.l-1, 33.7 (± 34.2, range; 0.2 to 130.9) nmol.l-1 and 89.4 (± 64.9, range; 13.8 to 303.0) mcg.l-1, respectively. Overall, 25(OH)D was significantly less than the lower end of the adequate range (p=0.002), and ferritin and calcium were significantly greater (p<0.001). For calcium, 6 (15%) participants were lower and 33 (85%) were within reference values. For 25(OH)D, 31 (80%) participants were lower, 4 (10%) participants were within, and 4 (10%) participants exceeded reference values. For ferritin, 1 (3%) participant was lower, 35 (90%) participants were within and 3 (8%) participants exceeded reference values.
CONCLUSION: Biomarker assessment of calcium and iron demonstrated the majority of elite rugby players had sufficient concentrations, although given the individual variability, all athletes should be screened for adequacy. Inadequate vitamin D concentrations was common, which may impair muscle and immune function, contribute towards poor bone health and reduce performance measures. Dietary intakes should be optimised and multiple measures of serum 25(OH)D should be obtained across the season to account for exposure to sunlight.
CONTACT:
D.R.Smith@leedsbeckett.ac.uk

IS THE IRON STATUS OF ADOLESCENT ARTISTIC GYMNASTS A PROBLEM WORTHY OF ATTENTION?

GIRO, R.1, SOUSA, M.2, MARQUES, I.T.3,4, RÊGO, C.3,4,5,6

1: FCNAUP , 2: ESS-IPL , 3: CUF PORTO HOSPITAL , 4: ESB-UCP , 5: FMUP , 6 CINTESIS

INTRODUCTION: Adolescent gymnasts are at risk of iron deficiency due to increased nutritional demands for growth and sexual maturation, exercise-induced iron losses and typically insufficient dietary intakes to cover the needs. Still, few studies have explored this issue, particularly in male gymnasts. This study aimed to evaluate the iron status of adolescent artistic gymnasts of both sexes and to characterize potentially influencing factors.
METHODS: Convenience sample of 22 artistic gymnasts (22.7% males, 13.8±1.9 years). Percentages of body fat (%BF) and skeletal muscle mass (%SMM) were measured (InBody230®). Body mass index (BMI)-for-age zscores were calculated (WHO AnthroPlus®). All athletes filled out a questionnaire to inform about training habits (days and hours of training/week) and self-assess pubertal stage (Tanner). Girls reported age of menarche, regularity of menses and oral contraception usage. Biochemical parameters were studied to characterize iron status (hemogram, ferritin and high sensitivity C-reactive protein). Dietary intakes of energy, protein, carbohydrates, lipids, iron and nutrients that may interfere with its absorption (vitamin C, calcium and fibre) were quantified (3-day food record). The prevalence of inadequacy (PI) was determined considering the percent of athletes below the European Food Safety Authority Average Requirements for

energy (Physical Activity Level of 2.0) and all micronutrient intakes except for iron, where the sum of the individual probabilities of inadequacy was calculated according to the Dietary Reference Intakes. Intakes <25 g/d were considered inadequate for fibre. Sex-specific data was compared using the t-student or Mann-Whitney U tests. Pearson and Spearman correlations were studied.
RESULTS: No significant differences were found between sexes for the training, iron status and nutritional intake variables (p≥0.05). Athletes trained a median of 6 (3-6) d/w in a total of 20.8 (6.0-27.0) h. Depletion in iron stores (ferritin <15µg/L) was observed in 4 (20%) gymnasts with equal prevalence between girls (n=3, 20%) and boys (n=1, 20%) and 1 (4.5%) case of anaemia was registered in a female athlete (haemoglobin <12g/dL). The PI was 100% for energy and fibre, 86.4% for calcium, 50.0% for vitamin C and 22.4% for iron. Moderate correlations between haemoglobin levels (13.6±0.9 g/dL) and BMI-for-age z-scores (0.04±0.88; r=-0.530, p=0.011), %BF (13.7±5.0; r=-0.583, p=0.007) and %SMM (47.0±3.3; r=+0.562, p=0.010) were found. Iron intake [10.2 (5.2–25.7) mg/d] was positively correlated with energy (1745.8±300.1 kcal/d; ρ=+0.694, p<0.001) and protein [1.71 (1.11–3.41) g/kg/d; ρ=+0.623, p=0.002] intakes and protein intake was positively correlated with the number of training d/w (ρ=+0.548, p=0.008).
CONCLUSION: Gymnasts of both sexes are susceptible to iron deficiency. Considering its repercussions on health and athletic performance, targeted nutritional support and regular monitoring of iron status are recommended.
Contact: up201307940@fcna.up.pt

IRON METABOLISM REGULATION IN WOMEN AFTER AN ENDURANCE PROTOCOL DEPENDING ON FERRITIN STATUS

ALFARO-MAGALLANES, V.M., BARBA-MORENO, L., CUPEIRO, R., ROMERO-PARRA, N., RAEL, B., MAESTRE-CASCALES, C., SÁNCHEZ-DÍAZ, C., BODOQUE, M., SALMERÓN, C., PEINADO, A.B.

TECHNICAL UNIVERSITY OF MADRID

INTRODUCTION: Intense endurance exercise produces inflammation and IL-6 elevation, which seems to be one of the most powerful factors up-regulating hepcidin levels (1). Nevertheless, this fact can be conditioned by body ferritin levels prior to exercise (2). In addition, sexual hormones may also influence hepcidin response (1). The purpose of this study was to compare the influence of serum ferritin status and menstrual cycle phases over iron, hepcidin and IL-6 regulation in endurance female athletes.
METHODS: Fifteen endurance trained females (35.5±4 yrs; 58.1±5.6 kg; 163.9±5.9 cm; 50.5±3.7 VO2max) performed a maximal graded test and three continuous running sessions of 40 min at 75% of the VO2max velocity throughout different phases of the menstrual cycle (early follicular phase=EFP, mid follicular phase=MFP and luteal phase=LP). Blood samples were taken pre-exercise, 0h and 3h post exercise. Ferritin levels were measured pre-exercise, whereas iron, IL-6 and hepcidin levels were measured in all samples. Two groups were set depending on ferritin status: <20 µg/L (F1) and ≥20 µg/L (F2).
RESULTS: Mix lineal model showed lower iron levels (p=0.004) for F1 (54.1±8.5 µg/dl) than F2 (91.1±8.7 µg/dl), whereas differences between groups for IL-6 and hepcidin were not observed (p>0.05). Menstrual phase and ferritin group interaction presented differences only for iron concentrations (p=0.005). F1 showed lower levels (p=0.07) in EFP (41.7±9.8 µg/dl) than LP (66±10.2 µg/dl), while F2 presented lower levels in EFP (74.76±10.3 µg/dl) than MFP (100.2±9.9 µg/dl; p=0.01) and LP (98.2±10.3 µg/dl; p=0.08).
CONCLUSION: Menstrual phase showed lower iron levels during EFP as expected due to menstrual bleeding (1). Our results did not show differences between ferritin groups for hepcidin and IL-6, contrary to previous studies (2). These differences could be due to the fact that our study sample was only women, instead of men or both genders. Despite some studies have reported oestrogen and progesterone influence on hepcidin and IL-6 levels, no differences for hepcidin and IL-6 were found along menstrual cycle phases. These studies tested sexual hormones influence in animals, in vitro, isolated or with supranatural doses, which is far away from a natural menstrual cycle (1). Summing up, it seems that female´s iron metabolism response to endurance exercise at different ferritin status is similar, although further investigation need to be performed to clarify sexual hormone influence over iron regulation.
References: 1. Sangkhae V, Nemeth E. Adv Nutr 2017;8(1):126–36.
2. Peeling P, Sim M, Badenhorst CE, Dawson B, Govus AD, Abbiss CR, et al. PLoS One. 2014;9(3).
Contact: victor.alfaro10.va@gmail.com

VALINE INTERMEDIATE 3-HYDROXYISOBUTYRATE IS A POSSIBLE BIOMARKER OF MUSCULAR BCAA UTILIZATION FOR ENERGY PRODUCTION IN EXERCISE

MIYAZAKI, T.

TOKYO MEDICAL UNIVERSITY

INTRODUCTION: In skeletal muscles during endurance exercises, carbohydrates and lipids have been well-known to be used as energy sources, but branched-chain amino acids (BCAAs) are also catabolized for energy production. However, the method of evaluating the metabolism of muscular BCAA as energy source during exercises has been unestablished. In the muscles, three BCAAs are catabolized in the mitochondria to acetyl-CoA and/or succinyl-CoA of the TCA cycle via the first common steps and subsequent own steps formed CoA-compounds. In valine catabolic pathway, a small molecule 3-hydroxyisobutyrate (3HIB) is produced from a precursor CoA-compound in the mitochondria, and has been confirmed to be increased in the circulating fluids in situations that increase muscular BCAA metabolic activity such as fasting and diabetes mellitus. Present study purposed to evaluate the changes of 3HIB concentration in serum and skeletal muscles and the influences of BCAA supplementation on the 3HIB concentration in endurance exercises.
METHODS: [1. Animal Study] Wister male rats were loaded to a transient treadmill running at 20 m/min for various durations (0, 30, 60, 120 min, until to exhaustion [135.0 ± 10.5 min]; N=7/group). 3HIB concentration in serum and skeletal muscles (soleus and gastrocnemius), and glucose and free fatty acid (FFA) concentrations in serum were measured after the exercises. [2. Human Study] BCAA (3.2g) or placebo supplementations were given to healthy college males after every meal for two days before a full-marathon race (N=14/group). 3HIB, glucose, and FFA concentrations in serum were measured at two days before, immediately after, and one day after the race. In both studies, 3HIB concentration in serum and muscles was measured by HPLC-MS/MS system.
RESULTS: [Study 1] 3HIB concentration in serum and both muscles significantly increased in a time-dependent manner with significant correlation after the treadmill exercises. Serum glucose and FFA concentrations were significantly decreased and increased, respectively, dependently on the exercise durations. [Study 2] Immediately after the full-marathon race, serum 3HIB concentration significantly increased compared to that before the race, and recovered to basal level after one day. Serum FFA concentration also significantly increased immediately after the race. The increased 3HIB concentration in serum immediately after the race was significantly enhanced by the BCAA supplementation.

CONCLUSION: 3HIB concentration in serum significantly increased correlated with its muscular concentrations by endurance exercise, and the exercise-induced increase of serum 3HIB level was emphasized by BCAA supplementation. Present results suggested that 3HIB in blood could be a possible biomarker of muscular BCAA utilization for energy production in exercise.

Oral presentations

OP-PM57 Exercise interventions

FOUR WEEK MODIFIED HIGH-INTENSITY CIRCUIT TRAINING USING BODY WEIGHT IMPROVES PEAK OXYGEN CONSUMPTION, BUT NOT BODY COMPOSITION IN SEDENTARY WOMEN

KHEMTONG, C.

MAHIDOL UNIVERSITY

INTRODUCTION: Nowadays, weight loss exercise programs have become a popular trend among many nations. High-intensity circuit training using body weight (HICTBW) is the combination of exercises that can be completed within 8 minutes per circuit, while it can improve cardiorespiratory fitness effectively (Brett et al., 2013). However, whether the duration of training as short as 4 weeks of modified HICTBW training has beneficial effects on cardiovascular fitness and weight control for sedentary people is unclear. Therefore, the aim of this study was to investigate the effects of 4-week modified HICTBW on cardiorespiratory fitness and body compositions in healthy sedentary women.
METHODS: Twenty-four sedentary women (age: 35±3 years) were equally divided into trained (TNW) and untrained (CNW) groups. TNW group performed 4-weeks, 3 times weekly, a modified HICTBW training which consisted of 30-sec work and 10-sec rest for 12 exercise positions per 1 round, continuously increased by 1 round every 2 weeks for 4 weeks. Whereas CNW group performed the usual physical activity for 4 weeks. Both groups were advised not to change their dietary habit throughout the program. Body composition parameters, i.e. body weight, body fat mass, and skeletal muscle mass as well as cardiorespiratory fitness parameters, i.e. heart rate (HR), exercise workload and relative peak oxygen consumption (VO2peak) using indirect calorimetry method (Oxycon® mobile, Germany) were measured before and after 4 weeks of training.
RESULTS: At baseline, no differences for all parameters were observed between TNW and CNW groups. After 4-week of HICTBW program, TNW group had significantly increased in exercise workload and VO2peak and lower in HR while performing submaximal exercise testing when compared with CNW group. In both groups, no changes were observed for body composition parameters.
CONCLUSION: 4-week modified program of HICTBW can improve cardiorespiratory fitness parameters, but there was no effect of weight loss in sedentary women who did not change their dietary habits. Our observations seem to suggest that a short duration of 4-week modified HICTBW program does not affect body composition in sedentary women.
Reference
Brett Klika and C. Jordan. (2013). ACSMs Health & Fitness Journal 17(3).
Contact: Khemtong, C. [tmedmet.md_sci3@hotmail.com]
Ajjimaporn, A. [g4036011@gmail.com]

WALKING TRAINING IMPROVES CARDIOVASCULAR FUNCTION AND REGULATION, SYSTEMIC AND LOCAL NITRIC OXIDE BIOAVAILABILITY, OXIDATIVE STRESS AND INFLAMMATION IN PATIENTS WITH INTERMITTENT CLAUDICATION

FORJAZ, C.1, ANDRADE-LIMA, A.1, CHEHUEN, M.1, SILVA JR, N.1, MIYASATO, R.1, SOUZA, R.1, BRUM, P.1, OLIVEIRA, E.1, WOLOSKER, N.2,3

UNIVERSITY OF SÃO PAULO

INTRODUCTION: The increase in cardiovascular morbimortality in individuals with peripheral artery disease (PAD) and intermittent claudication (IC) is associated with alterations in cardiovascular function, cardiac autonomic modulation, endothelial function, oxidative stress and inflammation (Criqui et al.2010). Walking training (WT) is recommended to improve walking capacity in these individuals (Hirsch,et al., 2001), however, knowledge about WT effects on the above mentioned processes are scarce and controversial. Thus, the present study was design to evaluate, in individuals with PAD and IC, the effects of WT on cardiovascular function and autonomic modulation as well as on blood and muscle markers of endothelial function, oxidative stress and inflammation.
METHODS: Thirty-two men with PAD and IC were randomly allocated in two groups: WT (n = 16, 2 sessions/week, 15 bouts of 2 min walking at an intensity corresponding to the heart rate of the pain threshold interspersed with 2 min of passive pause) and control (CO, n =16, 2 sessions/week, 30 min of stretching). At the beginning and end of the study, the following evaluations were done: cardiovascular function (blood pressure – BP, heart rate – HR, rate pressure product – RPP); cardiovascular autonomic modulation (HR variability); oxide nitric availability (blood nitric oxide – NO and muscle nitric oxide synthase – eNOS); oxidative stress (catalase – CAT, superoxide dismutase – SOD, lipid peroxidation – LPO measured in blood and muscle biopsy); and inflammation (interleukin-6 – IL-6, C-reactive protein – CRP, tumor necrosis factor alpha – TNF-alpha, intercellular adhesion molecules – ICAM, vascular adhesion molecules – VCAM measured in blood and muscle biopsy). Data were evaluated by between-within 2-way ANOVA and $P < 0.05$ was set as significant.
RESULTS: WT decreased cardiovascular overload (reducing systolic BP, mean BP, HR and RPP) and improved cardiac autonomic modulation (decreased sympathovagal balance and increased baroreflex sensitivity). WT increased plasma NO and muscle eNOS. WT improved antioxidant defense (increased blood SOD, blood CAT and muscle SOD). It also improved systemic and local inflammation (decreased blood CRP, TNF-alpha, ICAM and VCAM and reduced muscle IL-6, CRP, TNF-alpha, ICAM and VCAM). All these variables presented significant interaction in ANOVA ($P<0.05$)
CONCLUSION: In men with PAD and IC, WT improves cardiovascular function and autonomic modulation, increases NO bioavailability and decreases systemic and local oxidative stress and inflammation. These positive adaptations were observed in the muscle directly affected by the disease as well as systemically, demonstrating an overall effect of WT in individuals with PAD. These alterations may explain, at least in part, the lower cardiovascular morbidity and mortality of these individuals after WT.
References: 1 Criqui, M. et al. (2010). J Vasc Surg, 52, 85-90.
2 Hirsch, A. et al. (2001). JAMA, 286, 1317-24.
Contact: cforjaz@usp.br

THE EFFECT OF THE MEDEX COMMUNITY-BASED EXERCISE REHABILITATION PROGRAMME ON PHYSICAL FUNCTION AND PHYSICAL ACTIVITY IN INDIVIDUALS WITH CHRONIC DISEASE

SKELLY, F., MOYNA, N.M., MCCAFFREY, N., LOUGHNEY, L., FURLONG, B.

DUBLIN CITY UNIVERSITY

INTRODUCTION: Community-based exercise rehabilitation (CBER) is an effective disease management tool for individuals living with chronic conditions. Research has provided evidence for the beneficial effects of attending CBER on functional capacity and quality of life, however these studies have mainly been focused on cardiac and pulmonary rehabilitation programmes. MedEx is a novel CBER programme located at Dublin City University, which accommodates a diversified population of chronic diseases.
Aim: To determine the effect of the MedEx programme on physical function and physical activity in individuals with a range of chronic conditions.
METHODS: 238 participants (46% male; age (mean ± SD) 62.4 ± 11.3 yr) were recruited following referral to CBER by healthcare professionals. Participants had an established diagnosis of coronary artery disease (n=61), chronic obstructive pulmonary disease (n=54), peripheral arterial disease (n=27), cancer, (n=71), or type 2 diabetes (n=25). Participants underwent assessments of anthropometrics (BMI) strength (sit-to-stand test and handgrip dynamometry), flexibility (sit-and-reach test) and aerobic endurance (6-minute time trial). Physical activity was recorded over 7 days using an activPAL3 accelerometer. Participants were instructed to attend 2 MedEx supervised group exercise classes per week on a continuous basis. The 60 minute classes consist of a combination of aerobic and resistance exercise. Participants attended a group exercise consultation at induction and month 1, 3 and 6, which involved the use of behaviour change techniques to improve exercise adherence. Repeat assessments were conducted at 3, 6 and 12 months. Repeated measures ANOVA were used to detect changes in means over time.
RESULTS: By 12 months, 55 participants had dropped out and 52 were lost to follow-up. Of 131 who completed the trial the mean no of sessions was 33.6 ± 24.6 over 12 months. There was a significant effect of time on BMI, F (3, 303)=9.08, sit-to-stand, F (3, 294)=43.74, handgrip, F (3, 309)=5.49, sit-to-reach, F (3, 249)=2.92, 6-minute time trial, F (3, 294)=54.40, and step counts F (3, 216)=2.61. BMI decreased between baseline and 3, 6 and 12 months and between 3 and 6 months. Sit to stand improved between baseline and 3, 6 and 12 months and from 3 to 6 months and 3 to 12 months. Handgrip increased from baseline to 6 and 12 months. Sit and reach improved between 3 and 12 months. Six-minute time trial distance increase between baseline (499.3 ± 111.7 m) and 3 (568.0 ± 149.6 m), 6 (586.4 ± 157.4 m), and 12 months (587.5 ± 148.9 m) and between 3 and 6 months. Step count increased between baseline (7322 ± 2947 steps/d) and 3 months (8097 ± 3422 steps/d).
CONCLUSION: The MedEx CBER had beneficial effects on physical function and physical activity in individuals with a variety of chronic diseases. Many of these benefits were achieved in the first 3 months and maintained.

SUPERVISED, BUT NOT HOME-BASED, ISOMETRIC TRAINING IMPROVES BRACHIAL AND CENTRAL BLOOD PRESSURE IN MEDICATED HYPERTENSIVE PATIENTS: A RANDOMIZED CONTROLLED TRIAL

RITTI-DIAS, R., FARAH, B.Q., RODRIGUES, S.L., SILVA, G.O., PEDROSA, R.P., CORREIA, M.A., BARROS, M.V., DEMENICE, R., MARINELLO, P.C., SMART, N.A., VIANNA, L.C.

UNIVERSIDADE NOVE DE JULHO

INTRODUCTION: The purpose of this study was to compare the effects of supervised and home-based isometric handgrip training on cardiovascular parameters in medicated hypertensives.
METHODS: In this randomized controlled trial, 72 hypertensive individuals (38 to 79 years old, 70% female) were randomly assigned to three groups: home-based, supervised isometric handgrip training or control group. Home-based and supervised isometric handgrip training was completed thrice weekly (4x2minute at 30% of maximal voluntary contraction, with 1-minute rest between bouts alternating the hands). Before and after 12 weeks brachial, central and ambulatory blood pressures (BP), arterial stiffness, heart rate variability, vascular function, oxidative stress and inflammation markers were obtained.
RESULTS: No significant ($p>0.05$) effect was observed for ambulatory BP, arterial stiffness, heart rate variability, vascular function and oxidative stress and inflammation marker in all three groups. Brachial BP decreased in the supervised group (Systolic: 132±4vs.120±3 mmHg; Diastolic: 71±2vs.66±2 mmHg, $p<0.05$), whereas no significant difference was observed in the home-based (Systolic: 130±4vs.126±3 mmHg; diastolic: 73±3vs.71±3 mmHg) and control groups ($p>0.05$). Supervised handgrip exercise also reduced central BP systolic (120±5vs.109±5 mmHg), diastolic (73±2vs.67±2 mmHg); and mean BP (93±3vs.84±3 mmHg), whereas no significant effect was found in the home-based (Systolic: 119±4vs.115±3 mmHg; Diastolic: 74±3vs.71±3 mmHg) and control groups ($p>0.05$).
CONCLUSION: Supervised, but not home-based, isometric training lowered brachial and central BP in hypertensives.

EFFECTS OF COMBINED PHYSICAL ACTIVITY INTERVENTION PROGRAM ON NUTRITIONAL STATUS AND HEALTH-RELATED PHYSICAL FITNESS IN THAI WORKING-AGE POPULATION

OUTAYANIK, B.

KASETSART UNIVERSITY

INTRODUCTION: One indicator of the quality of Thai working-age population in the country is healthy and the key to healthy living consists of 3-E; Emotion, Eating and Exercise. ACSM recommends that the regular exercise on daily living in adults should include cardiorespiratory exercise, resistance exercise, flexibility exercise and neuro-motor exercise (ACSM, 2018). Therefore, the aim of this study was to examine the effects of an 12-week combined physical activity intervention program on nutritional status and health-related physical fitness in Thai working-age population of Kasetsart University, Bangkok, Thailand.
METHODS: One-hundred and twenty-four male and female personnel of Kasetsart university (aged 23-56) were divided randomly into two groups. Group 1 participated into 12-week combined physical activity intervention that comprises a combined exercise program (5 sessions per week of 60 minutes), nutritional education activity and emotional management activity. Group 2 was not received any activity intervention. Measurement were taken at baseline and after 12 weeks, and include lung capacity (LC), %fat, muscle mass (MM), bone mass BM), weight, body mass index (BMI) and levels of fasting blood sugar (FBS), cholesterol (Cho), triglyceride (Tri), high-density lipoprotein (HDL), low-density lipoprotein (LDL), and health-related physical fitness (PACER), modified sit and reach, 60s sit up, handgrip dynamometer test, back and leg dynamometer test to both group. Statistical analysis included descriptive statistics, Pair Sample t-test, and Independent Sample t-test.

RESULTS: Over an 12-weeks intervention study, the experimental group improved significantly their weight, %fat, muscle mass, BMI, FBS ($p<0.01$), cholesterol ($p<0.05$) and cardiorespiratory fitness (CF), and lower back & hamstring flexibility (LBHF), and abdominal muscular strength and endurance (AMSE), and right & left hand and back & leg muscular strength ($p<0.01$). BM, Tri, HDL and LDL did not change significantly during the study period ($p>0.05$). Experimental group were significant improvement than control group in CF ($p<0.01$), LBHF ($p<0.01$), AMSE ($p<0.01$), and right & left hand ($p<0.05$, $p<0.05$), back & leg muscular strength ($p<0.05$, $p<0.01$), and BMI, LC, %fat, weight ($p<0.05$). There were no significantly differences of MM, BM, FBS, Cho, Tri, HDL, LDL between control group and experimental group ($P>0.05$).
CONCLUSION: This study showed that twelve-week combined physical activity intervention program improved the weight, %fat, muscle mass, BMI, FBS, cholesterol, CF, LBHF, AMSE and muscular strength. Therefore, the combined physical activity intervention programs after work every day should be promoted to all personnel of Kasetsart university and enclosed into the plan or mission of university for develop the quality of the working-age population.

EXERCISE TRAINING DURING CHEMOTHERAPY PRESERVES SKELETAL MUSCLE FIBER AREA, CAPILLARIZATION AND MARKERS OF MITOCHONDRIAL FUNCTION, IN PATIENTS WITH BREAST CANCER

MIJWEL, S., CARDINALE, D., NORRBOM, J., IVARSSON, N., WENGSTRÖM, Y., SUNDBERG, C.J., RUNDQVIST, H.
KAROLINSKA INSTITUTET

INTRODUCTION: Exercise has been suggested to ameliorate the detrimental side effects of chemotherapy on skeletal muscle. In the OptitTrain randomized controlled trial for patients with breast cancer (Mijwel et al. 2018), we found beneficial effects over the intervention on lower limb muscular strength and aerobic fitness in both exercise intervention groups, consisting of moderate-intensity aerobic combined with high-intensity-interval training (AT-HIIT) and resistance- combined with high-intensity-interval-training (RT-HIIT), compared to usual care (UC). Therefore, we hypothesized that the exercise training adaptations found in the exercise intervention groups would be reflected on skeletal muscle showing a maintained or improved muscle fiber area, satellite cells, markers of mitochondrial function and capillarization in response to both RT-HIIT and AT-HIIT. The aim of this study was to compare effects AT-HIIT and RT-HIIT to UC on skeletal muscle morphology and function in patients undergoing chemotherapy.
METHODS: Resting skeletal muscle biopsies were obtained pre- and post-intervention from 23 randomly selected women from the OptiTrain-breast-cancer-trial that underwent RT-HIIT, AT-HIIT, or UC during chemotherapy for 16 weeks. Analyzes included citrate synthase activity, immunoblotting for protein levels, myosin heavy chain typing, and immunohistochemistry. ANCOVA adjusted for baseline values was used. All tests were two-tailed and were considered significant at $p<0.05$.
RESULTS: Over the intervention, citrate-synthase activity, muscle fiber cross-sectional area (CSA), capillaries/fiber, and myosin-heavy-chain isoform type-I were reduced in UC. Exercise was able to counteract these declines (citrate synthase: UC vs. RT-HIIT: $p=0.027$, AT-HIIT vs. UC: $p=0.005$; CSA: UC vs. AT-HIIT: $p=0.007$, UC vs. RT-HIIT $p=0.001$; capillaries/fiber: UC vs. AT-HIIT: $p<0.001$, UC vs. RT-HIIT: $p=0.002$; myosin-heavy-chain type-I: UC vs. RT-HIIT: $p=0.016$). AT-HIIT promoted electron-transport-chain protein levels (complex I: $p=0.003$, complex II: $p=0.007$, complex IV: $p=0.004$ vs UC and RT-HIIT favored satellite cell count vs. both UC ($p=0.007$) and AT-HIIT ($p=0.038$).
CONCLUSION: AT-HIIT and RT-HIIT maintained or improved markers of skeletal muscle function compared to the declines found in the UC group, indicating a sustained trainability in addition to the preservation of function during chemotherapy. These findings advocate the importance to implement exercise programs for patients with breast cancer during chemotherapy to prevent the negative side effects of chemotherapy and inactivity on skeletal muscle.
References:
Mijwel S, Backman M, Bolam KA, Jervaeus A, Sundberg CJ, Margolin S, Browall M, Rundqvist H, Wengström Y (2017) Adding high-intensity interval training to conventional training modalities: optimizing health-related outcomes during chemotherapy for breast cancer: the OptiTrain randomized controlled trial. Breast Cancer Res Treat. doi:10.1007/s10549-017-4571-3

Oral presentations

OP-BN43 Biomechanics of running and sprinting

GROUND REACTION FORCE ASSESSMENT FOR MONITORING ACCELERATION SPRINT PERFORMANCE IN SEMI-PROFESSIONAL SOCCER

WDOWSKI, M.M., GITTOES, M.J.R.
COVENTRY UNIVERSITY & CARDIFF METROPOLITAN UNIVERSITY

INTRODUCTION: The majority of sprint running bouts in professional soccer are over short distances, with rapid accelerations requiring the production of large ground reaction forces (GRF). Typically, sprint acceleration performance in soccer is assessed using split time protocols. Alternative methods that provide extended monitoring and mechanistic insight have been advocated. The efficacy of using GRF monitoring including medio-lateral components instead of typical assessments of acceleration performance in soccer players has however, yet to be fully elucidated. The aim of this study was to investigate the relationship between first foot strike ground reaction force metrics and split time acceleration performance in semi-professional soccer players.
METHODS: Nineteen semi-professional male soccer players participated (Mean±SD: 21.1±1.9 years, 79.4±7.3 kg, 1.79±0.06 m) completed three 20 m acceleration sprints from a left foot forward standing start. Timing gates recorded split times for 0-5 m, 5-10 m, 10-15 m, 15-20 m and 0-20 m intervals. A forceplate captured ground reaction force data (1000 Hz) in the vertical (Z), anterior/posterior (Y) and medial/lateral (X) directions of the first right foot strike contact phase. The ratio and orientation of ground reaction force vectors for the YZ comparison were calculated using the procedures outlined by Morin et al. (2011). Using similar methods, corresponding measures were determined for the XY and XZ components.
RESULTS: Higher accelerating players over the 0-20 m interval tended to have a lower minimum YZ orientation ($R2=0.18$, $p=0.03$). Improved performance over the 5-10 m interval was correlated with a lower average XY orientation ($R2=-0.21$, $p=0.02$). Average YZ orientation was negatively correlated with the 15-20 m interval ($R2=-0.19$, $p=0.03$). Higher accelerating players tended to have a greater peak Y GRF over the 5-10 ($R2=-0.56$, $p=0.000$), 10-15 ($R2=-0.44$, $p=0.001$), 15-20 ($R2=-0.54$, $p=0.000$) and 0-20 m ($R2=-0.43$, $p=0.001$) intervals. Higher accelerations in soccer sprinting may require early stabilisation of lateral loading in the initial step and the development of increased vertical force orientation to benefit late acceleration.

CONCLUSION: Measurement of first foot strike multi-component GRF metrics in soccer players could provide a valid approach for monitoring and developing mechanistic understanding of early and late acceleration sprint performance.
REFERENCES:
Morin, J. B., Edouard, P., & Samozino, P. (2011). Technical ability of force application as a determinant factor of sprint performance. Medicine & Science in Sports & Exercise, 43, 1680–1688.

A MODIFIED MODEL EQUATION FOR STEADY LOCOMOTION PREDICTS MECHANICAL INTERNAL WORK IN SPRINT RUNNING.

PAVEI, G.1, MONTE, A.2, OTSU, T.3, NUMAZU, N.3, FUJII, N.3, ZAMPARO, P.2, MINETTI, A.E.1

1UNIVERSITY OF MILAN; 2UNIVERSITY OF VERONA; 3UNIVERSITY OF TSUKUBA

INTRODUCTION: Previous estimate and model of mechanical work or power during sprinting always neglected the role of swinging the limbs, though it has been proved to be a considerable amount in other unsteady locomotion activities such as shuttle running especially at maximal speed (Zamparo et al. 2016). Aim of this study was to measure the internal work during maximal sprinting and related it to mechanical external work and sprint distance.
METHODS: 21 athletes involved in different sport (age 23±2 yrs, mass 66.9±11.4 kg, height 1.73±0.07 m) performed two maximal 20 m sprint in a gym. The 3D position of 18 markers placed on segments endpoints of the subjects was recorded by means of 35 Vicon cameras (Oxford Metrics) at 100 Hz to obtain the trajectory of the body center of mass (BCoM) and segments displacement. From the time course of BCoM total energy the external work (Wext, J/(kg m)) was computed. The internal work (Wint, J/(kg m)), the work necessary to rotate and accelerate limbs with respect to BCoM was calculated. From kinematic data, stride frequency (SF), mean velocity and duty factor (the fraction of contact time in a stride) were also computed. All analyses have been performed on the whole sprint (20 m) and on three shorter distances: the initial 5 m, 10 m and 15 m.
RESULTS: Wint increases by decreasing sprint distance (1.82, 1.95, 2.12, 2.38 J/(kg m) at 20, 15, 10 and 5 meter respectively) and increases its percentage in relation to Wext from 55% on 5 m, to 69% on 20 m. Mean velocity increases with distances (3.9, 4.8, 5.4, 5.8 m/s at 5, 10, 15 and 20 meter respectively), stride frequency is constant (2.07 Hz) whereas duty factor decreases across distances (0.31, 0.27, 0.25, 0.24 at 5, 10, 15 and 20 meter respectively).
CONCLUSION: Wint can be computed only by motion capture and a 20 m sprint required a considerable number of cameras, so that longer distances analyses seem unfeasible or barely manageable. Minetti (1998) developed a model equation to compute Wint during steady walking and running by knowing SF, velocity, duty factor and a compound inertial factor (q) ≈ 0.1. We tested this model on sprint data and found that q values change with sprint distance, so that the equation needs to be adapted by including q=0.2325*x^-0.211 (R2=0.978, p<0.001), where x is sprint distance (1 REFERENCES: Minetti AE (1998). J Biomech, 31, 463-68
Zamparo P, Pavei G, Nardello F, Bartolini D, Monte A, Minetti AE (2016). Eur J Appl Physiol, 116, 1911-19

FOOT STRIKE PATTERNS AND TENDON HYPERTROPHY IN ENDURANCE RUNNERS: IS TENDON SIZE RELATED TO RUNNING PERFORMANCE?

UENO, H.1, SUGA, T.1, TAKAO, K.1, MIYAKE, Y.1, NAGANO, A.1, ISAKA, T.1

1: RITUMEIKAN UNIVERSITY

INTRODUCTION: Tendon hypertrophy can occur in situations when tendons are exposed to chronic mechanical loading in humans (Bohm et al., 2014). In particular, long-term training induces Achilles tendon (AT) hypertrophy in endurance runners (Magnusson and Kjaer, 2003). However, whether long-term training in endurance runners also induces patellar tendon (PT) hypertrophy is poorly understood. Furthermore, joint kinetics of lower limb is different among foot strike patterns (FSP), as classified to rearfoot strike (RFS), midfoot strike (MFS), and forefoot strike (FFS) based on initial ground contact position of the foot during running (Stearne et al., 2014). Thus, it can be speculated that degree of AT and PT hypertrophy would be different between RFS and MFS/FFS runners. The present study aimed to determine the differences in AT and PT CSAs between RFS and MFS/FFS runners. Additionally, we examined the relationships of AT and PT CSAs with running performance in RFS and MFS/FFS runners.
METHODS: Twenty habitual RFS runners and 20 habitual MFS/FFS runners participated in this study. Their FSP were determined based on video images during submaximal running. The CSAs of AT and PT in participants were measured using magnetic resonance imaging. The AT and PT CSAs were calculated at its proximal, middle, and distal portions. To obtain overall and relative CSAs for AT and PT, three CSAs of each tendon were averaged, and it was normalized with body weight to the two-third power.
RESULTS: Physical characteristics and personal best 5000-m race time did not differ significantly between RFS and MFS/FFS runners. Similarly, relative AT CSA did not differ significantly between the two groups. There was no relationship between relative AT CSA and personal best 5000-m race time in both groups. Additionally, relative PT CSA did not differ significantly between the two groups. However, we found that relative PT CSA was significantly correlated with personal best 5000-m race time in MFS/FFS runners (r = -0.483; P = 0.031), whereas such a relationship was not observed in RFS runners.
CONCLUSION: The present findings suggest that although difference in FSP may not affect tendon hypertrophy, PT CSA may relate to running performance in MFS/FFS runners, but not in RFS runners. Knee joint stiffness during running is higher in FFS than in RFS (Hamill et al., 2014). Therefore, larger PT CSA may contribute to higher running performance potentially by modifying knee joint stiffness in MFS/FFS runners.
REFERENCES:
Bohm S et al., (2015). Sports Med Open, 1(1) 1-7.
Magnusson SP and Kjaer M, (2003). Eur J Appl Physiol, 90(5-6), 549-553.
Stearne SM et al., (2014). Med Sci Sports Exerc, 46(8), 1578-1587.
Hamilll J et al., (2014). Eur J Sports Sci, 14(2), 130-136.

COMPARASION OF DISTANCE RUNNERS AND NON-RUNNERS IN A HOPPING TASK

BALINT, K., ÖRS, S., JÓZSEF, T.

UNIVERSITY OF PHYSICAL EDUCATION

INTRODUCTION: Several studies demonstrated that the shorter Achilles tendon moment arm (MA-AT) are related to a better performance in sprinting, distance running (Lee et. al. 2009, Sholz et. al. 2008, Raichlen 2011 et. al.). However Werkhoven et. al. (2017) suggested that

the longer MA-AT in non-athletes correlated to a better jumping performance and explained by the possible specialized adaptation of elite human athletes. The purpose of this study was to examine and compare the mechanical, neuromuscular and structural behaviour of the lower leg in Caucasian long distance runners (LDR) and non-runners (NR) during hopping task.
METHODS: Seven elite LDR and nine physically active male (NR) volunteered to participate in the study. After ten minutes cycling in a cycle ergometer and several minutes of habituation to repetitive bilateral hopping exercise, the subjects performed 8-12 hopping on a force platform. The hops were filmed with a video camera from the right side perpendicular to sagittal plane. Ultrasonography (US) was applied to record the pennation angle and fascicle length change in (MG) during hopping. EMG activity was also recorded from tibialis anterior (TA), soleus (SOL), lateral and medial gastrochnemius muscles of the right leg (LG and MG) using bipolar surface electrodes. Achilles tendon moment arm was measured in a sitting position using the methods described by Scholz et al. (2008).
RESULTS: The average jumping height was 17% greater in NR than in LDR, but the contact time was similar. The NR had longer MA-AT ($p \leq 0,04$) than LDR. The average EMG (aEMG) data comparison revealed differences between the two groups. The shortening to stretching aEMG ratio of the SOL was 27% lower in LDR than in NR. The US analysis showed no difference in the change of the fascicle length between groups during the hops. The center of gravity (CoG) positive and negative acceleration showed no difference between the two groups. Jumping height was not influenced by the length of MA-AT in either group. The stiffness negatively correlated to the jumping height in both groups ($r=-0,84$ $p \leq 0,02$). A longer MA-AT were associated with higher negative acceleration of CoG in both group ($R=0,74$ $p \leq 0,02$).
CONCLUSION: Our results may indicate that longer MA-AT in NR resulted in higher hopping height. However the correlation analysis has not supported this conception since there was no correlation between the two parameters in either group. It seems short MA-AT is not beneficial for fast movement and the habitual training seems does not affect the jumping performance. However, the LDR groups aEMG ratios shows similar differences between LDR and NR as reported by Sano et.al.(2013) comparing Kenyans runner with Caucasian non-runners.
References:
Sholz et. al. (2008). J. Exp. Biol. 211, 3266–3271.
Lee and Piazza (2009). J. Biomech. 45, 1601–1606.
Raichlen et. al. (2011). J. Hum. Evol. 60, 299–308.
Sano et. al. (2013). Eur. J. Appl. Physiol.113, 1395-1403.
Werkhoven (2017). J. Biomech. 57, 27-31.

LOWER LIMB SPRING-MASS ALTERATION AND FOOT STRIKE PATTERN DURING A 1500-M RUN

RIVIÈRE, J.R.1, HINTZY, F.1, MORIN, J.B.2, EDOUARD, P.3, MESSONNIER, L.1, SAMOZINO, P.1
UNIVERSITÉ DE SAVOIE MONT BLANC

INTRODUCTION: Middle-distance running causes severe fatigue impacting runners' lower limb mechanical behavior (Girard et al. 2012) which can be assessed using the spring-mass model providing information on leg stiffness (Kleg). Spring-mass model application to middle-distance running highlighted gradual decrease in Kleg during the run, possibly impacting runners' performance (Butler et al. 2003). However, the observed alteration of Kleg could be biased by changes in velocity within the test or inter-subject difference in the running distance (Rabita et al. 2011; Girard et al. 2012). Moreover, it remains unknown whether changes in Kleg originate from a change in foot strike pattern (FSP). The aim of the study was to assess the concomitant alterations in Kleg and FSP during a 1500-m run performed at constant velocity.
METHODS: On a 400-m track field, seven national-level middle-distance runners performed 500-m and 1000-m runs (separated by 1h30 of rest) on a first session and a 1500-m run on a second session at least 24 h apart. Each run was paced at constant velocity corresponding to 95% of their individual 1500-m best time. Over the three runs, FSP (proportion of fore-foot strikes: FFS, rear-foot strikes: RFS and mid-foot strikes: MFS) and Kleg (Morin et al. 2005) were measured using a 10-m optical system placed at nine different points (50, 150, 250, 450, 550, 650, 950, 1050 and 1450 m).
RESULTS: Kleg decreased gradually with increasing distance ($r=-0.87$; $p<0.01$; -19% at the end of the run) with post-hoc significant differences with values at 50 m only observed from 650 m ($p<0.05$). Concurrently, runners maintained their FSP over the 1500-m run with no change in the mean strike behavior, the latter being 13%RFS/87%MFS at 50 m, 16%RFS/84%MFS at 650 m and 17%RFS/83%MFS at 1450 m.
CONCLUSION: During a 1500-m run performed at 95% of competition velocity, leg stiffness progressively decreased, which confirms the decrease in lower limb mechanical behavior during a middle-distance run independently of running velocity's alteration. In addition, the alteration in Kleg was not associated with changes in FSP and thus may rather be related to the decreasing runner's capabilities to produce force rapidly at ground strike (i.e. neuromuscular fatigue; Girard et al. 2012).
REFERENCES:
Butler RJ, Crowell HP, Davis IM (2003). Clin Biomech, 18:511–517
Girard O, Millet GP, Micallef J-P, Racinais S (2012). Eur J Appl Physiol, 112:2323–2330
Morin J-B, Dalleau G, Kyröläinen H., Jeannin T., Belli A (2005). J Appl Biomech, 21:167–180
Rabita G, Slawinski J, Girard O, Bignet F., Hausswirth C (2011). Med Sci Sports Exerc, 43:685–692

EFFECTS OF SOCCER-SPECIFIC LOADING ON KNEE NEUROMECHANICS IN ACL-INJURED, ACL-RECONSTRUCTED AND HEALTHY SOCCER PLAYERS: A PILOT STUDY.

NUCCIO, S.1, LABANCA, L.1, ROCCHI, J.E.1,2, SBRICCOLI, P.1, MACALUSO, A.1,2
1: UNIVERSITY OF ROME FORO ITALICO; 2: VILLA STUART SPORT CLINIC, ROME, ITALY

INTRODUCTION: ACL injury and re-injury are two of the most common and devastating injuries in soccer. It has been extensively documented that exercise leads to a 20%-30% transitory increase in Anterior Knee Laxity (AKL) which, despite being physiological, increases the tendency toward altered sport-related landing biomechanics (Shultz et al., 2013). The neuromechanical behaviour of ACL-reconstructed (ACL-R) and ACL-injured (ACL-I) knees after specific-loading exposure has been poorly addressed. Therefore, the aim of this study was to investigate the effect of real on-field loading on AKL, muscle strength and neuromuscular patterns of a single-leg drop landing (SLDL) in ACL-R, ACL-I and healthy (ACL-H) soccer players.
METHODS: One ACL-R (height: 1.77 m; body mass: 75kg), 1 ACL-I (height: 1.74 m; body mass: 71kg) and 1 ACL-H (height: 1.76 m; body mass: 70kg) competitive soccer players volunteered in this investigation. A 45-min version of the Soccer Aerobic Field Test (SAFT45) was employed to simulate the mechanical and physiological demands of half soccer-match. To assess the effect of SAFT45 on knee neuro-

mechanics, the following assessments were randomly conducted in both legs, prior and after SAFT45: 1) Anterior Tibial Translation (ATT); 2) Knee extension and flexion Maximal Voluntary Isometric Contraction (MVICext; MVICflex); 3) Biceps Femoris (BF) and Vastus Lateralis (VL) pre-impact EMG duration during SLDL. The difference in percentage between PRE- and POST-SAFT45 in ATT, MVICext, MVICflex and pre-impact EMG duration of VL and BF was calculated.
RESULTS: AKL in the operated leg of ACL-R and ACL-H was unchanged after SAFT45, whereas AKL of the injured leg of the ACL-I and the healthy leg of ACL-R considerably increased (about 28%). MVICext and MVICflex decreased in all participants of about 12.5%, except for the injured leg of ACL-I which showed an increase of 2% in MVICflex. The reconstructed leg of ACL-R showed an increased pre-impact EMG duration of VL of about 10%, whereas both ACL-I and ACL-H showed a decreased pre-impact EMG duration of VL (3% and 2%, respectively). Pre-impact EMG duration of BF was reduced of about 35% in the ACL-R leg and of about 10% and 13% in ACL-I leg and ACL-H, respectively.
CONCLUSION: Alterations in muscle strength, abnormalities in anterior knee laxity and quadriceps dominance during landing tasks were found in response to soccer-specific loading. Since such alterations are all risk factors for ACL injury and re-injury (Hewett et al., 2016) future studies are needed to deeply address this area of investigation.
References: 1. Shultz et al. Med Sci Sports Exer 2013; 45:1553-61
2. Hewett et al. J Orthop Res 2016; 34:1843-55
Contact: nuccio.stefano@gmail.com

Oral presentations

OP-SH07 Approaches to physical activity / functioning

Y-PATH: TARGETING CHILDHOOD PHYSICAL ACTIVITY THROUGH A NATIONAL WHOLE - SCHOOL APPROACH

BELTON, S.
DUBLIN CITY UNIVERSITY

The Y-PATH programme (Youth-Physical Activity Towards Health) is a whole school physical activity intervention, targeting 12 – 15 year old post primary school youth. The Y-PATH programme of research commenced in 2010 following the MRC's framework for development of complex interventions. Initial cross sectional data informed intervention design, which was followed by an exploratory trial in 2011, and a Cluster Randomized Controlled trial in 2013 – 2015. Subsequently in 2017 the programme was process evaluated, with a view to streamlining resources and training to better meet the needs of teachers and students in schools. The final hurdle for this programme is the critical step of national dissemination.
Methods used across the eight year development and evaluation of Y-PATH (n ≈ 30 teachers and n ≈ 1,000 students) include focus group interviews with teachers and students, questionnaires with teachers and students (including PA self-efficacy, attitude, motivation), and a range of physical measures for students including physical activity via accelerometry, cardiovascular fitness, body composition, and fundamental movement skill (FMS) measurement (using TGMD-2).
Research has shown the Y-PATH programme to be effective in improving the FMS levels of students, and helping to alleviate the age related decline in physical activity. The effects of the intervention were significant and positive for all children in the intervention group regardless of gender, weight status, or PA level. Process evaluation revealed four main themes: 1) material and resource suitability, 2) content suitability, 3) implementation considerations, and 4) current PE curricular context. Teachers and students have highlighted the timely potential of the Y-PATH programme to meet the PE 'Wellbeing' curricular needs of schools, and students. Findings indicate that both teachers and students in schools positively receive the programme. Key stakeholders including many national agencies have been identified as central for a sustainable national dissemination plan.
Though many agencies may agree the need for a programme such as Y-PATH to support PE and Physical Literacy in schools, and to foster a whole school approach to PA promotion, converting this agreement into action is an extremely difficult challenge. The road map so far will be discussed, with remaining barriers and challenges identified.

SCHOOL-BASED HIGH-INTENSITY INTERVAL TRAINING CAN IMPROVE IMPORTANT ASPECTS OF PHYSICAL FITNESS IN ADOLESCENT GIRLS

WESTON, K.L.1, MCLAREN, S.J.1, BARKER, A.R.2, WESTON, M.1
1. TEESSIDE UNIVERSITY 2. UNIVERSITY OF EXETER

INTRODUCTION: Alongside continuing scientific interest on the use of high-intensity interval training (HIIT) in healthy and clinical adult populations, research on HIIT as a health promotion tool in young people is increasing. Nonetheless, the effectiveness of school-based HIIT is unclear with previous studies recruiting relatively small and predominantly male samples. Whether school-based HIIT is feasible and effective in females therefore, is relatively unknown. As such, we examined the effect of a 4-week school-based HIIT intervention on physical fitness in adolescent girls.
METHODS: Using a cluster controlled design, participants (n=132) were recruited from one school in Northeast England; 66 girls (aged 12.4 ± 0.3 years [mean ± SD]) were assigned to the 4-week HIIT intervention, and 66 girls (aged 13.3 ± 0.3 years) acted as controls and continued usual Physical Education (PE) lessons. The HIIT sessions replaced PE lessons for intervention participants, and comprised 10 maximal effort repetitions across two sessions per week (one boxing-based, one running). In week one, repetitions were performed for 45-s, followed by 90-s recovery. Every week thereafter, repetition length increased, and recovery decreased, each by 5-s respectively. To quantify the intensity of the sessions, participants' ratings of perceived exertion (RPE) were recorded on a tablet-based application of the Children's OMNI walk/run scale. Outcome measures were 20 m shuttle-run test (20m SRT) performance, handgrip strength, 10 m sprint time, 20 m sprint time and standing broad jump distance. Data were analysed using an ANCOVA model (covariates; maturity offset and outcome baseline value), with magnitude-based inferences subsequently applied. A linear mixed model was applied to RPE data to separate the variability in RPE between- and within-subjects.
RESULTS: Mean (±SD) HIIT session attendance (expressed as % of total sessions provided) was 76 ± 13%. Mean RPE was 4.9 Arbitrary Units (AU), with a between- and within-subject SD of 1.5 AU and 1.6 AU, respectively. Post-intervention, effects were most likely beneficial for 20m SRT performance (+7 shuttles; 90% confidence interval +4 to +10 shuttles), likely beneficial for left handgrip strength (+1.5 kg; +0.3

to +2.6 kg), and possibly beneficial for right handgrip strength (+1.1 kg; -0.1 to +2.3 kg) and 20 m sprint time (-0.01 s; -0.10 to +0.01 s) in intervention participants versus controls.
CONCLUSION: A boxing- and running-based HIIT intervention, delivered during PE lessons can improve important aspects of physical fitness in adolescent girls. The relatively short duration of the HIIT sessions and overall intervention length may increase the likelihood of such protocols being implemented by schools in the future.

DASH – THE IMPACT OF A PHYSICAL EDUCATION INTERVENTION ON SCHOOLCHILDREN IN TOWNSHIPS IN PORT ELIZABETH, SOUTH AFRICA

PÜHSE, U., WALTER, C., MÜLLER, I., STEINMANN, P., GERBER, M., UTZINGER, J.

UNIVERSITY OF BASEL, SWITZERLAND, NELSON MANDELA UNIVERSITY, PORT ELIZABETH, SOUTH AFRICA, SWISS TROPICAL AND PUBLIC HEALTH INSTITUTE, BASEL, SWITZERLAND

Sedentary behaviour, overweight, obesity and lacking physical activity are a global trend and is particular true for children living in underprivileged urban settings such as townships in South Africa (HAKSA Report Card 2016). Participating in regular physical activity and eating a healthy diet are key behaviours for reducing risk factors for non-communicable diseases (NCDs) such as hypertension, diabetes and obesity, which were explored in the DASH study (Disease, Activity and Schoolchildren's Health, www.dash-sa.com). A multi-fold school-based intervention toolkit was developed that aimed to contribute to the improvement of the health and well-being of schoolchildren in disadvantaged neighbourhoods of Port Elizabeth, South Africa. The intervention was applied in 10-week blocks, and comprised four elements: (i) weekly physical activity and dancing-to-music lessons, (ii) health and hygiene lessons, (iii) nutritional supplementation and (iv) deworming.
In numerous publications the DASH study provides evidence that improvements in children's physical activity and nutrition not only contributes to their cognitive performance in school, but can also have an impact on overall cardiovascular risk factors. Physical activity was also found to correlate with health-related quality of life, and parasite infection appear to have a small, but significant negative effect on the physical fitness of infected children, as expressed by their maximum oxygen uptake. Furthermore, a multidimensional, school-based physical activity intervention can reduce the increase in cardiovascular risk factors (BMI and skinfold thickness).
Taken together a well-designed, multidimensional physical activity programme contributes to the improvement of the health and well-being of schoolchildren in disadvantaged neighbourhoods of Port Elizabeth in South Africa. To increase effectiveness and sustainability of the results, the intervention will be extended to cover the entire school term and adapted to additional age groups. In a follow- up project (the KaziBantu-project) we build on the existing evidence from DASH and scale the intervention program for the entire primary school.
Keywords: Physical fitness, physical education intervention, cardiovascular risk factors, South Africa

THE IMPACT OF THE DAILY MILE ON PHYSICAL HEALTH AND FITNESS IN DUTCH PRIMARY SCHOOL CHILDREN

COLLARD, D.C.M., SCHOLTEN, V.

MULIER INSTITUTE

Introduction: The Daily Mile is a popular, simple and free initiative that sees children run/walk/jog for 15 minutes every day in their primary school. The aim of The Daily Mile is to improve the physical health and fitness as well as social, emotional and mental health of children. The aim of this study was to determine the impact of The Daily Mile in The Netherlands.
Methods: The impact of The Daily Mile was determined by means of the RE-AIM model (Glasgow et al., 1999). The RE-AIM model consists of five elements that relate to health behaviour interventions. The elements Reach, Effectiveness, Adoption, Implementation and Maintenance are essential to improve the impact of an intervention such as The Daily Mile. Teachers (n=53) and primary school children (n=187) who participated in The Daily Mile in The Netherlands filled out a questionnaire. Complementary, interviews were performed with teachers to collect data on factors for success and constraints.
Results: The Daily Mile is mainly performed in primary schools (children aged 8-12 years old). On average, The Daily Mile is implemented by the schools three times a week. At the schools that participated in the research 1757 children are reached. Teachers rate The Daily Mile on average by 7.5. They experience positive effects in children, especially when the children are restless. Positive effects were found on physical fitness, physical health and social health. Children experience that they feel more energetic and they are able to pay more attention in the classroom after running The Daily Mile. Not all teachers are willing to adopt The Daily Mile in the school curriculum and most of the time the intervention is not yet institutionalized or part of the routine organizational practices and policies.
Conclusion
Teachers and children who participated in The Daily Mile are enthusiastic. However, The Daily Mile is not implemented every day as intended. Participants feel positive effects on health and fitness as a result of extra physical activity during school. Many schools experience difficulties with the implementation and sustainability of the program.
Reference
Glasgow, R.E., Vogt, T., & Boles, S.M. (1999). Evaluating the public health impact of health promotion interventions: the RE-AIM framework. American Journal of Public Health.
Contact: Name: Dorine Collard. Email: d.collard@mulierinstituut.nl

THE EFFECT OF SCHOOL, FAMILY AND FRIENDS ON STUDENTS' PERCEIVED AUTONOMY SUPPORT AND AUTONOMOUS MOTIVATION: A CROSS-NATIONAL SURVEY

SOÓS, I., HAMAR, P., DIZMATSEK, I., SZABO, A., LING, J., OJELABI, A., WHYTE, I., BOROS-BÁLINT, A., SZABO, P., SIMONEK, J.

UNIVERSITY OF SUNDERLAND, UNITED KINGDOM, HUNGARIAN UNIVERSITY OF PHYSICAL EDUCATION, BUDAPEST, HUNGARY, EÖTVÖS LORÁND UNIVERSITY, BABES-BOLYAI UNIVERSITY, CONSTANTIN DE PHILOSOHER UNIVERSITY, NITRA

Introduction and Aims
After the fall of the communist regimes, the focus in physical education has shifted from skill-based to health-related activities in most of the East-European nations. Aetiological research and ecological models (Baumann et al., 2012) show that the change has reshaped young people's perceived autonomy support and decisions related to their leisure-time physical activity.
This study aimed to examine the social agents that influence students' perceived autonomy support and autonomous motivation in leisure-time behaviour.
Method

A three-wave prospective design was employed, and data were collected from 11-18 year old students (n=1000, mean age=15.0, male 42%, female 58%) in three East-European countries - Romania, Hungary and Slovakia and the United Kingdom. The Helsinki Declaration's ethical guidelines were followed. Data collection instruments comprised PASSES, BREQ-2 and Godin's Leisure-Time PA Scale and used in the context of three, Theory of Planned Behaviour, Self-Determination Theory and Trans-Contextual Model.
Data were analysed by IBM SPSS v. 24 and AMOS.
Results and Conclusion
Our results demonstrated that PE teachers' autonomy support influenced students' autonomous motivation in schools. However, this correlation was reversed in a few cases due to the traditionally controlling education systems in many Eastern European schools, corresponding to Hein et al. (2016). Nevertheless, students' perceived autonomy support from family and friends positively correlated with their autonomous motivation. British students perceived the strongest autonomy support from PE teachers ($p<.001$), while Eastern European students perceived the highest level of autonomy support both from parents ($p<.001$) and friends ($p<.001$).
We conclude that an optimal relationship should be developed between PE teachers and students, that autonomy support be maintained by family and friends to encourage students to pursue physical activity behaviour.
References: Baumann, A.E. Seis, R.S., Sallis, J.F., Wells, J.C., Loos, R.J.F., Martin, B.W. (2012). Correlates of physical activity: Why are some people physically active and others not? Lancet, 380, 258-271.
Hein, V., Emeljanovas, A., Mieziene, B. (2016). A cross-cultural validation of the controlling teacher behaviour scale in physical education. European Physical Education Review, 4, 1-16.
Contact: istvan.soos@sunderland.ac.uk
Key words
Perceived autonomy support, autonomous motivation, leisure-time physical activity

INTERNET-BASED PROMOTION OF CHINESE TRADITIONAL HEALTH-PRESERVING SPORTS: HEALTH QIGONG

LIU, H., CHOW, B.

HONG KONG BAPTIST UNIVERSITY

Abstract:
Recently, a lack of public attention has become a major impediment to the promotion of Chinese traditional health-preserving sports (Jie, 2015). Although researchers have shown an increased interest in using information technology to promote sports, reports on the mobile-internet-based promotion of Chinese traditional sports are sparse, and there is limited information regarding the status quo of Health Qigong and its social acceptance.
Health Qigong is one of the most widely accepted Chinese traditional health-preserving sport (GAS, 2017; Jahnke, 2010). This paper aimed to investigate the status quo of Health Qigong among practitioners and non-practitioners in Mainland China. Some strategies for Chinese traditional health-preserving sports were proposed.
Cross-sectional surveys were conducted with 362 adult-aged participants (216 practitioners, 146 non-practitioners) in Mainland China. A 40-item questionnaire was designed to assess sociodemographic characteristics, practice/contact situation, transmission channels, perceived values and the internet use behaviors.
It was evident from the survey results that the majority of Health Qigong practitioners were older individuals. The main channel participants got to learn this sport were through social sports sites and university courses. Over 70% of practitioners had more than five friends who also practice Health Qigong. Nearly 90% of practitioners used mobile internet. Furthermore, the findings reflected the barriers to its promotion were (a) a lack of young practitioners resulted in weak sustainable development; (b) non-practitioners perceived that Health Qigong was incommensurate with the group they belong to; and (c) there were limited channels used to promote the sport.
These strategies are recommended to promote Health Qigong: (a) target specific audience groups in promotion; (b) promote the sport culture to build a unique brand; and (c) highlight its distinctive values and characteristics in promotion.
Keywords: Chinese traditional sports; Internet-based; Health-preserving sports; Sports promotion
References: 1. Jie, P. (2015). Research on current situation and promotion strategy of Health Qigong in Changzhou community. (Unpublished Master dissertation). East China Normal University, China.
2. General Administration of Sport of China (GAS). (2017). Characteristics of Health Qigong. Retrieved February 11, 2018, from: http://www.sport.gov.cn/qgzx/n5407/c825620/content.html
3. Jahnke, R., Larkey, L., Rogers, C., Etnier, J., & Lin, F. (2010). A comprehensive review of health benefits of qigong and tai chi. American Journal of Health Promotion, 24(6), e1-e25.

Oral presentations

OP-SH06 Coaching and psychological aspects of team performance

ELITE AGE GRADE PLAYER PERCEPTIONS OF PERFORMANCE ANALYSIS IN RUGBY UNION

HAMMOND, V.1,2, HANNON, J.1, RICHARDSON, A.1, MORAHAN, D.1, GODSON-TREACY, J.1, MACMAHON, S.1, MCGRATH, D.1

UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: Performance analysis (PA) - defined as the process of recording and analysing the movement of athletes during sports performance - has become an integral part of elite and sub-elite sport. While PA is currently considered to be a burgeoning field of research, there is only a small number of studies evaluating players' perceptions of performance analysis and optimal delivery. Furthermore, little research of this nature exists in elite underage sports, where arguably, the pedagogy of player feedback and the consumption of performance data could play a critical role in player development. This study thus aimed to examine a National Under 20 rugby team (IRFU U20s) players' perceptions of PA.
METHODS: Having received institutional ethical approval, an anonymous questionnaire was administered to the IRFU U20 squad (n= 25; age - 18.8years (+/-.41)) in a training camp environment. Percentage responses were computed across all questions and responses relating to types of feedback are presented here.

RESULTS: 64% of the squad found individual video analysis (i.e. one-on-one with coach) to be "very valuable" compared with 32% finding team/opposition video analysis (i.e. review of match footage in a group setting) "very valuable"; 32% found match statistics (e.g. tackles made, line-outs won) "very valuable", with 16% for GPS. Valuing one-on-one feedback with a coach the most, was a prevalent theme among players: 56% reported that receiving video clips alone (i.e. to phone/laptop) was either "valuable" or "very valuable" (combined); the same proportion applied to whole team video analysis; 100% of players reported receiving video analysis one-on-one with coach as either "valuable" or "very valuable"; 84% found video analysis in positional groups "valuable" or "very valuable". 56% of players perceived the provision of match statistics with respect to positional role (e.g. scrum half: passing, hooker: throwing) as "very important", compared with 28% "very important" for set pieces, 32% for team defence, 36% for team attack, 28% for decision making. An open question asked how PA sessions can be improved and 33.3% of respondents expressed a desire for more one-on-one feedback.
CONCLUSION: These results suggest that U20s IRFU players perceive individual, coach-led performance feedback to be of paramount importance. This may reflect the developmental and competitive nature of underage international rugby, along with the fact that the team does not train or play together frequently. Given the resource constraints that exist at underage level, extensive individualised player feedback from coaches is not feasible. Better exploitation of technology may be required, not simply as a platform for sharing video, but for didactic feedback approaches that facilitate constructive questioning based on the coach's philosophy, requiring self-reflection and self-regulation. This could lead to a deeper understanding within the players of their contribution at the level of the team.

INTER-COUNTY GAELIC FOOTBALL COACHES' PERCEPTIONS OF THEIR PRACTICE ACTIVITIES, SESSION SEQUENCE AND COACHING BEHAVIOURS

KINNERK, P.1, HARVEY, S.2, MACDONNCHA, C.1, LYONS, M.1

UNIVERSITY OF LIMERICK

INTRODUCTION: Game-Based Approaches (GBAs) have been advocated as pedagogies that develop players' decision making and skill execution. However, there is limited evidence to suggest GBAs have been accepted by coaches and that they are being employed in various coaching contexts. Benchmarking of a coaches' practice through examining the time a coach dedicates to 'training form' (technical drills) and 'playing form' (conditioned games), sequencing of activities and coach behaviours provide an indication of a coaches' pedagogical approach to coaching (Hall et al., 2016). Consequently, the aim of this research was to examine Gaelic football coaches' perceptions of their coaching practice and determine whether their practices were aligned with GBA pedagogy. In addition the research seeked to investigate differences in coaching approaches according to time of season (early, peak) and coaching level (academy, adult).
METHODS: 150 Gaelic football coaches coaching at Inter-County level completed an on-line survey describing their coaching practice at two distinct phases of the season (i.e. early and peak season). Descriptive analyses of the survey data were conducted, alongside interpretive analyses using one-way ANOVA.
RESULTS: Coaches reported using more "training form" activities in early season than "playing form" activities. In peak season, coaches reported using a majority of "playing form" activities. In relation to the sequencing of activities within practice sessions, coaches indicated using "training form" activities in the early-mid section of sessions before progressing on to "playing form" activities later on in sessions. Few differences were found in practice activities and reported behaviours across levels coaches coached at.
CONCLUSION: The high percentage use of 'training form' activities reported by coaches coupled with coaches' linear sequencing of practice activities are contrary to the guidelines advocated in GBA pedagogy that emphasises more 'playing form' activities and sequencing the session around the game, thus being the organising centre of the session. Coaches should seek to increase time spent in activities deemed more relevant to game form.
References: Hall, E. T., Gray, S., & Sproule, J. (2016). Journal of Sports Sciences, 34(10), 896-905

HOW TO USE TIME-TRIAL PERFORMANCE OF ELITES FROM PREVIOUS GENERATIONS TO SELECT THE FUTURE ELITES?

STOTER, I.1, KONING, R.2, VISSCHER, C.1, ELFERINK-GEMSER, M.1

1: UMCG, RUG , 2: FEB, RUG

INTRODUCTION: The aim of the present study is to provide performance benchmarks for future elite athletes in time-trial sports. Becoming an elite athlete is an exceptional performance and scientific support for elite athlete performance development is scarce, due to the limited number of people who reach the elite level. The present study uses longitudinal data of different generations to tackle this issue and introduces a simple method to make the benchmarks useful for future generations.
METHODS: 1500 m Season Best Times (SBT) of Dutch skaters (388 females, 810 males, age 13-26 years), who competed in at least six skating seasons between 1993 and 2013, were corrected for the prevailing world record (WR): rSBT=(SBT/WR)*100%. Three performance groups were defined: elite (rSBT<110%), sub-elite (110% RESULTS: Calendar year explained 17-30% and 24-25% of the improvements in SBT over 20 years for respectively females and males ($p<.001$). Correction for the prevailing WR neutralized this effect ($p>.05$) or diminished it to less than 2% ($p=0.013$). Of all athletes performing within the defined elite benchmarks, the elite group represented <20% up to age 16 and <50% up to age 21. Elites performed better than other performance groups at age 15-24 for female ($p<.05$) and age 13-25 for male skaters ($p<.05$) but did not develop performance faster. Results were confirmed with an out of sample group (n=182). In the out of sample validation group, 100% of the performances of the female elite and 95% of the performances of male elite were within the defined elite performance benchmarks.
CONCLUSION: Correcting SBT for the prevailing WR makes it possible to increase the number of elite athletes to study and create benchmarks useful for future generations. The benchmarks can be used to define the number and level of skaters needed to support the future elites and provide guidelines for performance development from age 13- 26 years.

TEAM PERFORMANCE INDICATORS THAT DISCRIMINATE BETWEEN SUCCESSFUL AND UNSUCCESSFUL TEAMS IN ELITE MENS FIELD HOCKEY

BRADLEY, J.

INSTITUTE OF TECHNOLOGY CARLOW

Introduction: In sports performance, a performance profile can be used to represent typical performance and gain insight into the psychological, physical, tactical, technical aspects of sport (ODonoghue, 2013). Understanding what aspects of performance contribute to success in team sport is crucial to allow coaches to inform their training and preparations for future competitions. Performance Analysis has become an essential tool to enhance coaches decision making. However, despite its use within the applied setting in field hockey,

studies within published literature is sparse. Therefore, the aim of this study was to determine the key events within elite mens field hockey that discriminate between successful and unsuccessful teams.
Methods: Twenty-five, international field hockey matches, played during the World League 3 tournament in 2017, were analysed using the Sportscode Elite (Version 10.3, Sportstec, Warriewood, Austrailia). Each match was analysed by the same analyst who had extensive knowledge of hockey and the software. A coding facility was used to record key events relating to team performance throughout each match. A Mann Whitney U test was utilised to determine whether there was a statistically significant difference ($p<0.05$) between performance indicators for winning versus losing teams.
Results & Discussion: The mean circle penetrations in winning performances (median = 23) was significantly higher than that of losing performances (median = 14) ($U = 107.5$, $z = -3.98$, $p <0.001$). Entries into the attacking area (25m line) were also significantly higher for winning performances (median = 22) than that of losing performances (median = 16) ($U = 185.5$, $z = -2.47$, $p <0.05$). The number of field goals scored affected match outcome with winning teams (2.32 1.80 field goals) scoring more field goals than losing teams (0.36 0.64 field goals). No significant differences were found between penalty corners awarded and winning/losing teams ($p = .739$).
Conclusion
These results identify team performance indicators that discriminate between winning and losing in elite field hockey, with circle penetrations and attacking 25 entries appearing significant. The relationship between circle penetrations/attacking entries and winning highlights the importance of efficient use of territory within field hockey. Coaches and trainers should place great importance on these events when analysing matches and designing training interventions.
References: ODonoghue, P. (2013). Sports Performance Profiling. In Routledge Handbook of Sports Performance Analysis (pp. 127-137). Abingdon: Routledge.

ANALYSIS OF SUBSTITUTION TIMES IN SOCCER

SWARTZ, T.

SIMON FRASER UNIVERSITY

This paper considers the problem of determining optimal substitution times in soccer. We review the substitution rule proposed by Myers (2012) and provide a discussion of the results. An alternative analysis is then presented that is based on Bayesian logistic regression.
We find that with evenly matched teams, there is a goal scoring advantage to the trailing team during the second half of a match.
In addition, we provide a different perspective with respect to the substitution guidelines advocated by Myers (2012).
Specifically, we observe that there is no discernible time during the second half when there is a benefit due to substitution.

11:30 - 12:30

Mini-Orals

MO-PM16 Ageing and Age-related disease

RESTING CEREBRAL BLOOD FLOW AND PERFUSION USING TRANSCRANIAL DOPPLER AND MAGNETIC RESONANCE IMAGING.

BURLEY, C.V., MULLINGER, K.J., FRANCIS, S.T., WHITTAKER, A.C., LUCAS, S.J.E.

UNIVERSITY OF BIRMINGHAM AND UNIVERSITY OF NOTTINGHAM

INTRODUCTION: Resting cerebral blood flow (CBF) and perfusion measures are used to quantify brain health. Yet, different imaging modalities are used to obtain these measures, and different measurements can be described as representing resting CBF. This study examined whether different approaches alter the resting CBF outcome measure between age and fitness groups. In the same cohort, we examined: (1) imaging modality [transcranial Doppler (TCD) approach measuring middle cerebral artery velocity (MCAv) and cerebrovascular conductance (CVCi) vs. magnetic resonance imaging (MRI) approach using arterial spin labelling (ASL)], and 2) typical analysis approach [resting MCAv and CVCi (TCD) vs. quantitative estimate of cerebral perfusion and blood flow transit times (MRI ASL)] for determining resting CBF.
METHODS: 35 healthy volunteers participated (20 young: 24±7y; 15 old; 66±7y). Participants completed two experimental sessions (TCD/MRI) on separate days. Resting CBF was calculated for TCD and MRI data using typical analysis approaches. Between group ANOVAs examined effects of ageing and aerobic fitness within each imaging modality. CBF measures were correlated (Pearsons) against age and fitness status, and between analysis approaches.
RESULTS: Differences were observed between younger and older participants for resting CBF measures derived using both TCD (MCAv: 69 vs 55 cm/s; $p<0.01$; CVCi: 0.89 vs 0.67 cm/s/mmHg; $p<0.01$) and MRI (transit times: 0.67 vs 0.73 s; $p<0.01$). On average, the younger group had higher grey matter cerebral perfusion (MRI: 69 vs 61 mL/100g/min; $p=0.13$). Older fit participants had higher TCD CVCi (0.77 vs 0.48 cm/s/mmHg; $p=0.02$) compared to their unfit counterparts, and fitness was positively associated with both MCAv ($r=0.52$) and CVCi ($r=0.73$) measures ($p<0.05$). Unexpectedly, the younger fit group had slower MCAv (TCD) and transit times (MRI ASL) compared to their unfit counterparts (61 vs 75 cm/s, $p=0.02$ and 0.70 vs 0.65 s, $p<0.01$, respectively), and fitness was negatively correlated with TCD MCAv ($r=-0.49$, $p<0.05$) and positively correlated with MRI transit times ($r=0.61$, $p<0.05$). No significant difference was observed between fitness groups for the other resting CBF measures. Across the whole cohort, MRI transit times correlated with TCD MCAv and CVCi ($r=-0.60$ and $r=-0.46$ respectively; both $p<0.01$).
CONCLUSION: Findings indicate that TCD and MRI modalities can provide complementary resting CBF measures (e.g. TCD velocity and MRI transit times), with similar differences across the whole cohort and between subgroups (age/fitness) observed across modalities. However, having accounted for differences in transit times between cohorts, tissue perfusion measures obtained with MRI ASL (the most common measure used for MRI), did not show significant age or fitness effects between groups. Thus, to enable comparison of studies across modalities that assess resting CBF the metrics of CBF measured must be comparable (e.g. flow velocity [TCD] vs blood transit time [MRI]).

NORMAL VALUES FOR MAXIMAL INSPIRATORY PRESSURE IN ELDERLY OVER 60 YEARS

ROLDAN, A.1, FORTE, A.2, CORDELLAT, A.1, MONTEAGUDO, P.1, BLASCO-LAFARGA, C.1

UNIVERSITY OF VALENCIA

INTRODUCTION: Maximum inspiratory pressure (MIP), which measures respiratory muscle strength (Schoser et al., 2017), decreases with age (Black & Hyatt, 1969). It's been suggested that this decline accelerates once over-55, but it is unclear how does this specific strength reduces in elderly (Sclauser et al., 2014). On the other hand, different authors have determined normal values for MIP (Black & Hyatt, 1969) and lower limits of normal (Harik-Khan, Wise, & Fozard, 1998), but there are still discrepancies about normal values by age and sex (Rodrigues et al., 2017), and little is known about the influence of being physically active, both of which are aims of this study.
METHODS: 51 healthy non-smokers elderly undergoing a multicomponent exercise training program volunteered to participate in the study (26 females, 72.74 years, range 61.00-84.90 and 25 males, mean age 69.84 years, range 64.40-76.60). Body composition, blood pressure, MIP and spirometry were assessed, followed by lineal regression model analysis by means of R.
RESULTS: Men between 64.00-76.00 years reduces the MIP in 2.87 units each year from an initial average value of 98.53 units, while the reduction in women between 61.00-85.00 years is of 0.19 units/year from an initial average value of 47.40 units.
CONCLUSION: Our results display a different pattern of MIP, with respect to age and gender compared to previous studies (Black & Hyatt, 1969; Enright et al., 1994). Age shows to be an important factor in the evolution/reduction of MIP. We also conclude that its loss for women is progressive with ageing and so remains after 65 years old, while it reduces stronger for men from that age. Similar to general strength losses, average men's strength at 65 years is larger as compared to women, so their loss might also be larger, despite being active. Future studies need to confirm this pattern and analyze new determining factors for the MIP, since it predicts respiratory weakness before changes in spirometry (Schoser et al., 2017).

POSTPRANDIAL VENOUS AND CAPILLARY BLOOD GLUCOSE DIFFERENCES FOLLOWING REST OR EXERCISE IN OBESE INSULIN RESISTANT MALES

ALLERTON, D., STEVENSON, E.

NEWCASTLE UNIVERSITY

INTRODUCTION: Accurate and precise measurement of circulating glucose concentration is essential for diagnosis and management of diabetes. Whilst venous blood is widely used to determine glucose concentration, metabolism at surrounding tissues may lead to differences when compared to capillary or arterial blood, particularly in the post-meal milieu, and previous studies raise doubts about published equivalence values. The magnitude of this difference may also be influenced by prior activity. Therefore, the aim of this study was to compare venous and capillary blood glucose measurements following consumption of a mixed-macronutrient meal after rest or exercise.
METHODS: Twelve centrally-obese males (age: 41±9 years, BMI: 37.8±2.1 kg/m2, HOMA-IR: 6.9±4.9) completed two trials in a randomised order. On each occasion participants consumed a standardised mixed-macronutrient breakfast meal (468 kcal; 70% carbohydrate, 17% fat, 13% protein) and remained seated for 240 min. Prior to the breakfast meal participants either rested or completed 30 min low-moderate intensity treadmill walking exercise (50±4%V̇O2peak). Simultaneous venous and capillary blood samples were taken at regular intervals during the postprandial period. Blood glucose concentration was immediately determined following each sample using a benchtop analyser.
RESULTS: Venous and capillary whole blood glucose did not differ at baseline after rest (p=0.923) or exercise (p=0.793), however post-meal peak glucose in capillary blood was significantly higher than in venous blood, both at rest (8.26±1.14 vs 7.28±1.13 mmol/l, p<0.001) and following exercise (8.45±1.09 vs 7.94±0.98 mmol/l, p=0.004). In both trials AUC across the postprandial period was greater when calculated from capillary in comparison to venous samples (both p=0.001). The magnitude of the capillary-venous difference in glucose concentration was reduced following exercise when compared to rest (0.18±0.11 vs 0.33±0.21 mmol/l, p=0.014).
CONCLUSION: Blood glucose values derived from different sample types are similar in the fasted state, however mean glycaemia is higher in capillary relative to venous whole blood when measured postprandially. The activity status of participants appears to influence the magnitude of this effect, with prior exercise reducing the capillary-venous difference following a meal. Thus it may not be appropriate to consistently apply published equivalence values or correction factors to interpret glucose measured in different blood compartments, and it is recommended that sample type is indicated when reporting values in order for appropriate interpretation of results to occur.

HABITUAL EXERCISE SUPPRESSES AGING-RELATED MUSCLE ATROPHY

KONNO, M., AOKI, K., SHIROMOTO, J., TOKINOYA, K., HONDA, K., TAKEKOSHI, K., OHMORI, H.

TSUKUBA UNIVERSITY

INTRODUCTION: It is well known that aging causes loss of muscle mass and strength, called sarcopenia (1). Declining mitochondrial function and increasing protein degradation are considered as factors of sarcopenia. Thus, promotion of mitochondrial function and suppression of protein degradation may contribute to prevent or alleviate sarcopenia. It is reported that the mitochondrial function improves by habitual exercise training (2). The aim of this study was to clarify whether habitual exercise could suppress a decrease of mitochondrial function and an increase of protein degradation with aging, leading to suppression of sarcopenia.
METHODS: Thirty mail SAMP 8 (senescence accelerated mouse prone 8) mice at 27 weeks age were allowed to acclimate to the environment for a week before the experiment. After acclimatization, these mice were divided into three groups : 28wks sedentary control group (28w Con), 44wks sedentary control group (44w Con), and 44wks habitual exercise group (44w EX) . The treadmill running was conducted in 44w EX mice at a speed of 15 m/min for 30 min at a frequency of 5 days per week for 16 weeks. 28w Con mice were dissected after acclimatization. 44w EX mice were dissected after the training period and 44w Con mice were dissected at the same timing as 44w EX mice. A grip strength test of limbs was conducted one day before dissection in each group. Soleus, gastrocnemius, and plantaris muscles were isolated from the hindlimb and weighed. The gastrocnemius muscle was instantly frozen with liquid nitrogen and stored at -80°C for biochemical measurements.
RESULTS: Respective wet weight of gastrocnemius and plantaris muscles was significantly lower in 44w Con than in 28w Con, but was not lower in 44w EX. The result of grip strength test was similar to that of muscle weight. Cox4, a gene involved in mitochondrial function, was significantly decreased in 44w Con as compared with 28w Con, but did not decreased in 44w EX. There was a significant increase in PGC-1α in 44w EX as compared with 28w Con. MuRF-1 and MAFbx, which are indicators of skeletal muscle protein degradation, did not change in 44w Con as compared with 28w Con, but a significant decrease was observed in 44w EX.

CONCLUSION: It was suggested that habitual exercise during the aging process could suppress the reduction of muscle mass and strength based on an increase of mitochondrial function and a decrease of protein degradation. In the future, we will further examine conditions such as exercise intensity and duration in order to explore the optimal exercise prescription for sarcopenia.
[References]
(1) Cruz-Jentoft AJ et al. Sarcopenia: European consensus on definition and diagnosis: Report of the European Working Group on Sarcopenia in Older People. Age Ageing 39(4): 412-23, 2010.
(2) Ghosh S et al. Reduction in reactive oxygen species production by mitochondria from elderly subjects with normal and impaired glucose tolerance. Diabetes. 60: 2051– 2060, 2011

THE RELATION BETWEEN THE OBESITY INDEX AND BODY FATNESS ACCORDING TO AGE IN WOMEN

ODABAS, I., SUNA, N., GULER, L.
HALIC UNIVERSITY, SCHOOL OF PHYSICAL EDUCATION AND SPORT

INTRODUCTION: A lot of indexes have been used in order to define the obesity. The aim of the study was to examine the relation between body fatness according to age and the obesity indexes which have been used extensively today.
METHODS: A total 2860 women (1347 of them were aged 20-29; 1026 of them were aged 30-39; 487 of them were aged 40-49) participated in the study voluntarly. Anthropometric features were measured according to the Anthropometric standardization manuel in the study. Body mass index, waist hip ratio, conicity index, sum of trunk skinfolds (subscapular, chest, suprailiac, and abdominal) and sum of extremity skinfolds (triceps, biceps, thigh, and caf) were calculated. Body fat percentage values were calculated using Yuhazs formula. Normality test was used for the data in SPSS. Pearson correlation was used for the data which have a normal distribution and Spearman correlation was used for the data which do not have normal distribution($p<0,01$).
RESULTS: As a result, It was found a significant correlation between the body fatness of the group aged 20-29 and conicity index, sum of trunk and sum of extremities. Also there was a significant correlation between the BMI, conicity index, sum of trunk and sum of extremities of the groups aged 30-39 and 40-49 ($p<0,01$).
CONCLUSION: Obesity indexes can be used in order to determine the body fatness of adults according to the study results.

DIAGNOSING SARCOPENIA IN OVERWEIGHT PEOPLE

JUNGREITMAYR, S., RING-DIMITRIOU, S.
PARIS LODRON UNIVERSITY OF SALZBURG

INTRODUCTION: According to the EWGSOP (Cruz-Jentoft, 2010) diagnosing sarcopenia can be executed by using the combination of skeletal muscle mass (SMI), handgrip strength and gait speed. However the association of those markers is questioned (Spira, 2015). Thus we applied the proposed EWGSOP-algorithm in overweight and obese community dwelling people to check for its validity in this particular sample.
METHODS: Skeletal muscle mass (seca mBCA525), handgrip strength (Trailite, TL-LSC100) and habitual gait speed (Brower TS, USA) were assessed in 46 participants aged over 60y. SMI (Cruz-Jentoft, 2010) and body mass index were calculated after measuring height (seca217) and body mass (seca813). Individuals were divided into overweight (OW) and obese (OB) by WHO-BMI classification. In order to detect differences between groups t-tests with $p<.05$ were carried out.
RESULTS: Participants consisted of 21 OW (7 males, M: 72.3 y ± 5.7, BMI 27.7 kg/m² ± 1.2; 14 females, F: 71.9 y ± 9.1, BMI 27.3 kg/m² ± 1.3) and 25 OB (10 M: 71.5 yrs ± 6.9, BMI 33.3 kg/m² ± 2.7; 15 F: 70.2 y ± 5.7, BMI 35.5 kg/m² ± 3.6). Mean differences were found between OW and OB in SMI within sex with $p <.01$ (kg/m²; OW-M 8.8 ± 0.7 vs. OB-M 10.6 ± 1.0 and OW-F 6.9 ± 0.9 vs. OB-F 8.3 ± 0.9). No significant differences were found in grip strength (kg; OW-M 37.0 ± 9.7 vs. OB-M 37.4 ± 7.3 and OW-F 26.6 ± 5.6 vs. OB-F 25.6 ±7.1) and gait speed (m/s; OW-M 1.17 ± 0.23 vs. OB-M 1.16 ±0.2 and OW-F 1.21 ±0.23 vs. OB-F 1.1 ± 0.28). Based on SMI calculation, sarcopenia was found at higher rates (All: 41.3%, OW 57% and OB 28%) than in studies including all BMI categories (Spira, 2015). Using the EWGSOP algorithm, SMI combined with hand grip and gait speed, only 19.6% (OW+OB) would have been diagnosed with sarcopenia.
CONCLUSION: The analysis of algorithms revealed that neither habitual gait speed nor handgrip strength were sufficient to detect sarcopenia in community-dwelling individuals compared to the result found with SMI only. These results indicate the need of further research in regard to overweight and obese compared to normal weight people.
References:
Cruz-Jentoft, A. J., Baeyens, J. P., Bauer, J. M., Boirie, Y., Cederholm, T., Landi, F., ... & Topinková, E. (2010). Sarcopenia: European consensus on definition and diagnosisReport of the European Working Group on Sarcopenia in Older PeopleA. J. Cruz-Gentoft et al. Age and ageing, 39(4), 412-423.
Spira, D., Norman, K., Nikolov, J., Demuth, I., Steinhagen-Thiessen, E., & Eckardt, R. (2016). Prevalence and definition of sarcopenia in community dwelling older people. Zeitschrift für Gerontologie und Geriatrie, 49(2), 94-99.

BARIATRIC SURGERY REDUCES AEROBIC EXERCISE CAPACITY

FAORO, V., FORTON, K., DEBOECK, G., DEREPPE, H.
FACULTY OF MOTRICITY SCIENCE

INTRODUCTION: Bariatric surgery has a considerable positive effect on weight loss and on metabolic and cardio-vascular risks. It has therefore been extensively used this last decade to overcome obesity. However, the impact of this surgery on aerobic exercise capacity and limiting factors remains unclear.
The aim of this study was to determine how weight loss, 1 year after bariatric surgery, affects the aerobic exercise capacity (VO2max).
METHODS: Fourty-two obese women (Age: 42 ± 12 years, weight : 114 ± 16 kg, BMI: 47 ± 4 kg/m2) underwent a cardiopulmonary exercise test (CPET) before and 1 year after bariatric surgery (weight : 78 ± 15 kg, BMI: 29 ± 4 kg/m2). Exercise was performed on a cycloergometer with an incremental increase of workload (W) of 15 Watt/min until exhaustion. Gas exchange (oxygen uptake (VO2), carbon dioxide release (VCO2)) and ventilation (VE) were measured continuously via a facial mask with additional measurements of heart rate (HR), blood pressure (BP) and arterial oxygen saturation (SpO2). The first ventilatory threshold (VT) was measured according to the V-slope method.

RESULTS: Bariatric surgery allowed for 36 ± 6 kg weight loss in a one year period. VO2max corrected for body weight was increased after weight loss (17 ± 3 vs 22 ± 4 ml/min/kg, p<0.001). However, VO2max was reduced by 10% after surgery when expressed in absolute value (1.9 ± 0.4 vs 1.7 ± 0.3 l/min, p<0.01).
The magnitude of the weight loss was correlated to the decrease in VO2max, maximal workload and maximal O2 pulse (R>0.31, p<0.05).
The ventilatory response to exercise and chemosensibility was not affected by weight loss as maximal ventilation, and the VE/VCO2 slope did not change.
Chronotropic response and the oxygen pulse remains constant after surgery suggesting no cardio-vascular affection.
A lower VT one year after surgery (72 ± 11 vs 65 ± 10 % of VO2max, p<0.01) with a higher respiratory exchange ratio (RER) (1.15 ± 0.08 vs 1.25 ± 0.10, p<0.001) suggest a muscular deconditioning.
The magnitude of the decrease in VO2max after surgery was directly correlated to the changes in VT, maximal O2 pulse (R>0.41, p<0.01) and inversely correlated to the changes in the end exercise RER (R=-0.54, p<0.001), suggesting a probable muscular limitation.
CONCLUSION: While bariatric surgery provides an important weight loss, the aerobic exercise capacity is reduced with no cardio-respiratory changes but a probable muscular deconditioning.

LEVELS OF CHOLESTEROL IN PATIENTS WITH CORONARY DISEASE AFTER A CARDIAC REHABILITATION PROGRAM

ROMERO-ARENAS, S.1, MARTÍNEZ-PASCUAL, M.2

1UNIVERSIDAD CATÓLICA DE MURCIA & 2HOSPITAL UNIVERSITARIO LOS ARCOS DEL MAR MENOR .

INTRODUCTION: Cardiac rehabilitation improves the control of cardiovascular risk factors and decreases the total and cardiovascular morbidity and mortality of patients with coronary disease. In this way, the objective of this study was to analyze the effect of a cardiac rehabilitation program on cholesterol levels of patients with coronary heart disease.
METHODS: All patients with coronary heart disease who participated in a cardiac rehabilitation program were recruited retrospectively between June 2015 and June 2016. The program included eight weeks of progressive physical exercise, recommendations on healthy diet and therapy with statins. The physical exercise program consisted of performing 40 minutes of aerobic exercise on cycle-ergometer, three days per week. Before starting the program, the participants performed an incremental cycling test with gas analysis, and the power output at the anaerobic threshold was obtained. The power output at the anaerobic threshold was used to determine the intensity of the exercise. The first four weeks the participants pedaled with a power output 10% lower than that achieved at the anaerobic threshold, and the following four weeks the participants pedaled with a power output 5% lower than that achieved at the anaerobic threshold. Before and after the cardiac rehabilitation program, a blood test was performed that included cholesterol levels. In addition, patients cholesterol levels were monitored 9 months after the end of the cardiac rehabilitation program. For the statistical analysis an ANOVA was performed.
RESULTS: Thirty-two patients were recruited for this study. After the program, patients improved total cholesterol levels (Pre: 156.3±54.8 mg/dl vs. Post: 123.4±30.1 mg/dl; p=0.001), LDL-cholesterol (Pre: 96.5±40.4 mg/dl vs. Post: 66.5±16.4 mg/dl; p<0.001), HDL-cholesterol (Pre: 37.0±8.1 mg/dl vs. Post: 41.2±12.0 mg/dl; p=0.018) and triglycerides (Pre: 143.9±121.4 mg/dl vs. Post: 101.6±36.7 mg/dl; p=0.049). The differences in the levels of LDL-cholesterol (p=0.001), HDL-cholesterol (p<0.001) and total cholesterol (p=0.040) persist after nine months of follow-up.
CONCLUSION: The participation of patients with coronary heart disease in a cardiac rehabilitation program over a period of eight weeks is associated with a decrease in total cholesterol, LDL-cholesterol and triglycerides levels, and an increase in HDL levels. The differences in the levels of total cholesterol, LDL-cholesterol and HDL-cholesterol persisted after 9 months of follow-up.

EXERCISE INTERVENTIONS AIMING TO IMPROVE CARDIORESPIRATORY FITNESS IN CANCER PATIENTS UNDERGOING ADJUVANT TREATMENT; A META-ANALYSIS OF RANDOMIZED CONTROLLED TRIALS

BJOERKE, A.C.H.1, SWEEGERS, M.2, BUFFART, L.M.2, RAASTAD, T.3, NYGREN, P.4, BERNTSEN, S.1,4

UNIVERSITY OF AGDER

INTRODUCTION: Cardiorespiratory fitness, defined as maximal oxygen uptake (VO2max), is generally lower in patients with cancer, compared to the healthy population. It is important to maintain functional independence, and higher VO2max is associated with higher survival. The aims of the present study were to investigate the effect of aerobic exercise on VO2max compared with usual care, and to determine whether frequency, intensity, duration and exercise volume affect training-induced changes in VO2max among cancer patients receiving adjuvant treatment.
METHODS: Medline and Embase through OvidSP were searched to identify randomized controlled trials examining the effects of aerobic exercise on VO2max in adult patients with cancer receiving adjuvant treatment. Only studies using maximum tests, directly or indirectly measuring VO2max were included. Two independent reviewers extracted data, and assessment of study quality was performed using TESTEX [1]. Effect sizes (ES) and differences across intervention characteristics were calculated using Comprehensive Meta-Analysis software. Exercise duration and exercise volume were analyzed with meta-regression.
RESULTS: 13 randomized controlled trials including 1175 patients with various cancer types, mostly breast, prostate or colon cancer or acute myeloid leukemia receiving adjuvant chemo-, radio- and/or hormone therapy were included. Exercise interventions significantly improved VO2max compared to controls (ES 0.46, 95% Confidence Intervals 0.27, 0.94). The duration of each exercise session (p=0.03) and total exercise volume (p=0.01) were significantly associated with improved VO2max. No other exercise characteristics were significantly associated with VO2max.
CONCLUSION: Results of the present study show that aerobic exercise interventions have beneficial effects on VO2max in patients with cancer undergoing adjuvant treatment. Interventions with larger exercise volumes as well as longer session durations resulted in largest improvements in VO2max. Whether there is a dose-response relationship between exercise intensity, frequency and VO2max has to be explored in future studies. Health professionals should encourage patients with cancer to be physically active from the time of diagnosis.
REFERENCES:
1. Smart, N.A., et al., Validation of a new tool for the assessment of study quality and reporting in exercise training studies: TESTEX. Int J Evid Based Health, 2015. 13(1): p. 9-18.

Mini-Orals

MO-PM17 Cardiovascular physiology

EXAMINING THE EFFECTS OF DIFFERENT EXERCISE MODALITIES AND INTENSITIES ON CEREBRAL BLOOD FLOW.

FURLONG, R.

UNIVERSITY OF BIRMINGHAM

INTRODUCTION: Regular exercise positively effects brain health in both clinical and non-clinical populations. It is associated with increased cerebral blood flow velocity (CBFv), which is thought to induce positive cerebrovascular adaptation via shear stress and cyclic strain. The optimal exercise modality and intensity to maximally increase CBFv is yet to be identified. This study examined how exercise modality (running vs. cycling) effects CBFv at a range of exercise intensities, including high intensity interval training (HIIT).
METHODS: Participants completed in both modalities: two maximal oxygen consumption (VO2max) tests to determine workload for each modality, two 5-stage incremental tests (3-minute stages at 35%, 50%, 65%, 80% and 95% VO2max), and two HIIT tests ('Clinical model': four 4-minute bouts of exercise at 90% maximum heart rate (MHR)). The order of incremental and HIIT tests was randomised. Measures of middle cerebral artery velocity (MCAv) via Transcranial Doppler; oxygen consumption (VO2) and end-tidal carbon dioxide (CO2; Vyntus CPX metabolic cart) and heart rate were obtained. Blood velocity and respiratory data between incremental tests were compared using a 2-way ANOVA, while HIIT data within each modality was compared against the 65% VO2max stage data via a one-way ANOVA.
RESULTS: Preliminary findings from 6 completed participants indicates that 65% VO2max elicited the greatest change in MCAv from rest during running (up 13 cm/s) and cycling (up 8 cm/s) incremental tests; thereafter returning towards baseline resting values. These changes in MCAv were in line with the changes in end-tidal CO2 for both modalities. The first 4-minute running and cycling HIIT bout elicited the greatest increase in MCAv (15 and 10 cm/s, respectively), which were similar to those obtained during the 65% VO2max exercise stage (13 and 8 cm/s, respectively). However, subsequent HIIT bouts increased MCAv less (running: ~7 cm/s; cycling: ~2 cm/s for HIIT bouts 3 and 4) for both modalities.
CONCLUSION: These preliminary findings indicate that both running and cycling at 65% VO2max will maximally increase CBFv, increasing the stimulus for positive cerebrovascular adaptation. Further, a singular 4-minute HIIT bout may also provide the same, if not a greater stimulus for positive cerebrovascular adaptation via increased CBFv yet subsequent bouts of HIIT may elicit a lower stimulus for cerebrovascular adaptation (via shear stress and cyclic strain).

EFFECT OF INCREASED CENTRAL ARTERIAL STIFFNESS WITH RESISTANCE TRAINING ON CEREBRAL BLOOD FLOW PULSATILITY

NAKAMURA, N., KUBO, T., MURAOKA, I.

WASEDA UNIVERSITY

INTRODUCTION: Central arteries (e.g. the aorta and carotid artery) buffer blood flow pulsatility. Increased central arterial stiffness decreases buffer function and augments cerebral blood flow pulsatility, which leads to increased risk for cerebral microvascular damage. Resistance training (RT), in the form of moderate-to-high intensity exercises, has recently been recommended for the treatment of muscular hypertrophy and for maximizing strength. RT increases central arterial stiffness (Miyachi et al. 2004, Kawano et al. 2006), which may augment cerebral blood flow pulsatility. However, it is unknown whether increased central arterial stiffness with RT leads to augment cerebral blood flow pulsatility.
METHODS: Eighteen men (RT group: 9 men, 21±1 years; Control (CON) group: 9 men, 23±1 years) participated in the study. The B-stiffness index was measured in the right carotid artery as an index of central arterial stiffness, respectively. The pulsatility index (PI) was measured in the middle cerebral artery (MCA) using ultrasonography. All participants were subjected to these measurements before training and at 4 and 8 weeks after training. Subjects in the RT group completed 3 supervised RT sessions per week. During each training session, the subjects performed 3–5 sets of 6 exercises (leg press, bench press, lateral row, leg extension, shoulder press, arm curl) at 75% of 1 repetition maximal.
RESULTS: The B-stiffness index in the RT group was significantly increased at 4 and 8 weeks after training compared to that before training. In addition, the RT group demonstrated decreased arterial compliance. However, there was no significant change in PI throughout the study period. The B-stiffness index and PI in CON group were not changed throughout the study.
CONCLUSION: The present study showed that RT increased arterial stiffness and decreased arterial compliance 4 and 8 weeks after training. However, there was no significant difference in PI over this period. A previous study reported that increased central arterial stiffness and decreased arterial compliance with aging led to increased cerebral blood flow pulsatility (Tarumi et al. 2011). However, these parameters did not affect cerebral blood flow pulsatility under RT conditions. These results suggest that except central arteries may buffer cerebral blood flow pulsatility in this study.

POST-ISOMETRIC EXERCISE HYPOTENSION IS ASSOCIATED WITH INCREASED NITRIC OXIDE AND DECREASED LIPID PEROXIDATION

OLHER, R.R., SOUSA, I.R., SOARES, B.R., RIBEIRO, T.B., MELO, G.L.R., SOUZA, L.H.R., NEVES, R.P., ROSA, T.S., MORAES, M.R.

CATHOLIC OF BRASÍLIA UNIVERSITY

INTRODUCTION: Hypertension is known to be one of the major risk factors for heart disease in the world. On the other hand, recent scientific evidence suggests that isometric strength exercise (ISE) could be part of antihypertensive treatment. However, little is known regarding acute cardiovascular responses and the possible mechanisms involved in post-isometric exercise hypotension (PIEH) in hypertensive adults. Nitric oxide (NO-) and oxidative stress (OE) may be important elements involved in the pathophysiology of hypertension. The objective of the study was to investigate the acute effects of ISE on cardiovascular responses, NO- bioavailability and OE parameters in hypertensive adults.
METHODS: Fifteen adults with hypertension participated in the study [38.7 ± 9.1 years, 132.1 ± 8.0 mmHg of systolic blood pressure (SBP)]. Subjects were submitted to 5 sessions of ISE, being 2 in the leg-press 45°, 2 in the bench press and a control session. The sessions in each exercise consisted in: i) maximal voluntary isometric contraction (MVIC); ii) 4 sets x 1 contraction at 30% CVIM with 2 rest pause. For cardiovascular measurements, an automatic oscillometric BP monitor (Microlife, BPA100) was used. Venous blood was collected at rest,

immediately after the session and 60-min post-exercise for NO- analysis by the Griess method. The components of OE (Uric Acid, TBARS, TROLOX and SOD) were analyzed using commercial kits. For the statistical analysis, a repeated-measures ANOVA with Bonferroni post-hoc was used.
RESULTS: A significant reduction was observed in SBP (Δ = -5.27 ± 2.3 mmHg). A significant increase in plasmatic NO-bioavailability immediately after the ISE session was also observed (Δ = 23.94 ± 8.45 μL). Regarding OE parameters, TBARS (Lipid peroxidation) presented a significant reduction after the ISE session (Δ = - 094 ± 0.23 nmol / L), whereas uric acid, TROLOX and SOD showed no statistical differences. In comparison to the control session, no statistical differences were observed.
CONCLUSION: In conclusion, short duration ISE model elicited a decrease in reduction in lipid peroxidation, an increase in NO- bioavailability resulting in PIEH in adults with high blood pressure. Further studies should focus on the magnitude of blood pressure lowering and the cause-and-effect relationship between pro and antioxidant parameters.

DO YOUNG ATHLETES HAVE ALTERED VASCULAR STRUCTURE AND FUNCTION?

THOMANDL, L.1, WEBERRUß, H.1, SCHULZ, T.1, HOFMANN, H.1, OBERHOFFER, R.1

1: CHAIR OF PREVENTIVE PEDIATRICS, TECHNICAL UNIVERSITY OF MUNICH

INTRODUCTION: Physical activity (PA) reduces the risk of atherosclerosis and therefore cardiovascular diseases. Cardiorespiratory fitness positively influences cardiovascular health and is inversely correlated with subclinical markers of atherosclerosis (carotid intima-media thickness, cIMT, and arterial stiffness). Studies in adult athletes show that persistently increased vigorous PA can improve this correlation compared to moderate levels of PA. Therefore, the aim of this study is to investigate if young athletes already have an altered structure and function of the vascular system compared to the normal population.
METHODS: From November 2017 to February 2018, 39 healthy competitive athletes (32 boys) between 11 and 17 years were examined in our pediatric outpatient department. PA level was assessed using the activity questionnaire MoMo-AFB. IMT of the left and right common carotid artery is defined as parameter for arterial structure and was measured with B mode ultrasound according to AEPC-guidelines (Dalla Pozza et al., 2015). Arterial function was assessed with stiffness index (β), pulse wave velocity β (PWVβ), and elastic modulus (Ep) as measures for arterial stiffness, and arterial compliance (AC) as measure for elasticity by eTRACKING (M-mode). Age and sex independent z-scores were calculated according to Weberruß et al. (2015), comparisons with the normal population were calculated by one-sample t-tests (p=0.05).
RESULTS: Young athletes performed 12 different types of sports in total (endurance and muscular endurance) for 528.46±186.68 minutes per week. All participants showed a normal vascular structure (cIMT=0.48±0.04mm) and function (β=3.06±0.69, PWVβ=3.58±0.36m/s, Ep=34.73±8.84, AC=1.56±0.41). Compared to normal values, young athletes had significant lower z_PWVβ (-1.13±0.91), z_β (-0.92±0.89), z_Ep (-1.20±1.03) and higher z_AC (0.99±1.02), p<0.001 for all. z_cIMT did not differ significantly between athletes and the normal population (0.27±1.08, p=0.124).
CONCLUSION: Young athletes have a lower arterial stiffness, measured at the common carotid artery, compared to the normal population. However, arterial wall thickness tended to be higher in athletes. This may indicate a physiological adaptation of the vessels to persistently vigorous PA in young athletes. As most of the studies reporting reduced wall thickness in adult athletes refer to endurance exercise, strength sports is associated with higher wall thickness. Therefore, the tendency to increased cIMT in our study could be the consequence of additional strength training in muscular endurance sports. However, increased PA in children and adolescence improves vascular function.
REFERENCES:
Dalla Pozza R, Ehringer-Schetitska D, Fritsch P, Jokinen E, Petropoulos A, Oberhoffer R; Association for European Paediatric Cardiology Working Group Cardiovascular Prevention. (2015). Atherosclerosis, 238, 380-387.
Weberruß H, Pirzer R, Böhm B, Elmenhorst J, Dalla Pozza R, Netz H, Oberhoffer R. (2015). Atherosclerosis, 242, 48-55.

EFFECTS OF EXERCISE DURATION ON PERSISTENT CEREBRAL OXYHAEMOGLOBIN LEVELS IN THE SUPPLEMENTARY MOTOR AREA AND PRIMARY MOTOR CORTEX AFTER MODERATE-INTENSITY CYCLING

TSUBAKI, A., MORISHITA, S., TOKUNAGA, Y., SATO, D., QIN, W., KOJIMA, S., ONISHI, H.

NIIGATA UNIVERSITY OF HEALTH AND WELFARE

INTRODUCTION: Measuring cerebral oxyhaemoglobin changes in the supplementary motor area and primary motor cortex using near-infrared spectroscopy shows that the levels increase during moderate-intensity exercise and persist after the exercise . However, the effects of exercise duration on O2Hb persistence are unknown. We aimed to compare the effects of exercise duration on the persistence of O2Hb changes in SMA and M1 after moderate-intensity cycling exercise.
METHODS: We recruited healthy young volunteers to participate in this study. After an incremental exercise test on a cycle ergometer to determine VO2 peak, the subjects performed another cycle ergometer exercise on a different day. After a 3-min rest period, the exercise was initiated at a workload corresponding to 50% VO2 peak. The exercise continued for 10 min <8 women, 12 total subjects> and 20 min <9 women, 12 total subjects>, followed by a 15-min rest. Nine subjects <8 women> participated in both exercises. O2Hb levels in the SMA and M1 were measured using a 34-channel near-infrared spectrometry system. O2Hb level and other parameters were measured. The results were expressed as changes from the mean pre-exercise rest phase values and calculated every 60 s. To compare the effects of exercise duration on the persistence of O2Hb after exercise, the values measured during the 15-min post-exercise rest period were averaged, and an unpaired t-test was performed. Statistical significance was set at $p < 0.05$.
RESULTS: O2Hb levels increased to 0.042 ± 0.010 mM?cm in the SMA and to 0.053 ± 0.041 mM?cm in the M1 during the 10-min exercise period from pre-exercise rest, and increased to 0.055 ± 0.011 mM?cm in the SMA and to 0.069 ± 0.011 mM?cm in the M1 during the 20-min exercise period from pre-exercise rest. O2Hb values during the 15-min post-exercise rest period in the SMA were 0.023 ± 0.006 mM?cm after the 10-min exercise, and 0.040 ± 0.007 mM?cm after the 20-min exercise, and there were no significant differences
. In the M1 area, the O2Hb values during post-exercise rest were 0.027 ± 0.010 mM?cm after the 10-min exercise, and 0.052 ± 0.009 mM?cm after the 20-min exercise; there were no significant differences
CONCLUSION: An O2Hb incremental change was observed in both areas during the 10-min and 20-min 50% VO2 peak exercise. We also observed the persistence of O2Hb levels after exercise. However, the effect of exercise duration on the persistence of O2Hb changes in SMA and M1 were not detected.

THE EFFECT OF AEROBIC FITNESS AND BLOOD PRESSURE IN CORTICAL OXYGENATION AND DUAL TASK PERFORMANCE IN HEALTHY YOUNG ADULTS

GOENARJO, R.1, DUPUY, O.1, PEROCCHON, A.2, BERRYMAN, N.3, FRASER, S.4, BOSQUET, L.1

1: LABORATOIRE MOVE, UNIVERSITÉ DE POITIERS, FRANCE. 2: LABORATOIRE HAVAE, UNIVERSITÉ DE LIMOGES, FRANCE. 3: SPORTS STUDIES DEPARTMENT, BISHOP UNIVERSITY, CANADA. 4: INTERDISCIPLINARY SCHOOL OF HEALTH

INTRODUCTION: In daily life, mobility requires walking while performing a cognitive task. Although previous studies have evaluated dual task performance in young adults, few have evaluated the impact of aerobic fitness and blood pressure on dual tasking. The aim of this study was to evaluate the effects of aerobic fitness and mean arterial pressure (MAP) on prefrontal cortex (PFC) oxygenation during dual tasking in young adults.
METHODS: Twenty-four young adults were allocated according to their VO2peak using Metamax3b into 2 groups (high-fit, low-fit) then sub-grouped according to their 24-hour MAP (higher-MAP, lower-MAP). The submaximal continuous graded exercise test was performed on treadmill. Initial velocity was set at 5.6 km/h and the inclination was increased by 2% every minute until voluntary exhaustion. Cerebral oxygenation and changes in concentrations in deoxyhaemoglobin (HHb) in right PFC were assessed using fNIRS during dual tasking n-back test. On dual-tasking, cognitive performance was measured by counting the percentage of correct responses and gait performance was measured with an instrumented walkway system, GAITRite system. An analysis of variance (fitness x MAP x measures) was performed. The magnitude of difference was assessed by the Effect Size (ES)
RESULTS: Aerobic fitness had no effect on cerebral oxygenation in young adults ($p=0.46$; ES=0.44) but had a large effect on cognitive performance ($p<0.05$; ES=1.05). In low-fit group, MAP had a large effect on cerebral oxygenation ($p<0.05$; ES=0.84) and cognitive performance ($p<0.05$; ES=1.10). Mainwhile, in high-fit group, MAP had no effect on cerebral oxygenation ($p=0.76$; ES=0.18) nor cognitive performance ($p=0.82$; ES=0.13). Both MAP and aerobic fitness had no effect on motoric performance of dual tasking.
CONCLUSION: High-fit individuals, eventhough not showed greater decrease-in-HHb, as the most valid parameter for cortical activation (1), but had a better cognitive performance than young adults with low fitness levels. These condition suggest a more efficient brain processing in high-fit individuals (2). As cerebral blood flow and oxygenation are not independent of changes in blood pressure (3) and PFC oxygenation is related to cognitive performance (2), higher-MAP individuals, showed worse brain oxygenation and cognitive performance in young adults with low fitness levels. Those results seem to support that high aerobic fitness and lower-MAP are associated with greater oxygenation or efficiency in PFC and better cognitive performance in young adults.
References :
1 - Obrig H., Villringer A. (2003) Journal of Cerebral Blood Flow and Metabolism 23 :1-18
2 - Lucas S.J., Tzeng Y.C., Galvin S.D., Thomas K.N., Ogoh S., Ainslie P.N. (2010) Hypertension, 55 : 698-705
3 - Dupuy O. et al. (2015). Frontiers in Human Neuroscience, 9 (66) : 1-12

THE CIRCULATING PLATELET MICROPARTICLE RESPONSE TO AN EXERCISE STRESS TEST IN OVERWEIGHT MALES

STOREY, A., HARRISON, M.

WATERFORD INSTITUTE OF TECHNOLOGY

INTRODUCTION: High intensity exercise in individuals with elevated cardiovascular risk causes a transient increase in platelet activity with a concomitant increase in the risk of thrombosis (Ikarugi et al., 2003). The number of circulating platelet microparticles (PMP), procoagulant platelet fragments formed during platelet activation, is transiently increased in response to strenuous exercise (Chaar et al., 2011) and may contribute to the exercise-induced increase in thrombotic potential. Being overweight is associated with platelet an endothelial dysfunction and overall elevated cardiovascular risk. The aim of this study was to determine if overweight adult males exhibit a greater exercise-induced PMP response compared to healthy weight males.
METHODS: Ten healthy weight (HW) and fifteen overweight (OW) males (body mass index HW =23.6 ± 0.51kg.m-2 and OW = 28.5 ± 0.61kg.m-2; age HW = 39 ± 4.5 and OW = 38 ± 4.8) completed a treadmill-based exercise stress test according to the Bruce protocol. Venous blood samples were taken pre-, post- and 1hr-post exercise, and platelet free plasma was analysed by flow cytometry for PMP. Nineteen subjects also underwent assessment of endothelial function by means of forearm post-occlusive reactive hyperaemia using venous occlusion strain gauge plethysmography.
RESULTS: Both groups displayed an increase in PMP concentration immediately post-exercise, which returned to resting levels at one hour. The relative increase in PMP from pre- to post-exercise not significantly different between the two groups (HW: 151 ± 76.3%, OW: 301 ± 282.6%, $p > 0.05$). No relationship was observed between the extent of PMP response and various indices of endothelial dysfunction or cardiovascular risk including blood pressure, blood glucose, total cholesterol, HDL, LDL, triglycerides, VO2max and 10 year risk SCORE.
CONCLUSION: The results of the present study support previous evidence of an increase in PMP in response to acute exercise. Being overweight does not modulate this response, which does not appear to be related to endothelial dysfunction or cardiovascular disease risk.
Chaar, V., Romana, M., Tripette, J., Broquere, C., Huisse, M. G., Hue, O., Hardy-Dessources, M. D. & Connes, P. (2011). Effect of strenuous physical exercise on circulating cell-derived microparticles. Clin Hemorheol Microcirc. 47, 15-25.
Ikarugi, H., Shibata, M., Shibata, S., Ishii, H., Taka, T. & Yamamoto J. (2003). High intensity exercise enhances platelet reactivity to shear stress and coagulation during and after exercise. Pathophysiol Haemost Thromb. 33(3), 127-33.

HEART RATE AND SESSIONAL RATING OF PERCEIVED EXERTION BASED ESTIMATIONS OF INTERNAL TRAINING LOAD IN YOUTH SOCCER PLAYERS

VAHIA, D., KELLY, A., KNAPMAN, H., WILLIAMS, C.

UNIVERSITY OF EXETER

INTRODUCTION: When exposed to the same external load, players experience different internal load resulting in varied adaptations in fitness. In adult soccer, Internal Training Load (ITL) is measured using Heart Rate (HR) and sessional Rating of Perceived Exertion (sRPE) scale, but has been under-utilised for youth soccer. Studies on youth soccer players range from only 6 to 16 weeks, reflecting a relatively small portion of the season. The present study investigated the in-season variation in correlation between HR and sRPE estimations of training load for adolescent soccer players, over an entire competitive season.
METHODS: Fifteen male professional adolescent players in a Football League Category 3 Academy were monitored for 7 months over a competitive season. Data was collected and analysed for 160 training sessions. HR was measured for the entire session and converted to

HR training load using Edwards method. sRPE was recorded 20 minutes after the end of the session. Within-participant correlations and Bland-Altman agreement plots for HR and sRPE were calculated for each month to analyse the variation over the season, and for individual players to analyse the validity of the scale. Fisher's r-to-z transformation was used to analyse the difference in correlation between months. Regression equations and standard errors were calculated to quantify the error estimate of reporting for the sRPE scale.
RESULTS: The overall correlation was r=0.64 (95%CI 0.60-0.68; p<0.001). Results showed large to very large correlations for all months, ranging from r=0.60 to r=0.70. Fishers r-to-z transformations found no significant difference between the monthly correlations. Bland-Altman plots showed an agreement of methods for each month as well as individual players. Error estimations report an error of 1 to 2 units in sRPE estimations by players, depending on the duration of the session.
CONCLUSION: We therefore conclude that sRPE is a consistent method of measure of internal training load for the entire season. The large data set and higher statistical strength of this study may provide a more accurate representation of ITL in youth soccer. Validity analysis found no bias in sRPE measurements when compared to HR for all players in the study. This study supports the use of sRPE as a valid and feasible measure of ITL in soccer, when compared to HR measures and there is no bias between the two measures.

RELEVANCE BETWEEN BLOOD VOLUME AND ENDURANCE PERFORMANCE OF FEMALE RUGBY PLAYERS

SUGIMOTO, N., KAMIJO, Y., KANATANI, K., KAWABATA, T.

ENVIRONMENTAL PHYSIOLOGY FOR EXERCISE

INTRODUCTION: The functions of the human circulatory system during exercise include maintaining skin blood circulation necessary for thermoregulation and increasing/maintaining blood flow to active muscles. When these functions are hindered due to higher exercise intensity or workload, retention of performance including judgment ability becomes difficult and may lead to injuries.
Although a highly positive correlation between blood volume and maximum rate of oxygen consumption of players of sports other than rugby has been reported to date, almost no research on the relevance between blood volume and endurance performance of rugby players can be found. This study clarifies the physiological significance of the effect of blood volume on endurance performance as an assessment of physical strength of female rugby players.
METHODS: -Subject: Six female rugby players in a club team in Japan
-Measurement of Blood volume: The subjects rested in a sitting position for 15 minutes in a room at a temperature of 28˚C, and had 7 ml of their blood drawn. Further, Evan Blue dye was injected, and another 7 ml of blood was drawn after 10 minutes. The hematocrit value and hemoglobin concentration was measured with whole blood, and dye concentration in plasma was measured by the absorption method after centrifugation.
-Endurance performance: Bangsbo's YOYO intermittent recovery test level 1
RESULTS: The blood volume of the six players was 63.06–71.46 ml/kg, and the YOYO score was 16.1–18.2.
CONCLUSION: Since repeated work and rest is a characteristic of the sport of rugby and the recovery performance after such actions can be measured on the field, the YOYO score was used as the index for endurance performance. Significant positive correlation with blood volume was also found in this study, and it may be considered that it also impacts recovery performance, given the characteristic of the sport. As a result of analysis by the players' positions, the backs showed higher values than the forwards. Of the results, the highest value was given by a player with the role of the scrum half in Rugby Sevens. These results suggest that the role during a game and amount of body fat impact blood volume and endurance performance.

MUSCLE DEOXYGENATION DURING RAMP TEST IS DEPENDENT ON THE ANGIOTENSIN-CONVERTING ENZYME GENE POLYMORPHISM AND ENDURANCE TRAINING STATUS

FITZE, D.P., FRANCHI, M.V., VALDIVIESO, P., FLÜCK, M.

BALGRIST UNIVERSITY HOSPITAL

INTRODUCTION: The angiotensin-converting enzyme gene insertion/deletion polymorphism (ACE I/D genotype) has been often linked to trainability of muscle-based traits of endurance and strength. However, the associations between the ACE I/D genotype and peak oxygen uptake (VO2peak) are not conclusive [1-3] whereas studies that have focused on skeletal muscle features had more success [4-7]. Near-infrared spectroscopy (NIRS) offers the possibility of non-invasive measurement of skeletal muscle oxygenation during exercise. Therefore, the aim of this study was to investigate the individual and combined effects of the ACE I/D genotype and endurance training status on markers of muscle oxygen saturation (SmO2) during ramp test.
METHODS: 21 healthy subjects (Male: n = 12, age = 28 ± 4 years; Female: n = 9, age = 25 ± 4) performed a ramp test and were screened for the ACE I/D genotype. During the ramp test, VO2peak was measured while SmO2 of the vastus lateralis muscle was assessed using a NIRS device. VO2peak was used to differentiate between endurance-trained (> 50 mL·min-1·kg-1) and untrained subjects (< 50 mL·min-1·kg-1). Individual and combined effects of the ACE I/D genotype and endurance training status on SmO2 markers during ramp test were analysed using two factor analysis of variance (ANOVA).
RESULTS: ACE I/D genotype showed no significant effect on any of the SmO2 markers during ramp test. Endurance training status had a significant effect on the markers SmO2 min (p = 0.017) and delta deoxygenation (p = 0.033) and a highly significant effect on the marker delta 1/2 reoxygenation (p = 0.007). In addition, there was a significant interaction effect between the ACE I/D genotype and training status on the marker slope deoxygenation (p = 0.028).
CONCLUSION: Possible confounders, such as gender and training status, may have influenced a potential individual effect of the ACE I/D genotype. As the depletion of oxygen concentration in contracting muscle is largely affected by contraction-induced mitochondrial oxygen consumption [8]; the observed greater muscle deoxygenation in trained subjects could indicate an increased oxidative capacity in vastus lateralis. Conversely, the larger reoxygenation reflects an improved capacity for muscle oxygenation in endurance-trained subjects. Carriers of the ACE I-allele have been shown to demonstrate superior increases in the volume density of subsarcolemmal mitochondria in response to endurance training [5]. The highly significant steeper slope deoxygenation for trained subjects of the ACE I/I genotype could indicate a higher percentage of slow-oxidative type I muscle fibres and thus a higher mitochondrial volume density in these subjects.
References: 1.Rankinen et al. J Appl Physiol 2000
2.Sonna et al. J Appl Physiol 2001
3.Papadimitriou et al. BMC genomics 2018
4.Zhang et al. Clinical genetics 2003
5.Vaughan et al. Eur J Appl Physiol 2013
6.Vaughan et al. PloS One 2016

7.Valdivieso et al. Front Physiol 2017
8.Liguzinski et al. Am J Physiol Cell Physiol 2006

ADDITIVE EFFECTS OF AGING ON ENDOTHELIAL FUNCTION AND OXIDATIVE STATUS IN HYPERTENSION

MASODSAI, K., YANG, A.L.
UNIVERSITY OF TAIPEI

INTRODUCTION: The prevalence of hypertension has been increasing parallel with aging (Bromfield et al., 2014). Some evidences indicate that the decline in cardiovascular function and the increase in oxidative stress are associated with the aging process (Bolton & Rajkumar, 2011). However, whether aging additively affects endothelial function and oxidative status in hypertension remains unclear. Therefore, this study aimed to investigate the effects of aging on endothelial function and oxidative status in hypertension.
METHODS: The male spontaneously hypertensive rats (SHR) were randomly divided into 24- and 48-week-old SHR (24wk-SHR, 48wk-SHR) groups, while the age-matched Wistar-Kyoto (WKY) rats were served as the normotensive control (24wk-WKY, 48wk-WKY) groups. When all animals reached their age setting, the endothelial function, such as insulin-induced vasoactive response of isolated aortic rings, was evaluated by the organ bath system with force displacement transducers among four groups. Furthermore, the levels of oxidative stress (i.e. malondialdehyde, MDA) and antioxidant activity (i.e. catalase, CAT) were measured and compared among four groups.
RESULTS: Compared with the age-matched WKY groups, the insulin-induced vasorelaxation was significantly ($p < 0.05$) impaired in 24wk- and 48wk-SHR groups, respectively. In addition, it was significantly ($p < 0.05$) worse in the 48wk-SHR group compared with the 24wk-SHR group. After incubations of the inhibitors of nitric oxide synthase (NOS) and phosphoinositide 3-kinase (PI3K), the insulin-induced vasorelaxation was significantly ($p < 0.05$) reduced and not significantly different among four groups. The level of MDA was significantly ($p < 0.05$) higher in the 48wk-SHR group compared with the 48wk-WKY group, while the level of CAT was significantly ($p < 0.05$) reduced in the 48wk-SHR group compared with the 24wk-SHR group.
CONCLUSION: This study demonstrated that the older hypertensive rats had more severity in endothelium-dependent insulin-induced vasorelaxation together with the increased MDA level and impaired CAT activity. It suggested that aging could additively affect endothelial function in hypertension, which was partly through the oxidative status.
References: Bolton, E., & Rajkumar, C. (2011). Rev Clin Gerontol, 21, 99–109.
Bromfield, S. G., Bowling, C. B., Tanner, R. M., Peralta, C. A., Odden, M. C., Oparil, S., & Muntner, P. (2014). J Clin Hypertens (Greenwich), 16(4), 270-276.
Contact: kunanyamasodsai@gmail.com

Mini-Orals

MO-PM18 Genomics and cell signaling

AN EXPLORATORY STUDY OF GLOBAL GENE EXPRESSION CHANGES THROUGH RESISTANCE TRAINING: MUSCLE ADAPTATIONS AND INTER-INDIVIDUAL VARIABILITY

DAMAS, F.1,2, UGRINOWITSCH, C.2, PHILLIPS, S.M.3, JANNIG, P.R.2, HECTOR, A.J.3, MCGLORY, C.3, LIXANDRÃO, M.E.2, VECHIN, F.C.2, MONTENEGRO, H.4, TRICOLI, V.1, ROSCHEL, H.2, LIBARDI, C.A.1
1: FEDERAL UNIVERSITY OF SÃO CARLOS (UFSCAR) - BRAZIL; 2: UNIVERSITY OF SÃO PAULO - BRAZIL; 3: MCMASTER UNIVERSITY - CANADA

INTRODUCTION: Gene expression changes that occur acutely and chronically with resistance exercise (RE) training (RT) have substantial bearing on skeletal muscle adaptations. Exploratory methods can be used to investigate if known RE-modulated genes and new gene clusters are modulated acutely and chronically by RT. Thus, we investigated the effect of training status at rest and after acute RE on the global transcriptome of young men.
METHODS: Vastus lateralis muscle biopsies of nine young men (age: 26(2) y; BMI: 24(3) kg.m-2) who undertook lower limbs RT (six sets [three of 45° leg-press and three of leg extension exercises] of 9-12 maximum [to concentric failure] repetitions with 90s rest intervals) for 10-wk were collected pre- and 24h post-RE at the first (W1) and last (W10) weeks of training and analysed using microarray. Tests of differential expression were conducted for rested and after RE contrasts in both training states. To control for false discovery rate (FDR), multiple testing correction was performed at a cutoff of FDR < 0.05.
RESULTS: An unaccustomed RE bout (at W1) up-regulated muscle gene transcripts related to stress (e.g., heat shock proteins), inflammation, extracellular matrix and cytoskeleton remodelling, protein processing and turnover and ribossomal biogenesis. Trained muscles (at W10) became more metabolically efficient, favoring a more oxidative metabolism, showed refined response to stress, with better antioxidant and immune responses, and up-regulated gene transcripts related to extra-intra cellular signalling transmission, muscle scaffold organization, development and growth. In the rested condition, the 500 most expressed genes show inter-subject variability, which is increased after acute RE irrespective of training state.
CONCLUSION: Changes in gene transcripts reflected the high stress promoted by an unaccustomed RE, relating to muscle remodelling, inflammation, high protein metabolism and increased translational capacity. As RT progresses, muscles showed energy efficiency, promptness to respond effectively to stress, structural reinforcement, improved muscle contraction efficiency, and development of myofibrillar hypertrophy. Between-subject variability in the transcriptome response is increased with RE performance regardless of training state, which is in accordance with a large inter-subject variability in both the response to muscle damage/stress in an untrained state (1) and to muscle hypertrophy after an RT period (2). In conclusion, global gene expression analyses showed that chronic repetition of RE increases muscle efficiency to respond more focused and accurately to RE-induced stress; still, inter-individual variability is high regardless of training state, especially in response to RE.
References: 1) Damas et al. (2016). Int J Sports Med, 37(8), 633-40.
2) Ahtiainen et al. (2016). Age (Dordr), 38(1), 10.

REGULATORS OF THE ANGIOGENESIS PATHWAY AND RISK MODELS FOR ANTERIOR CRUCIATE LIGAMENT RUPTURES

RAHIM, M., LACERDA, M., COLLINS, M., POSTHUMUS, M., SEPTEMBER, A.V.

UNIVERSITY OF CAPE TOWN

INTRODUCTION: Previous studies have identified independent and haplotype associations within the genes encoding vascular endothelial growth factor (VEGFA) and its receptor kinase insert-domain receptor (KDR) with risk of anterior cruciate ligament ruptures and Achilles tendinopathy. The aim of this study was to explore the angiogenesis signalling pathway within the context of the more complex matrix remodelling pathway, following a pathway-based approach. Evidence suggests that the interleukins (IL-1β and Il-6) may upregulate the angiogenic response. Statistical modelling tools were used to develop a preliminary polygenic risk assessment model for ACL ruptures, incorporating the angiogenesis genes (VEGFA and KDR) and cell signalling molecules (IL1B, IL6, IL6R) which also function to regulate angiogenesis.
METHODS: A total of 232 asymptomatic controls (CON) and 234 participants with surgically diagnosed anterior cruciate ligament (ACL) ruptures, of which 135 participants reported a non-contact mechanism of injury (NON subgroup), were previously genotyped for the selected polymorphisms. Multivariate logistic regression analysis was used to identify the most informative contributors to ACL rupture risk from a range of eleven potential intrinsic risk factors: age, sex, BMI and eight genetic polymorphisms within five genes, namely, IL1B rs16944 C/T, IL6 rs1800795 G/C, IL6R rs2228145 C/A, VEGFA rs699947 C/A, VEGFA rs1570360 G/A, VEGFA rs2010963C/G, KDR rs2071559 A/G and KDR rs1870377 T/A.
RESULTS: The polygenic risk model identified the VEGFA rs699947 CC genotype (p=0.024, odds ratio (OR): 3.35, 95% confidence interval (CI): 1.17 – 9.62), rs2010963 GC genotype (p=0.049, OR: 2.43, 95% CI: 1.00 – 5.87), age (p=0.009, OR: 1.09, 95% CI: 0.57 – 2.11) and BMI (p=0.011, OR: 0.97, 95% CI: 0.95 – 0.99) as the most significant predictors of ACL rupture risk from the data included.
CONCLUSION: The results of this study highlight VEGFA, age and BMI as biologically significant components of this network requiring further investigation in the context of musculoskeletal soft tissue injury risk.

CHANGES IN FREE- AND EXOSOME-ASSOCIATED CIRCULATING MIRNAS AND MYOKINE PROFILE IN PROFESSIONAL SKY-RACERS DURING THE GRAN SASSO D'ITALIA VERTICAL RUN

LOMBARDI, G., FARALDI, M., SANSONI, V., PEREGO, S., GOMARASCA, M., BANFI, G.

I.R.C.C.S. ISTITUTO ORTOPEDICO GALEAZZI

INTRODUCTION: A first step in the adaptation to exercise is the modification of the gene expression profile leading to changes in the level of those molecules associated with skeletal muscle activity and energy metabolism, e.g., myokines, as well as those molecules involved in their transcriptional regulation, e.g., microRNA (miRNA). Since little is known about the exercise-dependent modifications on their expression, this study was aimed at studying the influence of strenuous exercise on circulating miRNA and their possible association with the myokine response.
METHODS: Pre- and post-race plasma samples were collected from 14 male athletes participating in a vertical run (+1000m gain, 3500m length) held in summertime at Gran Sasso d'Italia. Free- (f-miRNA) and exosome-associated (e-miRNA) circulating miRNAs were extracted from pooled plasma. A panel of 179 miRNAs, the most expressed in circulation, was assayed in triplicate by real-time PCR and analyzed by Exiqon GenEx v6. Relative expression was calculated by the 2-ΔΔCT method and normalization was made on the averaged value of the whole analysis. miRNAs associated with skeletal muscle activity and metabolism (myo-miRNA, according to mirDB) whose level was ≥5-fold up- or down-regulated in both free and exosome fractions were analyzed in triplicate in each single. Samples were assayed for a panel of 11 myokines by a magnetic bead-based multiplex immunoassay (interleukin-6 [IL-6], IL-15, irisin, fatty acids-binding protein 3 [FABP3], fibroblast growth-factor 21 [FGF-21], oncostatin [OSM], leukemia inhibitory factor [LIF] follistatin-like 1 [FSTL1], myostatin).
RESULTS: 47 f-miRNA were up-regulated and 7 down-regulated while amongst the e-miRNA 24 were up-regulated and 14 down-regulated; of these only 11 miRNAs were changed in both fractions. Among these, f- and e-myo-miRNAs (miR-143-3p, miR-29a-3p, miR-30a-5p, miR-424-5p, miR-485-3p and let-7e-5p) were analyzed in each single sample. The analysis show that these miRNAs were differentially modulated within the two fractions by the effort. Strenuous exercise affects the expression of myokines involved in energy metabolism (IL-6, IL-15, FABP3, FGF-21) inflammation (IL-6, OSM, LIF) and muscle anabolism (FSTL1) while it did not affect irisin and myostatin. There were significant correlations between the circulating levels of myokines and miRNA: all f-miRNA, except miR-424-5p, correlated directly with IL-6, IL-15, FABP3, FSTL-1, and OSM; among e-miRNAs, miR-485-3p correlated directly with IL-6, IL-15, LIF, FSTL-1, OSM, and indirectly with FGF-12 while let-7e-5p correlated directly with OSM.
CONCLUSION: These results indicate that whole-body adaptation to exercise is tightly regulated by miRNAs, other than myokines.

THE PREVENTIVE EFFECT OF VOLUNTARY PHYSICAL EXERCISE ON MENTAL DISORDERS IN HIGH-FAT-DIET-MICE

OYANAGI, E., WATANABE, C., KOBIKI, N., UCHIDA, M., KREMENIK, M.J., YANO, H.

KAWASAKI UNIVERSITY OF MEDICAL WELFARE

INTRODUCTION: Obesity, which is a major social problem not only in industrialized countries but also in developing countries, is regarded as one of the risk factors of mental health. Recently, it has been reported that gut microbiota might be an inducer of mental disorders. On the other hand, exercise, which is effective for preventing the onset of obesity, also causes a change in the gut microbiota. In addition, exercise habits might be effective for the prevention of mental disorders. However, it remains unclear whether or not mental disorders can be prevented via exercise habits. Therefore, in this study, we examined the effect of voluntary physical exercise on mental disorders in response to a high-fat-diet using a mouse model.
METHODS: 4-week-old male C57BL/6 (n=27) mice were divided into two groups: control diet (CD) and high-fat-diet (HFD).Then, each group was treated with or without voluntary wheel running (W and control: C) for 10 weeks. After that, anxiety behavior tests (open field test, marble burying test, forced swim test, and sucrose preference test) were carried out. The animals were euthanized after these behavior tests, and the collected brain tissue was measured for mRNA expression of brain-derived neurotrophic factor (BDNF), neuropeptide Y (NPY), interleukin-1beta (IL-1β) and IL-6 by real-time RT-PCR.
RESULTS: Body weight in the HFD group was significantly higher than that in the CD group. And, in both groups, weight gain suppression by the W condition was observed. In the open field test, the staying time in the central part of the field was significantly longer under the W mice compared with C mice in both groups. Although, in the marble burying test, the anxiety behavior increased under the W condition in both groups, the floating time of the W mice in the forced swimming test was shorter than that of the C mice in both groups. The result of the sucrose preference test showed that a significant low value in the HFD group and no effect of exercise was observed. BDNF and

NPY gene expression of the brain in the HFD group were significantly lower than those in the CD group, but the effect of wheel running was no observed.
CONCLUSION: It might clarify the effect of voluntary wheel running on the anxiety behaviors of high-fat diet fed mice by using various anxiety behavior tests.

AEROBIC EXERCISE INHIBITS TAU HYPERPHOSPHORYLATION THROUGH ACTIVATION OF THE PI3K/AKT PATHWAY IN THE HIPPOCAMPUS OF APP/PS1 MICE

FANG, G.

CHINA INSTITUTE OF SPORT SCIENCE

INTRODUCTION: Many studies suggest that regular physical exercise can reduce the risk of Alzheimer's disease and slow its onset and progression. However, the exact mechanism is still unclear. Clinically, Alzheimer's disease is characterized by the presence of extracellular amyloid plaques and intraneuronal neurofibrillary tangles, which are associated with amyloid-β and tau hyperphosphorylation respectively. The PI3K/Akt signaling pathway regulates tau phosphorylation and plays a pivotal role in the development of pathology in Alzheimer's disease. Here we investigated the effects of aerobic exercise on tau phosphorylation and examined whether these effects were mediated by the PI3K/Akt pathway in the hippocampus of APP/PS1 transgenic mice.
METHODS: 40 male APP/PS1 transgenic mice were randomly divided into four groups: sedentary group , exercise group , sedentary with GNE-317 treatment group and exercise with GNE-317 treatment group . GNE-317 is a potent and selective PI3K/Akt pathway inhibitor that can cross the blood-brain barrier and show effective suppression of Akt phosphorylation in the mice brain. The mice in the T-EX and T-EXG groups were given exercise training on a treadmill for 5 days/week for 8 weeks with 0% grade, and progressively ran from 30 min/day at 12 m/min, up to 60 min/day at 15 m/min. The mice in the T-SE and T-SEG groups were placed individually on another treadmill at 0 m/min for the same duration. 48 hours after the last exercise bout, all mice were intraperitoneally injected an anesthetic for inducing anesthesia, and the hippocampus were rapidly extracted. The protein and phosphorylation levels of tau, PI3K, Akt and GSK3β were assayed by Western blot and immunohistochemistry. The cognitive function were tested by morris water maze.
RESULTS: We found out that 8 weeks of aerobic exercise reduced tau phosphorylation at multiple sites including Ser202, Thr231 and Ser396, and increased phosphorylation of Akt at Thr308 and Ser473 and of GSK3β at Ser9. Furthermore, in the morris water maze test, the exercise group showed a reduced escape time and distance compared with those of the sedentary group, suggesting that aerobic exercise improved learning and cognitive ability. While the above-mentioned results were attenuated in the PI3K/Akt inhibitor GNE-317 treatment groups.
CONCLUSION: Our study demonstrated that aerobic exercise could inhibit tau hyperphosphorylation and improve cognitive funtion through activation of the PI3K/Akt pathway in the hippocampus of APP/PS1 mice.

ACUTE AND LONG-TERM EFFECTS OF BLOOD FLOW RESTRICTED TRAINING ON HEAT SHOCK PROTEINS: COMPARISON BETWEEN A FAILURE AND A NON-FAILURE PROTOCOL

HODY, S.1, CUMMING, K.T.2, WERNBOM, M.3, BJØRNSEN, T.4, PAULSEN, G.2,5, RAASTAD, T.2

1: ULG , 2: NSSS ; 3: GU , 4: AG , 5:NIF

INTRODUCTION: The stress imposed on muscle fibres during low-load blood flow restricted resistance exercise (BFRRE) performed to failure seems to preferentially stress type I fibres (Cumming et al., 2014). Therefore, the aim of this study was to compare the effect of a failure (FA) vs non-failure (NON-FA) BFRRE protocol on heat-shock protein responses in the exercising muscles.
METHODS: Sixteen untrained men (18-45yrs) completed 14 BFRRE sessions divided into 2 blocks of 7 sessions in 5 days, interspersed by 10 days of rest. Legs were randomly assigned to either FA (4 sets to voluntary failure) or NON-FA protocol (30-, 15-, 15-, 15 reps) using unilateral knee extensions at 20% of 1RM with 30s rest between sets. BFRRE was conducted with partial blood flow restriction (100 mmHg) induced by a 15cm wide pressure cuff. Muscle biopsies were collected before, during and post intervention and analysed for αB-crystallin (αBc), HSP70 and MHC by immunofluorescence.
RESULTS: Relative to pre-exercise, an increase in αBc staining intensity (reflecting cytoskeletal bound proteins) was observed 2h post-exercise in type I and type II fibres for both legs (FA: 261 ± 194 and 202 ± 118%, $p<0.01$, respectively; NON-FA: 181 ± 118 and 162 ± 88%, $p<0.05$, respectively). At the acute phase, HSP70 staining intensity also showed an increase in type I fibres for both legs (FA: 136 ± 64%; NON-FA: 132 ± 44; $p<0.05$), but only NON-FA legs displayed an increase in HSP70 staining intensity in type II fibres (FA: 123 ± 52%, NS; NON-FA: 148 ± 57%; $p<0.01$).
During the rest week (11 days after the first session), both legs showed an increase in αBc staining intensity in type I (FA: 140 ± 55%, $p<0.01$; NON-FA: 128± 63%, $p<0.05$), but not in type II (FA: 140 ± 92%; NON-FA: 119 ± 82; NS). At this timing, only FA legs showed an increase of HSP70 in both type I and type II fibres (FA: 218 ± 224% and 172 ±115%, $p<0.01$, respectively; NON-FA: 128 ± 40% and 134 ± 102%, NS, respectively). No significant differences were found ten days post intervention.
Interestingly, significant differences between legs were found in the acute and long-term HSP responses for type I fibres. These fibres showed higher staining intensity of αBc 2h after the first session and of HSP70 during rest period in the FA legs compared to NON-FA legs ($p<0.05$).
CONCLUSION: The immunostaining analyses indicate that cytoskeletal proteins are stressed in both fibre types after the first session of both BFRRE protocols, with a higher stress response in type I fibres after FA protocol than after NON-FA protocol.
Reference: Cumming KT, Paulsen G, Wernbom M, Ugelstad I, Raastad T. (2014). Acta Physiol, 211, 634–646.

EFFECTS OF 12 WEEKS AEROBIC EXERCISE, WITH OR WITHOUT CALORIC RESTRICTION, ON MITOCHONDRIAL FUNCTION, MITOPHAGY AND THE MTORC1 SIGNALING PATHWAY IN SKELETAL MUSCLE OF AGING RATS

WEN, L., ZHANG, J., LIN, X., ZHAO, Y.Q., YU, M.C., ZHANG, Y.

TIANJIN UNIVERSITY OF SPORT

INTRODUCTION: It has been reported that both aerobic exercise and caloric restriction has benefit effects on improvement of a decreased mitophagic capacity due to aging muscle. However, there is no report on whether that was regulated by the mTORC1 (mammalian target of rapamycin complex 1) signaling pathway. The aim of this study was to examine the effects of aerobic exercise, with or without caloric restriction, on the mitophagy and mitochondrial function and the expression of proteins involved in the mTORC1 signaling pathway in the skeletal muscle.

METHODS: 21-month SD rats were allocated into 4 groups (n=8 in each): control (C), calorie restriction (CR, 60% diet of C group), treadmill exercise (E), and calorie restriction and treadmill exercise (CR+E). During the entire protocol, treadmill parameters were set as the belt speed of 15m/min and the slope of 5◦. The exercise intensity was at approximately 64% VO2 max. The E and CR+E groups were given the corresponding exercise with 1 hour per session, 5 sessions per week, for 12 weeks. Under anaesthesia, soleus muscles were collected24 h after the last session. Mitochondria were isolated immediately from a part of muscles by differential centrifugation. Oxygen electrode method was used to detect mitochondrial oxygen consumption. The respiratory control rate (RCR) was the ratio of ST3 (oxygen consumption rate after ADP) to ST4 (ADP-free oxygen consumption rate). The left muscles were stored in -80°C for the analysis of protein expression (including AMPKα,p-AMPKα（T172）, mTOR, p-Raptor, ULK1, p-ULK1（S757）, p-ULK1（S555）, LC3, p62, Parkin and BNIP3) by western blotting later.
RESULTS: There was a significant decrease in both the mitochondrial ST3 and ST4 respiration rate in the CR and the mitochondrial ST4 respiration rate in the CR+E (both P<0.01, by one-way ANOVA), and a significant increase in the mitochondrial ST3 respiration rate in the E (P<0.05), the mitochondrial ST4 respiration rate, the RCR and the activity of mitochondrial ATP synthase in the E (all P<0.01), as compared to the C respectively. The mitochondrial ST3 and ST4 respiration rate were significantly reduced in the CR+E (P<0.01) as compared to that in the E. The mitochondrial ST3 respiration rate was significantly increased (P<0.01), while the mitochondrial ST4 respiration rate was significantly decreased in the CR+E (P<0.01) as compared with that in the CR. The CR had an increased p-AMPK α and p-Raptor, while a reduced ULK1-757 and p62, than the C respectively (all P<0.01). However, both the E and the CR+E had a higher p-Raptor, while a lower of both ULK1-757 and BNIP3 than the C. p-AMPK αwas significantly decreased, while ULK1-757 was significantly increased in the CR+E, as compared to that in the CR (P<0.01).
CONCLUSION: Both aerobic exercise and caloric restriction could lead to an increase of mitophagy, which is the essential process for the maintenance of mitochondrial structural integrity. That may have an effective effect on the prevention of reduced skeletal muscle mitochondrial function from aging. This study indicated that the mTORC1 signaling pathway may play an important role in the promoting mitophagy resulted from aerobic exercise or caloric restriction.

THE EFFECT OF ACUTE EXERCISE ON T CELL VITAMIN D RECEPTOR (VDR) EXPRESSION IN YOUNG AND OLDER MALES

LITHGOW, H., FLORIDA-JAMES, G., ROSS, M., BARLOW, P., LEGGATE, M.
EDINBURGH NAPIER UNIVERSITY

INTRODUCTION: A low vitamin D status has been identified as an association risk factor in the etiology of numerous chronic diseases, with older adults identified as generally more deficient than younger populations. Exercise has been shown to act as a direct and indirect stimulus on key vitamin D metabolites, specifically the vitamin D receptor (VDR) (1, 2), however investigations are limited to murine model studies.
METHODS: The primary aim of the study is to explore whether a single bout of exercise upregulates VDR expression in circulating systemic T cells. Healthy young (n=11, age: 27 ± 2 y, BMI: 26.2 ± 3.5 kg/m2), young-mid (n=10, age: 39 ± 6 y, BMI: 25.2 ± 1.9 kg/m2) and older (n=12, age: 67 ± 4 y, BMI: 25.9 ± 2.9 kg/m2) male adults performed three trials: a single bout of resistance exercise (repeated maximal voluntary isometric contractions), a bout of endurance exercise (60 min cycling at 55% work load max), or a control trial (no exercise –60 min rest). Intravenous blood samples were collected pre- and post-exercise (0, 1, 3 hours) and analysed for cell-surface and intracellular T cell (CD3, CD4, CD8 T cell subsets) VDR expression via flow cytometry analysis.
RESULTS: The results are pending following analysis of the completed data set.
CONCLUSION: The findings could support exercise as a strategy to improve the orchestration of vitamin D metabolism through its main mediator the VDR, particularly in older adults whom are more deficient. Upregulating VDR receptor expression can alter gene transcription and thus regulate protein synthesis (3), therefore playing a mediating role in the prevention, development and progression of chronic diseases.

Mini-Orals

MO-PM19 Thermoregulation

EFFECT OF ACUTE HEAT EXPOSURE ON INDOOR ROWING PERFORMANCE AND PACING IN AMATEUR ROWERS

OHAGAN, C., ORME-SMITH, M.
SHEFFIELD HALLAM UNIVERSITY

INTRODUCTION: Exercising in hot and humid environments presents a greater cardiovascular challenge than in temperate conditions. This can result in a decrease in performance, which is particularly likely in athletes unaccustomed to hot conditions. Previous research in cycling and running time trials has found that decreased performance is often accompanied by changes in pacing strategies, as afferent feedback from internal and environmental sensations affect conscious control of the athletes distribution of effort across the exercise bout. The aim of this study was to investigate the effect of acute exposure to high environmental temperature on performance and pacing of a 2000m indoor rowing trial in amateur rowers.
METHODS: Eighteen amateur club rowers (females: n = 14, age = 30 ± 14 years, stature 170 ± 5 cm, body mass 68 ± 7 kg; males: n = 4, age = 19 ± 1 years, stature = 184 ± 2 cm, body mass 84 ± 12 kg, (all values shown as mean ± standard deviation)) completed three 2000 m trials on an indoor rowing machine; two in moderate environmental conditions replicating a typical summer day in the United Kingdom (MOD) (20.5 ± 1.2 C, 34 ± 8 % relative humidity) and one in conditions replicating an unusually hot summer day in the United kingdom (HOT) (30.4 ± 0.6 C, 49 ± 2 % relative humidity). During the trials, participants received no feedback except verbal indication of distance remaining after 500m, 1000m and 1500m of the trial. Heart rate was recorded throughout the trial, ear canal temperature and blood lactate concentration were measured immediately after completion of the trial. Reliability of the performance test was assessed by calculation of the typical error (TE); the effect of environmental conditions on performance, pacing and physiological variables was assessed by paired t-tests
RESULTS: Performance (time to complete) was worse in the hot condition (MOD: 489 ± 48 s, HOT: 498 ± 46 s, $p < 0.01$); the mean difference between conditions (8.7 s) was greater than two times the typical error obtained from repeated trials in the moderate condition (TE: 4.3 s), suggesting that the observed difference was both statistically significant and real. Pacing pattern (percentage of total time used to complete each 500m segment of the trial) did not differ between conditions. End-trial ear canal temperature was higher in the hot condi-

tion (MOD: 36.5 ± 0.7) C, HOT: 37.1 ± 0.6 C, p = 0.02); there were no between-condition differences in average heart rate during the trial or end-trial blood lactate.
CONCLUSION: This study found that in amateur athletes, 2000m rowing performance was decreased in hot and humid conditions compared to moderate environmental conditions. As this was not accompanied by a change in pacing profile, it is likely that the decreased performance was due to cardiovascular limitations or a self-selected conservative effort throughout the trial rather than changes in pacing strategy.

EVALUATION OF A NOVEL SHORT TERM HEAT ACCLIMATION PROTOCOL USING FAN COOLING

YUTA, M.1, SADAYOSHI, S.1, KEI, N.2, NORIKAZU, H.3

WASEDA UNIVERSITY

INTRODUCTION: Heat acclimation(HA) lessens a risk of heat stroke during exercise in heat. As a protocol inducing HA, continuous exercise of which intensity is gradually increased from lower to higher level is recommended. However, when applying the protocol to training in heat, we could not give athletes high enough intensity of exercise due to a possible risk of heat stroke. The present study aimed to evaluate effect of fan cooling on the HA protocol. We hypothesized that the fan cooling during the HA protocol enables athletes to conduct high intensity exercise with successful HA.
METHODS: Seventeen adult males were divided into two group with or without fan-cooling (FAN and CON, respectively) during HA protocol. At least one wk before the HA protocol, heat tolerance test (HTT) was conducted: 120-min walking on a treadmill at 5km/h and 2% grade in an environment of 40℃ and 40% RH. Rectal temperature(Tre), heart rate(HR), local sweat rate (LSR), and Na+ concentration of sweat([Na+]) were measured. The HA protocol consisted of 5 exercise days and in between 4 resting days. On the exercise day, subjects were asked to perform 6 bouts of high intensity exercise which consist of 5s maximum sprints, jogging at 50% of VO2max for 105s, and 10s rest using ergometer. Tre and HR were monitored during the exercise period. Fan-cooling was applied during entire exercise period in the FAN group. The HTT was repeated within 3 days after the completion of the HA protocol. Exercise in the HA protocol and HTT were ceased when Tre reached 39 ℃.
RESULTS: In the FAN group, walking time in the HTT became longer after the HA protocol (from 102.7 ± 17.7 to 120.0 ± 0.0 min). However, the time remained unchanged in the CON group (from 108.8 ± 18.7 to 111.3 ± 16.2 min). In the FAN group, Tre at the end of the HTT was lower after the HA protocol(from 38.4 ± 0.3℃ to 38.0 ± 0.4℃); however, the Tre was unchanged. LSR increased and [Na+] decreased after the HA protocol only in the FAN group. The total duration of the HA protocol was greater in the FAN than in the CON group (286.0±22.8 and 187.8±53.9 min, respectively).
CONCLUSION: We found that the fan cooling increased the efficiency of the HA protocol. On the contrary, when the fan cooling was not utilized, no effect of the protocol was observed. We speculated that 3 factors of the fan cooling were associated with the efficiency: i) total duration of exercise, ii) coducted time of higher intensity of exercise, and iii) net period that higher Tc was maintained. The present study showed that fan cooling enables the efficiency of the short-term HA protocol. In addition, even in a hot environment on a field, the protocol could be conducted with minimizing the risk of heat stroke. We must further investigate physiological and psychological mechanisms involved in the prolonged exercise duration and obtaining HA.It was shown that HA occurs by using fan-cooling in the 5-day HA training with high intensity exercise.

EFFECTS OF A COOLING GLOVE AND JACKET ON REPEATED SPRINT PERFORMANCE AND MANUAL DEXTERITY IN THE HEAT

MARONI, T., WALLMAN, K., DAWSON, B., DENNIS, M., BRADE, C., NAYLOR, L.

UNIVERSITY OF WESTERN AUSTRALIA

INTRODUCTION: Team-sport players often use cooling modalities during breaks in play to attenuate an elevated core temperature (Tc) and improve subsequent exercise performance. Hand cooling represents a simple and practical cooling method that is easily transported and applied in the sporting field for reducing Tc. However, the effect of hand cooling on subsequent repeat-sprint performance or in comparison to other cooling modalities commonly used in team sport is unknown. Therefore, this study aimed to assess the effectiveness of using a cooling glove (CG) and a cooling jacket (CJ), used separately and combination, compared to no cooling (NC) during a half-time break in reducing Tc in hyperthermic athletes and then to assess the effects of this cooling on subsequent repeated-sprint exercise and manual dexterity performance (Purdue Pegboard Test) in hot/humid conditions.
METHODS: Twelve, non-heat acclimatised, male team-sport athletes performed four experimental trials (within subjects, counterbalanced design) consisting of 2 x 30 min halves of repeated-sprint cycling bouts, separated by a 20 min half-time break, all performed in heat (35.0±1.2°C, 52.5±7.4% RH). During half-time, participants undertook 15 min of cooling using either: (1) the CG, (2) the CJ, (3) combination of CG and CJ (CG+J) and (4) a NC control. This half-time duration is similar to that used in Australian football, rugby union, soccer and hockey. Additionally, manual dexterity was assessed at baseline and immediately following both exercise bouts and the cooling period (all in the heat).
RESULTS: No differences were found between trials for gastrointestinal core temperature (Tg) (p)0.05), however, moderate to large effect sizes (d=0.53-0.74) were found for absolute change in Tg and cooling rates (°C/min) between CJ and NC at 5, 10 and 15 min of cooling. No significant differences were found for mean skin temperature (Tsk) cooling between trials however at the end of half-time participants reported a lower thermal sensation whereby they felt 'cooler' wearing CG+J compared to NC (p(0.05). The CG+J trial also resulted in reduced sweat loss compared to all other trials (p(0.05), however, there were no differences were seen between trials for power and work performance variables assessed in the second half of exercise (p)0.05). Additionally, manual dexterity performance was not impaired following cooling with the CG (p)0.05).
CONCLUSION: In conclusion, the use of the CG, CJ or CG+J during a 15 min half-time break of prolonged repeated-sprint cycling in heat did not significantly further decrease Tg compared to NC in team-sport athletes, nor did use of these cooling modalities result in improved subsequent exercise performance. Furthermore, manual dexterity was not impaired after 15 min of cooling using the CG.

WEARING A COOLING VEST DURING HALF-TIME IMPROVES INTERMITTENT EXERCISE PERFORMANCE IN THE HEAT

CHAEN, Y.

HIROSHIMA UNIVERSITY

INTRODUCTION: Endurance and intermittent exercise performance are impaired by high ambient temperatures. Various countermeasures are considered to prevent the decline in exercise performance in the heat, convenient and practical cooling strategies attracts attention. The purpose of this study was to investigate the effect of wearing a new type of cooling vest which coolded torso and neck during half-time on intermittent exercise performance that imitated intermittent athletic games.
METHODS: All measurements on the experiments were carried out with the bicycle ergometer. Eight male soccer players performed a familiarization session and two experimental trials of a 2 × 30 min intermittent cycling exercise protocol, which consisted of a 5s maximal power pedaling (body weight × 0.075 kp) every minutes separated by 25s unloaded pedaling (80 rpm) and rest (30s) in the heat (33.0°C; 50% relative humidity). The two trials included cooling-vest condition (VEST) and control condition (CON) ,and the difference is with or without wearing cooling vest imposed for 15 min at half-time (HT). Mean and peak power output, rectal (Tre) and skin temperature (neck, upper back, chest, right upper arm, thigh), heart rate (HR), deep thigh temperature, ratings of perceived exertion (RPE), and thermal comfort (TC) and thermal sensation (TS) were measured.
RESULTS: Mean power output at 2nd half was significantly greater ($p < 0.05$) in VEST (3rd trial: 589±58W, 4th trial: 584±58W) than in CON (3rd trial: 561±53W, 4th trial: 561±53W). HR were significantly lower in VEST during HT and higher in VEST at the last maximal pedaling ($p < 0.05$). At the end of HT, neck skin temperature and mean skin temperature were significantly lower in VEST (32.04±1.47°C, 33.76±1.08°C, respectively) than in CON (36.69±0.78°C, 36.14±0.67°C, respectively) ($p < 0.05$). During 2nd half, TS, TC and RPE were significantly lower in VEST than in CON ($p < 0.05$). There was no significant difference in Tre and deep thigh temperature throughout each conditions.
CONCLUSION: These results indicate that wearing a new type of cooling vest during HT significantly improves intermittent exercise performance in the heat with decreased neck and mean skin temperature and improved subjective responses.

COOLING DURING EXERCISE ENHANCES AEROBIC AND ANAEROBIC EXERCISE PERFORMANCES: WHICH BODY AREA SHOULD WE COOL? A SYSTEMATIC REVIEW WITH META-ANALYSES.

DOUZI, W.1, DUGUÉ, B.1, VINCHES, L.2, SAYED, C.2, HALLÉ, S.2, BOSQUET, L.1, DUPUY, O.1

1-LABORATOIRE MOVE, UNIVERSITÉ DE POITIERS, FRANCE. 2- ECOLE DE TECHNOLOGIE SUPÉRIEURE DE MONTRÉAL, CANADA.

INTRODUCTION: It is well known that hyperthermia during exercise is accompanied by a higher central and peripheral fatigue and conduct to impair aerobic and anaerobic physical performances (1, 2). To facilitate heat loss and optimize performance, athletes can implement cooling interventions to hasten body cooling and prevent heat illnesses. While most of the previous body cooling investigations have concentrated on different methods for pre-cooling, less attention has been paid to the use of cooling applications during exercise, which could be more practical in field of training (or even in competitions). However, it is not clear whether the effect of per-cooling on aerobic and anaerobic performance is of the same kind and whether the body area that is cooled has an importance.
METHODS: A literature search led to the identification of 1456 potential studies for inclusion in the analysis. Included studies should implement a physical exercise with sufficient details on the type, the duration, the intensity, and provide valid performance measures as well as a cooling intervention administered during exercise with sufficient details on the type and site of application.
RESULTS: 45 studies met our inclusion criteria. Per-cooling provided a performance benefit during aerobic (standardized mean difference (SMD) of 0.60, $Z=6.87$, $p<0.001$) and anaerobic exercises (SMD=0.27, $Z=2.34$, $p<0.02$). However, we observed a greater per-cooling benefit in performance during aerobic exercises than in anaerobic exercises ($Z = 2.54$, $p<0.01$). Air ventilation, cooling garments and ice vest are the most effective interventions to enhance aerobic performance with a large positive effect (0.92 CONCLUSION: Per-cooling improves aerobic and anaerobic exercise performance with a better benefit for aerobic exercises. The positive effect depends on the type and the site of cooling application.
References:
1. Girard O, Racinais S. Combining heat stress and moderate hypoxia reduces cycling time to exhaustion without modifying neuromuscular fatigue characteristics. Eur J Appl Physiol. 2014 ;114(7) :1521-32.
2. Girard O, Brocherie F, Bishop DJ. Sprint performance under heat stress : A review. Scand J Med Sci Sports. 2015 ;25 Suppl 1 :79-89.

Mini-Orals

MO-PM20 Inflammation, immune function and respiration

INFLUENCE ON RENALASE BY ACUTE EXERCISE AND ITS REGULATORY MECHANISM

TOKINOYA, K., SHIROMOTO, J., SUGASAWA, T., YOSHIDA, Y., OHMORI, H., TAKEKOSHI, K.

UNIVERSITY OF TSUKUBA

INTRODUCTION: Renalase is a novel flavin-adenine-dinucleotide - dependent monoamine oxidase that is predominantly expressed in the kidneys (1). It is also found in other tissues such as the skeletal muscles. Cell survival and protective effects of renalase have also been recently reported. Renalase expression in the kidneys and liver is regulated by NF-κB, Sp1, and HIF-1α.
In a previous study, we reported that the serum renalase increases with exercise despite a decrease in the kidney function (2). The dynamics of renalase expression in acute exercise and its mechanism are unclear. In this study, we aimed to clarify the effect of different exercise intensity on renalase expression, and to examine its mechanism.
METHODS: After habitual breeding for a week, 26 male Wistar rats ran for 30 min on a treadmill for 15 min after resting. The sedentary group rested on a treadmill (SED group), while the exercise group ran for 30 min at 10 m/min (LOW group), or 30 m/min (HIGH group). Soleus, plantaris, kidney, and blood samples were collected after exercise. Renalase protein expression and phosphate IkB-α were measured using Western blotting, while HIF-1α and Sp1 were measured using real-time RT-PCR in the skeletal muscle.
RESULTS: For the first time, we observed that 1) protein expression of renalase in skeletal muscles was increased after acute exercise, but 2) the expression in the kidneys decreased, 3) NF-κB regulated renalase expression in the plantaris muscle and HIF-1α in the soleus muscle, 4) Sp1 mRNA expression did not change.

CONCLUSION: In this study, we found that protein expression of renalase in skeletal muscles is increased after acute exercise, but its expression declines in the kidneys. In addition, its expression may be increased in response to exercise-induced oxidative stress. Furthermore, NF-κB in the plantaris muscle and HIF-1α in the soleus muscle may mainly regulate the expression of renalase, and different expression regulatory mechanisms may exist depending on the type of myofibers. Since mRNA expression of Sp1 did not change, the contribution of cytoprotective effect may be greater than the metabolic function of catecholamine.

SPARASSIS CRISPA INTAKE IS ATTENUATED THE REDUCTION OF LPS-INDUCED TNF-A PRODUCTION BY EXHAUSTIVE EXERCISE IN MICE.

UCHIDA, M.1, HORII, N.1, IEMITSU, M.1

1: RITSUMEIKAN UNIVERSITY

INTRODUCTION: In general, severe exercise induces immunosuppression. We have shown that lipopolysacchride (LPS)-induced tumor necrosis factor (TNF)-α production, as a bacterial infection model which induces immune response, was inhibited by exhaustive exercise in mice (Tanaka et al., 2010). Sparassis crispa (SC), which is one of the edible mushroom, has an immunopotentiative action such as enhancement of natural killer cell activity (Hasegawa et al., 2004). However, the effects of SC on the exhaustive exercise-induced immunosuppression remains unclear. The aim of this study was to investigate the effects of SC intake on reduction of LPS-induced TNF-α production by exhaustive exercise in mice.
METHODS: Male 4-week-old C3H/HeN mice were randomly divided into three groups: normal chow intake + sedentary (ND+S), normal chow intake + exhaustive exercise (ND+Ex), and SC intake (chow containing 5% SC powder) + exhaustive exercise (SD+Ex) groups. After 8-week interventions, all mice in two exercise groups ran on the treadmill until exhaustion, and, mice in the sedentary group were rested for 70 min. Each group was injected LPS (1mg/kg) immediately after exhaustion exercise or rest. At 1 hour after LPS injection, blood samples and tissues (liver, spleen, lung, large and small intestine and adipose tissue) were collected from each mouse, to measure plasma TNF-α concentrations using ELISA kits.
RESULTS: Plasma TNF-α levels in ND+Ex and SD+Ex groups were significantly lower than that in ND+S group at 1 hour after LPS injection. However, exhaustive exercise-induced reduction of plasma TNF-α level was partially attenuated by SC intake. Moreover, in the ND+Ex and SD+Ex groups, TNF-α concentrations in liver, spleen, lung, small intestine and adipose tissues significantly decreased as compared with ND+S group. Exhaustive exercise-induced reduction of TNF-α levels in small intestine and adipose tissues was partially attenuated by SC intake.
CONCLUSION: These results suggest that SC intake attenuates exhaustive exercise-induced reduction of TNF-α production in small intestine and adipose tissues, thereby SC intake may improve exhaustive exercise-induced immunosuppression.
References: Tanaka Y et al., (2010). Neuroimmunomodulation. 17(4): 279-279.
Hasegawa A et al. (2004). Jpn. J. Cancer Chemother. 31: 1761-1763.
Contact: m-uchida@fc.ritsumei.ac.jp

IMMUNE RESPONSE IN WOMEN DURING EXERCISE IN THE HEAT: A SPOTLIGHT ON ORAL CONTRACEPTION

MINAHAN, C., LARSEN, B., COX, A., QUINN, K.

GRIFFITH UNIVERSITY

INTRODUCTION: Sex hormones modulate the immune system[1], and it is well established that oral contraceptives (OC) change the hormonal milieu[2]. Given the relationship between sex hormones and immunity, it is surprising that relatively little research has investigated the role of exogenous female sex steroids on the modulation of immune function. Furthermore, OC are associated with an elevated core body temperature[3] and there is some evidence to suggest that exercising in the heat can exacerbate the immune response[4]. Exercising in the heat can also stimulate the production of the stress hormone cortisol[5], and women using OC have a different cortisol response to exercise when compared to naturally-cycling women[6]. Therefore, women using OC might display an altered immunoendocrine response compared to naturally-cycling women, particularly when exercising in the heat. This study compared the immune and stress response of women using OC to naturally-cycling women at rest and during exercise in temperate (TEMP; 22°C) and hot (HEAT; 35°C) conditions.
METHODS: Sixteen recreationally-active women participated in this study. Eight of the women were naturally-cycling (WomenNC) and the remaining eight women were taking a low-dose combined monophasic OC (WomenOC). Participants performed a 3-stage cycling trial in each condition at 90% (Stage 1), 135% (Stage 2), and 180% (Stage 3) of their pre-determined lactate threshold 1 (total = 52.5 min). C-reactive protein (CRP), serum cytokines (IL-1β, IL-1RA, IL-6, IL-8, IL-10, and TNF-α), and salivary cortisol were evaluated before and after exercise in both the TEMP and HEAT conditions.
RESULTS: Serum 17β-estradiol (75.74±57.21 pmol/L v 18.13±20.18 pmol/L, $p<0.01$) and progesterone (0.24±0.15 pmol/L v 0.12±0.06 pmol/L, $p<0.01$) were significantly higher in WomenNC compared to WomenOC, respectively. In both the TEMP and HEAT trials, core body temperature (Tc) was higher in WomenOC than WomenNC at baseline ($p<0.01$) and pre-exercise ($p<0.01$) but not post-exercise ($p=0.23$). There were no differences in cortisol or any of the pro- or anti-inflammatory cytokines measured at rest or after completion of the exercise trials ($p>0.05$). However, a trend ($p=0.07$) for higher C-reactive protein concentrations was noted for WomenOC (1.102±1.182), being more than three-fold higher than that observed in WomenNC (0.326±0.228).
CONCLUSION: The results obtained in the current study indicate similar immunoendocrine function in recreationally-active WomenOC and WomenNC both at rest and after exercise in temperate and hot environments.
1. Schuurs and Verheul. J Steroid Biochem 35:157-172, 1990; 2. Wiegratz et al. Contraception 67:25-32, 2003; 3. Charkoudian and Johnson. Exerc Sport Sci Rev 28:108-112, 2000; 4. Peake et al. Eur J Appl Physiol 102:391-401, 2008; 5. Brenner et al. Eur J Appl Physiol Occup Physiol 76:445-454, 1997; 6. Boisseau et al. Journal of Endocrinol Invest. 36:955-64, 2013.

EFFECT OF THE DIFFERENT IN STEP LENGTH DURING A STEP-DOWN EXERCISE WITH THE LOAD ON THE DELAYED-ONSET MUSCLE SORENESS IN THE LOWER LIMBS

TAMARI, Y.1, WADA, T.1, YOSHIDA, N.2, HAMADA, H.2, ONODERA, S.1

1: KAWASAKI UNIVERSITY OF MEDICAL WELFARE , 2: GRADUATE SCHOOL, KAWASAKI UNIVERSITY OF MEDICAL WELFARE

INTRODUCTION: Walking speed is determined by the multiplication of cadence and step length. We revealed that delayed-onset muscle soreness (DOMS) was suppressed during the stair-descending exercise with a cadence of 110 steps/min (Tamari et al., 2017). However,

the influence of difference in step length during the step-down exercise on DOMS has not been elucidated. This study aimed to clarify the effect of difference in step length during the step-down exercise with the load placed on DOMS muscles in the lower limbs.
METHODS: Eight healthy Japanese males volunteered to participate in this study. Their ages, heights, body weight, and body mass index were 22±1 years, 169.6±5.1 cm, 60.2±5.4 kg, and 21.0±2.1, respectively (mean±SD). All subjects were issued informed consent forms prior to participation in this study. The exercise task was a step-down exercise (rise; 15 cm). The subjects raised their right leg to the same height as the left leg after landing their left leg on the step, then the right leg landed on the floor. The subjects repeated this motion for 15 minutes. Step lengths during the step-down exercise were 30 cm (30-condition) and 60 cm (60-condition). The experimental conditions were implemented in a random order. The cadence was 90 steps/min. The subjects had a load of about 10% of the body weight. Measurements included heart rate, oxygen uptake, blood pressure (systolic blood pressure, diastolic blood pressure), rating of perceived exertion (RPE), muscle soreness, and maximal isometric strength (muscle damage indices). Muscle soreness was determined based on the visual analog scale. Muscle soreness was assessed before exercise, immediately post exercise, and on post-exercise days 1–7. Maximal isometric strength was recorded before exercise, immediately post exercise, and on post-exercise days 1–4.
RESULTS: There was no significant changes in heart rate, oxygen uptake, systolic blood pressure, diastolic blood pressure, and RPE in the 30- and 60-conditions (each; n.s.). Maximal isometric strength 24 h after exercise was significantly lower in the 30-condition than in the 60-condition ($p<0.05$). The disappearance of DOMS was more delayed in the 30-condition than in the 60-condition. DOMS 24 h after exercise was significantly higher in the 30-condition than in the 60-condition ($p<0.05$). These results suggest that the step-down exercise with a step length of 30 cm has a higher percentage of muscle damage compared to 60 cm and causes severe DOMS.
CONCLUSION: This study revealed that the step-down exercise burden on the lower limbs increases when the step length is 30 cm compared to 60 cm.
REFERENCES:
Tamari Y, Wada T, Yoshida N, Onodera S (2017). Japan Society of Physiological Anthropology, 22(4), 185-191.
CONTACT:
w8514001@kwmw.jp

EFFECT OF ULTRA-MARATHON ON MEDIATORS OF INFLAMATION AND ENDOTHELIUM IN EXERCISE-INDUCED HYPERTENSION ATHLETES

KIM, C.H., KIM, H., KIM, Y.J.

SOONCHUNHYANG UNIVERSITY, KOREAN NATIONAL UNIVERSITY OF EDUCATION, SUNGSHIN UNIVERSITY

INTRODUCTION: The purpose of this study is to exam the responses of anti-inflammatory, inflammatory, and endothelial regulation factors to 100KM ulatromaraton of athletes who have exercise-induced hypertension. For this study, we obtain and analysis IL6, TNF-alpha, IL-10, MCP-1, and NO from 100KM ultramarathoners before and right after the 100KM race.
METHODS: There were 40 volunteers who had ever won the 100KM marathon race before more than one time. They had the graded exercise test with measurement of blood pressure for assessing exercise-induced hypertension. Among them, eight athletes were categorized to normal control group (NRM) and 10 athletes were assessed by exercise-induced hypertension(EIH).
The graded exercise test with treadmill was performed for the maximal strenuous exercise and blood pressure. Exercise-induced hypertension was diagnosed as >140/90mmHg in normal and >=210mmHg in maximal exercise. Marathoners including EIH=10 and NRM=8 participated in 100KM ultra-marathon race and blood extracted from them before the race and right after the race. Blood samples of EIH and NRM were analyzed for TNF-alpha, IL-6, IL-10, MCP-1, CK, and NO as the makers of anti-inflammatory, inflammatory and endothelial regulation factors.
RESULTS: EIH had lower IL-10 than NRM during resting states and after the 100KM race EIM had significantly lower NO concentration than NRM. Therefore, the nitric oxide (NO) in the endothelial is inhibited during strenuous endurance exercise, resulting in vasoconstriction with increasing the blood pressure.
CONCLUSION: This study found out for the first time that the nitric oxide in the endothelial cell in blood vessels can not increase in exercise-induced hypertension athletes during strenous exercise; EIH inhibits the NO leading to the vasoconstriction of vassels with increasing the peripheral blood pressure. This result can indicate the mechanism of EIH and can be undersood. This NO inhibition in EIH can be used in treatment and prevention of EIH.

EFFECTS OF RESPIRATORY MUSCLES TRAINING ON DIAPHRAGM THICKNESS, RESPIRATORY FUNCTION AND EXERCISE CAPACITY OF MALE CYCLISTS

BAI, J.

BEIJING RESEARCH INSTITUTE OF SPORTS SCIENCE

INTRODUCTION: The respiratory system directly affects athletic performance, especially in the aerobic endurance performance. There is a close relationship between aerobic metabolism ability and performance of road cyclists. The athletes respiratory function is closely linked with aerobic endurance, respiratory muscles fatigue directly affect the ability to exercise. Therefore, it is necessary to improve the strength, endurance and anti-fatigue ability of respiratory muscles through breathing training. Respiratory muscle training at the same time can improve lung ventilation
Respiratory muscle and lower extremity muscle competition for blood, feeling of difficulty breathing and respiratory muscle fatigue these factors limit the exercise capacity. Diaphragm is the main respiratory muscle, although only about 0.5% of body weight, but its role in the inspiratory process of respiratory muscles accounted for 60% -80%. Diaphragm thickness is an important factor in measuring its function.
This study aims to improve respiratory performance by training the respiration muscle strength, thereby enhancing aerobic capacity, and ultimately improve performance, and compare related functions before and after training, so as to evaluate training effect.
METHODS: We included 10 healthy Long-distance male cyclists in this study (age: 18.5.5±1.51 height: 181.8±3.45cm, weight: 72.1±4.64kg). Subjects were trained for 6 weeks with the "PowerBreathe" respiratory muscle trainer and practiced for 10 minutes every day. Each set of 30 breaths, three sets a day and a day off every week. Keep the training load in 30rm.
Before and after breathing training, athletes were tested lung ventilation (vital capacity, forced vital capacity, maximum ventilation per minute) (CHESTGRAPHHI-101 breath tester); diaphragmatic thickness measurements (calm, end-inspiration, end-expiratory) (PHILPS HD7 XE type B ultrasonic instrument).

Before and after 6 weeks of training, the subjects were tested in the cycle ergometer performing for VO2max test (maximum oxygen uptake, maximum power, maximum ventilation, heart rate). (Speed : 95-100rev/min, 60W at the beginning, 20W was increased every 1 minutes till exhaustion).
Paired t-test was used to compare the two sets of data before and after respiratory muscles training.
RESULTS: After 6 weeks of respiratory muscles training, the athletes diaphragm thickness increased significantly by 9.5% (from 2.73±0.27 to 2.99±0.35mm) at the end of inspiration (P<0.05). Diaphragm thickness had no significant changes at the calm and end of expiratory (P>0.05).
After 6 weeks training, the MVV(maximal voluntary ventilation) was significantly increased than before (from 184.38±30.45 to 196.24±22.61 L/min, P<0.05). There was no difference in VC(Vital Capacity), FVC (Forced Vital Capacity), and FEV1%(Forced Expiratory Volume) when comparing six weeks ago(P>0.05), respectively.
10 subjects performed incremental cycling test. There was a significant increase in maximum power which improved 5.77% (417.13±14.02 to 441.28±27.96 watt) (P<0.05) and maximum ventilation/weight increased by 8.56% (from 2.57±0.24 to 2.79±0.28 L/min/kg) (P<0.05). After training the VO2max and maximum heart rate increased slightly, but there was no significant difference.
CONCLUSION: Six weeks of respiratory muscle training increases diaphragm thickness at end-inspiratory and increases maximal voluntary ventilation in male cyclists.
Six weeks of respiratory muscle training can effectively improve the maximum power and maximum ventilation of aerobic endurance test of male cyclists, but no effect on the VO2max was found.
Respiratory muscle training can increase the diaphragm thickness to enhance respiratory function, and thus improve the athletic performance.

USING POLYNOMIAL REGRESSION TO AUTOMATICALLY DETECT VENTILATORY INDICES IN PARACELSUS 10.000 PARTICIPANTS

PUEHRINGER, M., RING-DIMITRIOU, S., IGLSEDER, B., PAULWEBER, B.

UNIVERSITY OF SALZBURG

INTRODUCTION: Ventilatory indices (e.g. anaerobic threshold, VI-1; and respiratory compensation point, VI-2) have been shown to be useful in assessing the efficiency of training, and in classifying performance in various populations (Meyer & Lucía, 2005). Accordingly, precise identification of VI is essential in cardio-pulmonary exercise testing. Thus we compared different automatic detection methods, based on polynomial regression, with visually detected VI-1 and VI-2.
METHODS: Gas exchange measurements from incremental cycling (Master Screen CPX, Jaeger) of 50 females (55±3 y, 25.0±4.2 kg/m2 BMI, 24.0±6.6 ml/kg/min VO2peak) and 50 males (55±3 y, 26.5±4.3 kg/m2 BMI, 29.9±9.2 ml/kg/min VO2peak) served to determine VI-1 and VI-2 with three different methods. (1) visual, (2) automatic detection by polynomial regression using the time series data of ventilatory equivalents and end tidal pressures of oxygen (EQO2 and PETO2) and carbon dioxide (EQCO2 and PETCO2) and calculating their local minima, maxima, and maximum curvatures (Sherrill, Anderson, & Swanson, 1990), (3) semiautomatic detection by using methods (2) with a final visual selection of VI-1 and VI-2 (Meyer & Lucía, 2005). Mean differences and agreement between the methods were assessed separately for VI-1 and VI-2 using analysis of variance (ANOVA) with $p<0.05$, mean biases ± 95% limits of agreement (LOA), and intraclass correlation coefficients (ICC). The study was approved by the Salzburg Ethics Committee.
RESULTS: Overall, ANOVA revealed significant differences between the methods for VI-1 ($F(5, 225) = 24.7$, $p < .001$) and VI-2 ($F(5, 325) = 15.1$, $p < .001$), respectively. The highest level of agreement was found between visual and semiautomatic method (for VI-1: LOA=108±289 ml/min, ICC=0.86 [0.61, 0.94], and for VI-2: LOA=160±509 ml/min, ICC = 0.86 [0.68, 0.93]), and the semiautomatic method also resulted in the lowest number of indeterminable cases.
CONCLUSION: The automatic determination using local minimum of EQO2 and PETO2 time series showed higher agreement with the visual method than using the maximum curvature for VI-1, while it was the other way around for VI-2. As described by Meyer & Lucía (2005), the EQO2 time series occur with an inflection point at VI-1 and a second at VI-2. Because of intense hyperventilation the second point could be identified as VI-1. The results of this study demonstrate that automatic methods are useful to detect VI. However, different patterns in gas exchange response due to incremental testing require a systematic approach combining automatic and visual methods.
References: Meyer, T., & Lucia, A. (2005). Int J Sports Med, 26, S38-S48.
Sherrill, DL., Anderson, SJ., & Swanson, G. (1990). Med Sci Sports Exerc, 22, 684-689.

EVIDENCE OF THE EQUIVALENCE IN METABOLIC RATE AT RCP, [HHB]BP AND MLSS

INGLIS, E.C., IANNETTA, D., MURIAS, J.M.

UNIVERSITY OF CALGARY

INTRODUCTION: A correspondence between exercise intensity thresholds, such as the respiratory compensation point (RCP), the maximal lactate steady state (MLSS), and the near-infrared spectroscopy (NIRS) derived break point (BP) in the deoxyhemoglobin ([HHb]) signal (i.e., the [HHb]BP) have been shown to exist, suggesting that these demarcation points share similar physiological bases(1). However, others have proposed that this correspondence is rather coincidental(2). Therefore, current conclusions state both that the metabolic rate (VO2) associated to the RCP and the MLSS are(1) and are not(2) equivalent to the [HHb]BP. An approach to determine if the RCP, MLSS, and the [HHb]BP are all a representation of similar physiological events would be to study these responses before and after an exercise training intervention that is expected to result in changes in the VO2 associated to these boundaries. Thus, this study evaluated the interplay of these indices with regards to VO2, in a longitudinal manner.
METHODS: Nine amateur male cyclists reported to the lab for testing in 3 separate phases (PRE, MID and POST) over the course of a 7-month competitive cycling season, during which, although training was not controlled by the investigators, the participants aimed to improved and sustain their fitness level. Testing included a ramp incremental test to exhaustion (30W/min) to determined VO2max, RCP, and the [HHb]BP. Additionally, 2 30-min rides were performed at both PRE and POST for determination of MLSS. Expired gases and NIRS measurement were continuously measured throughout all testing sessions.
RESULTS: VO2 at both RCP and [HHb]BP were significantly higher at MID (RCP, 3.92 L/min; [HHb]BP, 3.92 L/min) and POST (RCP, 3.89 L/min; [HHb]BP, 3.90 L/min), compared to PRE (RCP, 3.69 L/min; [HHb]BP, 3.65 L/min) ($p<0.05$). In all phases no differences were found in VO2 at RCP (PRE, 3.69 L/min; MID, 3.92 L/min; POST, 3.89 L/min), MLSS (PRE, 3.72 L/min; POST, 3.81 L/min), and [HHb]BP (PRE, 3.65 L/min; MID, 3.92 L/min; POST, 3.90 L/min) ($p>0.05$). Significant correlations in VO2 existed between RCP and [HHb]BP ($r=0.89$ PRE, 0.94 MID, 0.84 POST), RCP and MLSS ($r=0.91$ PRE, 0.91 POST), and between [HHb]BP and MLSS ($r=0.73$ PRE, 0.75 POST) in all phases ($p<0.01$). Bland-

Altman plots comparing the VO2 values at RCP and [HHb]BP revealed no significant biases in any of the 3 phases (PRE, 0.03 L/min; MID, -0.01 L/min; POST, 0.00 L/min).
CONCLUSION: This study demonstrated that the VO2 associated with RCP, [HHb]BP and MLSS remained equal at each point where these were evaluated. Importantly, these similarities remained consistent even when the VO2 associated with RCP, [HHb]BP, or MLSS changed. This study demonstrated that the agreement among RCP, [HHb]BP and MLSS remained constant throughout the different phases, which provides a strong argument that they represent the expression of similar physiological response.
1) Keir, D.A. et al (2015) 10.1249/MS.0000000000000613 2) Caen, K. et al (2018) 10.1249/MSS.0000000000001547

Mini-Orals

MO-PM21 Team sports

THE DURATION-SPECIFIC PEAK RUNNING DEMANDS OF ACADEMY LEVEL RUGBY LEAGUE MATCH-PLAY

WHITEHEAD, S., TILL, K., DALTON-BARRON, N., IRETON, M., WEAVING, D., JONES, B.
LEEDS BECKETT

INTRODUCTION: Quantifying the peak distances that players cover across specific durations of time is important to enhance training prescription and appropriately prepare players for rugby league match play. This study aimed to quantify, and compare, the peak running demands of different positional groups during professional academy rugby league match play.
METHODS: Following institutional ethics approval, 10-Hz Global Positioning System (GPS) (Optimeye S5, Catapult Innovations) data were collected from one hundred and forty-nine players competing across nine teams during 21 professional Academy (under-19) matches. Players were split into six positional groups for analysis: hookers (Ho; no. = 40), fullbacks (Fb; n = 24), halves (Ha; n = 47), outside backs (OB; n = 104), middles (Mid; n = 118) and back rows (BR; n = 104). Players who played less than 10 minutes were excluded from analyses. Data were extracted using propriety software Openfield. 10-Hz velocity files were exported with the duration-specific peak running demands determined via moving averages of relative distance (m·min-1) for 10- and 30-seconds, and 1- to 5- and 10-minute durations. Data were log-transformed and differences between positional groups were analysed using linear mixed effect models to account for repeated observations on players and teams, followed by magnitude based inferences, with the threshold of the smallest worthwhile difference set at 0.2 x between-subject standard deviation.
RESULTS: The highest peak running demands for 10-seconds, 1- and 10- minutes were 368 ± 39, 178 ± 16, and 106 ± 9 m·min-1. Fb most likely had greater peak running demands compared to Mid, Ho and BR over 10- and 30-second, and 1- and 5-minute durations (% difference: 6.3 – 18.9, effect size [ES]: 2.1 – 6.0), and compared to OB over all durations except 10-seconds and 2-minutes (% difference: 6.1 – 11.4, ES: 2.9 – 6.4). Ho had most likely and very likely decreased peak running demands compared to OB at 10- and 30-seconds respectively (% difference: 5.1– 13.0, ES: 2.6 – 5.4), but most likely increased demands at 4-, 5- and 10-minute durations (% difference: 4.2 – 6.1, ES: 2.5 – 3.8). Similarly, compared to OB, the Mid and BR had most likely decreased relative distance at 10-seconds (% difference: 9.4 – 14.6, ES: 4.5 – 8.5), but very likely increased at 10-minutes (% difference: 2.9 – 3.4, ES: 2.5).
CONCLUSION: This study provides 'league-wide' peak running demands of Academy level rugby league match-play across varying durations that can be used by practitioners to prescribe conditioning drills and monitor the intensity of coach-led drills. Differences in the peak running demands are present between positional groups; Fb exhibit the greatest running intensities across all durations and OB have greater short duration, but lower long duration peak running demands compared to Ho, Mid and BR. Therefore position-specific prescription should be considered when prescribing velocity-based training intensities across short and longer durations.

AN ANALYSIS OF GAME MOVEMENT DEMANDS OF INTERPROVINCIAL WOMENS RUGBY UNION

CALLANAN, D., FITZPATRICK, P., RANKIN, P.
INSTITUTE OF TECHNOLOGY CARLOW, IRELAND

INTRODUCTION: The growth in womens Rugby Union (RU) has led to an increase in its professionalism, competitiveness and intensity. This warrants the need to identify the physiological demands to ensure practitioners can develop accurate planning and periodisation of training sessions for both individuals and positional groups (Ziv and Lidor, 2016). Despite the growth of female participation rates in RU, there is a dearth in the research examining women RU players.
METHODS: The members of two Interprovincial womens rugby union squads (n=34, age, weight 78.1 ± 9.0 kg, height 169.4 ± 6.1 cm and CMJ 29.0 ± 4.3 cm) volunteered to participate in this study. The number of data files collected for each position was as follows, forwards (n=46) and backs (n=38). Game movement demands were recorded using a 10 Hz global position series integrated (PLAYERTEK , Dundalk, Ireland). The locomotor variables that were analysed include the following: total distance (TD) (m), relative distance (RD) (m.min-1), max velocity (m.s-1) and sprint distance (SD) (>5.5 m/s) (m).
RESULTS: Backs covered significantly greater TD than forwards in the first half (3117 ± 289 v 2864 ± 207 m), second half (2987 ± 576 v 2605 ± 679 m) and total game (6104 ± 720 v 5469 ± 761 m) ($p<0.01$). There were significant differences observed in RD, with backs reporting a higher intensity across the first half (71 ± 6.2 v 65.6 ± 4.0 m.min-1), second half (67.7 ± 8.2 v 63.2 ± 6.9 m.min-1) and total game (69.4 ± 6.5 V 64.6 ± 4.8 m.min-1) ($p<0.01$). Backs had significantly greater max velocity speeds across the first half (6.68 ± 0.50 v 5.88 ± 0.53 m.s-1), the second half (6.66 ± 0.56 v 5.89 ± 0.67 m.s-1) and total game (6.91 ± 0.43 v 6.15 ± 0.62 m.s-1). ($p<0.01$). Backs also covered greater SD than forwards in the first half (158.9 ± 76.6 v 65.2 ± 50.9 m), the second half (146.5 ± 86.0 v 65 ± 51 m) and total game (305.4 ± 142.8 v 130.2 ± 85.2 m) ($p<0.01$).
CONCLUSION: These results highlight the various differences in game movement demands between backs and forwards across various time points and variables. These findings are similar to those reported by Suarez-Arrones et al. (2013). This information is pivotal for both coaches and sport science practitioners. The ability to quantify the games movement demands can allow conditioning staff to periodise individual training sessions to elicit the required physiological adaptations. Furthermore, it may provide additional information on the demands on the game for specific positional groups which may have an impact on the subsequent recovery process.
References:
Suarez-Arrones, L., Portillo, J., Pareja-Blanco P., Saez de V. (2014). Match-play Activity Profile in Elite Womens Rugby Union Players. The Journal of Strength & Conditioning Research, 28(2), pp.452-458.

Ziv, G. and Lidor, R. (2016). On-field performances of rugby union players-a review. The Journal of Strength & Conditioning Research, 30(3), pp.881-892.

IS THE KINETIC ENERGY EFFECTIVE AS ASSESSMENT OF THE RUGBY PERFORMANCE WITH BODY CONTACT?

KURITA, K.

UNIVERSITY OF EAST ASIA

INTRODUCTION: The physical fitness of rugby players is often evaluated by sprinting or strength. However, a characteristic of rugby performance is to combine running with body contact. We propose that kinetic energy that calculated from body weight (kg) and sprinting (m/s) is a good assessment of rugby performance play with body contact.
PURPOSE
To investigate whether Kinetic energy is effective as an assessment of rugby performance with body contact.
METHODS: For three years the top team of college rugby in Japan was investigated (the number of players totaled 332 between 2014-16). Body weight (kg), 10m&30m sprint time (seconds), momentum of 10m&30m sprints(kg・m/s), kinetic energy of 10m&30m sprints(kg・m2/s2), bench press 1RM(kg), and squat 1RM(kg) were measured as fitness characteristics.
Every season, the number of official match players and reserve players (performance level of each player) were included in the high level group of each measurement item . The effectiveness of each measured item was showed by comparing the relationship between the number of members (Forwards & Backs) participating in the official match and the number of people of top group that exceeded the reference value of each measurement item using "specificity". The reference value of each measured item was adjusted to the value of the player of the same rank as the number of official game participants in each year and position.
RESULTS: With forwards, specificity of kinetic energy of the 10m sprint was the highest (0.827), followed momentum by 30m sprint (0.813), and body weight (0.813). With backs, specificity of kinetic energy of the 30m sprint was the highest (0.846), followed by momentum of the 10m sprint (0.837), the momentum of the 30m sprint (0.827), in order respectively.
CONCLUSION: It was suggested that kinetic energy of the 10m sprint in FW and kinetic energy of the 30m sprint in BK had the highest specificity and therefore these are the most effective assessments of rugby performance with body contact.

TACKLE TECHNIQUE IN AMATEUR AND PROFESSIONAL RUGBY UNION PLAYERS

BARNES, A.

SHEFFIELD HALLAM UNIVERSITY

INTRODUCTION: Contact injuries during the tackle pose a serious threat to player welfare with concussions accounting for a significant proportion. Concussion rates in amateur rugby have been found to be significantly elevated compared to the professional game (Gardner et al., 2014), which may result from differences in tackle behaviours. This study sought to compare the tackle characteristics between amateur and professional rugby union players.
METHODS: Video analysis was conducted of 24 rugby games (12 amateur and 12 professional) from the English RFU league (2015-16 season) comprising 14 amateur (levels 5 and 6) and 22 professional teams (Level 1 and 2). Tackle incidences were coded using technical proficiency criteria (Burger et al., 2016) focussing on pre contact, contact and post contact phases. Normalised incidences of tackle behaviours were compared using independent t-tests and Cohens d effect size.
RESULTS: The total number of tackles in professional games was higher than in amateurs (professional: 154± 23 vs amateur: 128 ±11). Amateurs displayed a head down position more in the pre-contact phase (amateur 22± 8%; professional 11 ±5%, $p<0.01$, $d=1.73$) and made a higher percentage of their tackles with their head in front of the ball carrier compared to professionals (amateur 23± 3%; professional 13 ±4%, $p<0.01$, $d=2.95$). Professionals made a greater proportion of their tackles on the mid-torso of the ball carrier (professional 43 ±7%, amateur 32± 5%, $p<0.01$, $d=1.82$) and made a greater proportion of double (2vs1) tackles compared to amateurs (professional 33 ±4%, amateur 24± 5%, $p<0.01$, $d=1.68$)
CONCLUSION: Amateur players were more likely to display techniques which may increase the risk of injuries such as concussions, particularly related to the position of the head in the pre- and contact phases of the tackle (Burger et al., 2016). Research supports a reduced injury risk when tackling the ball carrier between he hips and sternum (Burger et al., 2016) compared to the shoulders or below the waist, a characteristic that was seen more in professional players in our results. Findings point towards the need for tackle education at the amateur level to help reduce injuries in this group of players. Despite an increased cumulative tackle load in professionals potentially putting them at greater risk of chronic injury, both physical conditioning and tackle skill have been suggested to contribute to injury risk (Hendricks et al., 2014), therefore future research should focus on the interaction of these factors at all levels of the game.
REFERENCES:
Burger N, Lambert M, Viljoen W, Brown J, Readhead C, Hendricks S. (2016). Br J Sports Med, 50, 932.
Gardner AJ, Iverson GL, Williams WH, Baker S, Stanwell P. (2014). Sports Med, 44(12), 1717-31.
Hendricks S, Lambert M. (2014). J Sport Sci Med, 13, 715-17

TRANSITION FROM PREPARATION PERIOD TO COMPETITIVE PHASE IN PROFESSIONAL FEMALE BASKETBALL: RELATIONSHIP BETWEEN TRAINING LOAD AND RECOVERY

SANSONE, P., TSCHAN, H., CONFESSORE, E., TESSITORE, A.

UNIVERSITY OF ROME FORO ITALICO

INTRODUCTION: The preparation phase is crucial to set up the athlete for the demands of competition. Considering the high demands of professional sports, training and recovery have to be carefully monitored in order to ensure the athletes' fitness and health. Therefore, this observational study monitored training load (TL) and recovery of professional female basketball players during the season's preparation and initial competitive phases.
METHODS: 13 female basketball players (age: 21 ± 3 years) from an Italian Serie A1 team were recruited. Training and recovery were monitored with the session-Rating of Perceived Exertion (sRPE) method by Foster et al. (2001) and Total Quality Recovery (TQR) scale (Kentta & Hassmen 1998), respectively. Data were collected over the preparation (M1: weeks 1-4) and the following two competitive (M2: weeks 5-8; M3: weeks 9-12) mesocycles. Weekly team parameters calculated were: training volume (V, sum of training hours); RPEm (mean of RPE values, in arbitrary units (AU); TL (sum of daily TLs, calculated in AU by multiplying each sessions RPE value for its duration in minutes);

TQRd (mean of daily TQRs, in AU); TQRfw (TQR at the start of the following week, in AU). Comparison between mesocycles was evaluated via one-way ANOVA (Bonferroni post-hoc). TL-TQRd correlations (Pearson's r) were calculated within mesocycles.
RESULTS: V was greater in M1 (14.6 ± 2 hrs), compared to M2 (11 ± .6 hrs) and M3 (10.1 ± .9 hrs) (p= .002, ES: .750). TL was higher in M1 (4018 ± 624 AU) compared to M3 (2867 ± 430 AU), but not different to M2 (3277 ± 221 AU) (p= .015, ES: .608). TQRfw was greater in M1 (5.5 ± .2 AU) compared to both M2 (4.8 ± .1 AU) and M3 (4.9 ± .2 AU) (p= .011, ES: .636). No effects were found for RPEm (M1: 5.0 ± .4 AU; M2: 5.5 ± .3 AU; M3: 4.6 ± .7 AU) (p= .085) and TQRd (M1: 5.0 ± .5 AU; M2: 4.7 ± .3 AU; M3: 4.7 ± .1 AU) (p= .464). TL-TQRd correlations were as follows: M1: r= -.314 (p= .684); M2: r= -.902 (p= .098); M3: r= -.312 (p= .688).
CONCLUSION: The main finding of this study is that the teams recovery (TQRfw) was higher during preparation compared to competition phases, suggesting a potential negative effect attributable to training design. In fact, the concurrent increase of training intensity (RPEm) (+12.2%) and decrease of volume (V) (-24.7%) from M1 to M2, planned to meet the demands of competition, may have been insufficient to optimize players' recovery; indeed, TL was not different between M1 and M2. Moreover, seen the negative moderate TL-TQRd correlations in M1 and M3, the nearly perfect one found in M2 highlights the athletes' vulnerability to TL in this transitional phase. Thus, this study suggests the importance of designing training and recovery in the transition from the preparation to the competitive phase.
REFERENCES: Foster C, Florhaug JA, Franklin J, Gottschall L, Hrovatin LA, Parker S, Doleshal P, Dogde C (2001). J Strength Cond Res, 15, 105-109.
Kenta G, Hassmen P (1998). Sports Med, 26, 1-16.
CONTACT p.sansone@studenti.uniroma4.it

THE EFFECT OF A PERIODISED SMALL-SIDED GAMES INTERVENTION ON PHYSICAL AND PHYSIOLIOGICAL MEASURES IN HURLING PLAYERS

MALONE, S.1,2, OWEN, A.3, COLLINS, D.K.1
GAELIC SPORTS RESEARCH CENTRE, INSTITUTE OF TECHNOLOGY TALLAGHT

INTRODUCTION: Small-sided games (SSG) allow coaches to develop both technical and tactical proficiency within players while furthermore allowing the development of aerobic and anaerobic fitness characteristics simultaneously (Malone, Hughes, Collins, 2017). The current investigation examined the effect of a periodzed small-sided games intervention across a six-week (two test weeks and four intervention weeks) pre-season period on physical (Yo-YoIR1, RSAb, and 5-,10-,20-m Speed) and physiological performance measures (VO2max, vVO2max, vOBLA, vLT and RE) within hurling players.
METHODS: Twenty-five (n=25) hurling players were observed across a 6-week training intervention with GPS and HR technologies, these players participated in 12 sessions of exclusive 4 min SSG bouts (4v4) across differing pitch dimensions from 100-200-m2 with the number of bouts of SSG increasing across the intervention period. Pre- and post-intervention tests included physiological (VO2max (mL·kg-1·min-1), vVO2max (mL·kg-1·min-1), PTV(km·h-1), RE (mL·kg-1·min-1), vLT (mmol·L-1), vOBLA (mmol·L-1) and physical testing (5-, 10-, 20-m speed (s), YoYoIR1 (m), RSAb (s)) methodologies.
RESULTS: Across the period, improvements in physiological qualities were observed. Large improvements in VO2max (mL·kg-1·min-1) were reported (ES: 1.79; 95%CI: 1.02 – 2.01) and vLT (ES: 1.56; 95%CI: 1.12 – 1.78) with moderate improvements in vVO2max (km·h-1) (ES: 0.93; 95%CI: 0.77 – 1.11) and vOBLA (ES: 0.89; 95%CI: 0.34 – 0.99). Moderate improvements in Yo-YoIR1(ES: 0.65; 95%CI: 0.33 – 0.78) and RSAb (ES: 0.41; 95% CI: 0.21 – 0.66) were also observed across the period with trivial differences observed for speed across 5-,10- and 20-m. Furthermore, the SSGs also led to an improvement in RE as indicated through significantly reduced VO2 and heart rate at running speed 8, 10, 12, 14 and 16 km·h-1 (ES: 0.99-1.78).
CONCLUSION: The present study supports previous studies (Owen et al., 2012; Malone, Hughes, Collins, 2017) that demonstrate the capacity of SSG to improve fitness in team sport players. Coaches should be aware that SSG represent an important concomitant training methodology that develops physiological characteristics in conjunction with technical and tactical capacities of players within simulated game environments. In conclusion, SSG have been shown to evoke improvements in physical and physiological fitness capacities within a relatively short period, making SSGs an appealing proposition for fitness coaches, players, and skills coaches within the hurling training process.

QUANTIFYING THE MATCH TO MATCH DEMANDS OF NBA BASKETBALL

DAMELIO, K., WARD, P., COUTTS, A.
UNIVERSITY OF TECHNOLOGY, SYDNEY

INTRODUCTION: Our current understanding of the match activity demands in the elite professional basketball is limited. In particular, our understanding of the detailed activity demands and their variation is limited. The aim of the present study was to determine the match to match variation of physical performance demands in the National Association of Basketball (NBA).
METHODS: Player optical tracking data (SportVU, Chicago, IL) was collected in competition during two seasons, 2015-16 (n = 379) & 2016-17 (n = 464) on the NBA. A total of 44,382 individual player observations were recorded in 2015-2016 (n = 21483) and 2016-2017 (n=22899) seasons. The physical activity data were categorized into total distance covered, high intensity running, high intensity running efforts, total accelerations, and high acceleration efforts. Between-match coefficients of variations (CV) were calculated for each player, across all games. The CV was then compared between home and away competitions, wins and losses, and by playing position (Center, Forward, Guard). A mixed effects linear model, with random intercepts, was used to estimate the within-and between-player variability. Variability was expressed using the CV (%) and CVs were presented with 95% CL as markers of uncertainty of the estimates.
RESULTS: Higher variability was observed for high-intensity activities, high intensity running efforts (16.2%) and number of high accelerations (15%.). In contrast, there was lower variability in global physical activity measures, total distance (3.6%), average speed (1.6%), and maximum speed (1.6%). Match-to-match variability in activity profile was not influenced by match outcome (win/loss) or match location (home/away). The between-match variability was relativity stable for all measures between and within NBA seasons (2015-16 & 2016-17).
CONCLUSION: While global physical activity measures are relatively stable, higher-intensity activities exhibit a large degree of between-match variability in NBA basketball. However, these measures remain relatively stable between positions, within and between NBA seasons. Enhanced understanding of the variation in the physical activity demands will allow practitioners to determine meaningful changes and can be used to inform athlete preparation.

WELLNESS, TRAINING LOAD AND RUNNING PERFORMANCE DURING AN IN-SEASON HIGH INTENSITY PERIOD IN ELITE FEMALE FIELD HOCKEY PLAYERS

MCGUINNESS, A., MALONE, S., KENNA, D., MCMAHON, G., PASSMORE, D., COLLINS, K.

INSTITUTE OF TECHNOLOGY TALLAGHT

INTRODUCTION: The aim of the current observational study was to quantify the global variation in players activity profiles during a high-intensity period and determine whether an association is apparent between wellness measures and running performance.
METHODS: Sixteen elite female field hockey players (23 ± 3years; 162.6 ± 13cm; 66 ± 6kg) participated in the current study. Participants were monitored with GPS technology and activity was categorised into total distance (m), relative total distance (m·min-1), and high intensity distance (m·min-1), max velocity (km·h-1), and relative maximal velocity (%) (3). The intensity of match-play was determined using the modified Borg CR-10 rate of perceived exertion scale(2). Wellbeing was monitored and players were asked to rank mood and sleep quality on a 10-point scale ranging from 1 (Worst) to 10 (Best) with muscle soreness ranging from 1 (A little) to 10 (A lot) daily (1).
RESULTS: Total distance (m) was likely higher when compared to game one (5135 ± 646m) in game 2 (5566 ± 920m). Relative distance (m·min-1) was likely lower when compared to game one (115.8 ± 11.5m·min-1) in game 7 (106.1 ± 9.8m·min-1). Relative high-speed (m·min-1 >16 km·h-1) was likely lower in games 5,6,7 (14.9 ± 4.1m·min-1, 14.9 ± 4.4m·min-1, 15.0 ± 5.8m·min-1). Max velocity (km·h-1) was possibly higher when compared to game 1 (23.8 ± 1.5km·h-1) in game 2 (25.1 ± 1.2km·h-1) and unlikely in game 6 (24.5 ± 1.1km·h-1). Session load was very likely higher when compared to game 1 (348 ± 61AU) in game 2 (436 ± 85AU) and very likely lower in game 3 (295 ± 52AU). Mood (8 ± 1.1AU) and sleep quality (8.2 ± 0.8AU) were likely lower in game one when compared to game 4 (7.2 ± 1.6AU) and game 7 (7.6 ± 1.0AU). Muscle soreness was likely higher when compared to game one (2.8 ± 1.1AU) in game 7 (3.6 ± 0.9AU). During these high intensity periods it was observed that a decrease in daily psychometric questionnaire was accompanied by changes in running performance.
CONCLUSION: The result of the current study suggest that changes to players muscle soreness and sleep quality decreases players running performance. However, decrements in running performance seen between games may be linked to the changes in team-tactics. Therefore, to prevent the effects of fatigue coaches should adapt strategies to enhance sleep quality and incorporate ways to reduce muscle soreness.
1. Gallo, T., Cormack, S., Gabbett, T. & Lorenzen, C. Pre-training perceived wellness impacts training output in Australian football players. J Sports Sci 34: 1445-1451, 2016.
2. Malone, S., Hughes, B., Roe, M., Collins, K. & Buchheit, M. Monitoring player fitness, fatigue status and running performance during an in-season training camp in elite Gaelic football. Sci Med Footb 16: 550-5, 2017.
3. McGuinness, Aideen., Malone, S., Hughes, B. & Collins, K. The Physical Activity and Physiological Profiles of Elite International Female Field Hockey Players Across the Quarters of Competitive Match-play. J Strenght Cond Res 1-21, 2018.

MAX INTENSITY PERIOD COMPARISON OF CLUB LEVEL AND INTERNATIONAL LEVEL FIELD HOCKEY - CUNNIFFE E,.DELAHUNT E, MCCARTHY-PERSSON,U, BOREHAM C, BLAKE C. SCHOOL OF PUBLIC HEALTH, PHYSIOTHERAPY AND SPORTS

CUNNIFFE, E.

UNIVERSITY COLLEGE DUBLIN

INTRODUCTION: Many studies have been published in Field Hockey outlining the physical demands of the game (1). These studies highlight the average demands of the game as a team or a positional group however they fail to identify the peak demands of game play where maximal output is required from each individual. Therefore, it is difficult for coaches to prepare athletes for the "peak" demands of the game. The max intensity period (MIP) is an output that is the 3-minute period of a match where physical output is at its greatest. This study explored the Max Intensity Period in elite hockey players, contrasting national (club) and international athletes.
METHODS: 18 Male national level and 21 international athletes were tracked utilising a 10 Hz GPS Unit (APEX, STATSport) and 100Hz Accelerometer for 11 games and 7 games respectively. The MIP was calculated post games in the APEX software (STATSport) based off total distance. Each unit was turned on at least 15 minutes pre-use to ensure satellite connectivity.
RESULTS: Mean total distance covered was greatest at international level for all positions, ranking in descending order from forwards to midfielders, outside backs and finally centre backs; range 510m - 462m. This same positional order was maintained at club level hockey; range 507m – 434m, marginally lower than the international players. In relation to peak output, positional ranking remained the same at both levels, with international players demonstrating greater output in all positions, except forward, with a range of 598m – 541m. Forwards were matched at both levels exhibiting 598m.Club players produce a range of 507 to 598m.
For metres per minute, mean output ranged 170 – 154 m/min at international level and 169-145m/min at club level, with the same positional ranking observed across levels and consistently higher output recorded by internationals. Internationals recorded higher peak m/min for all positions, except for forwards who demonstrated 199m/min at both club and international level.
On average international games demand 3 sprints more than club level during the Max Intensity Period per position. The greatest disparity in terms of max sprint demands is represented by international centre backs who were required in the max period to complete an extra 4 sprints.
CONCLUSION: There is a minimal difference in the average output during the MIP at both levels. However, there is an evident divergence between the peak sprint demands of each position with the peak demand being greater at international level.
White, A.D. and MacFarlane, N.G., 2015. Analysis of international competition and training in mens field hockey by global positioning system and inertial sensor technology. The Journal of Strength & Conditioning Research, 29(1), pp.137-143

LEVEL OF AGREEMENT BETWEEN CATAPULT AND SPORT PERFORMANCE TRACKING GPS DEVICES DURING TEAM SPORT MATCH PLAY

ELSWORTHY, N., KITTEL, A., SPITTLE, M.

CQUNIVERSITY

INTRODUCTION: Global positioning system devices are widely available to team sport participants of all levels, with a number of different manufacturers developing this technology. Catapult GPS devices are used extensively within elite sport and previous research has outlined the level of validity and reliability of these. Other units are available , however the accuracy of these units during team sport match

play is yet to be determined. The aims of this study, therefore, were to determine the level of agreement between Catapult and SPT units during team sport match play.
METHODS: Two GPS devices were worn by Australian football umpires during games and training . Various GPS metrics were analysed 6 m/s>, relative distance, Player LoadTM, and SPT Intensity Rating>. To determine the level of agreement, the mean difference, % bias, Pearson product moment correlation and effect sizes were calculated, with measures from Catapult devices regarded as the criterion measure.
RESULTS: Overall, data for the TD , sprint distance and relative distance were highly related, with near perfect correlations and small-trivial effect sizes reported. Bland-Altman plots identified that there was no trend to over or under-estimate TD, however as sprint distance increased, SPT devices over-estimated when compared to Catapult devices. Average Catapult PlayerLoadTM was 827 ± 442 AU, while SPT Intensity rating was 60.5 ± 27.4 AU, with a very large correlation between these measures .
CONCLUSION: Overall, results suggest that there is a relatively high level of agreement between the two GPS devices. While there is some over-estimation for sprint distance within the SPT units, most external load variables were highly correlated, when compared to the Catapult devices. Typically, GPS technology over estimates distances at higher running speeds , with lower frequency units . The overall findings for these data, however, were similar between devices, despite differences in the recording rate. These results suggest that SPT units may provide an acceptable level of agreement compared to Catapult GPS devices, with no trend to over or under estimate in various external load measures. The SPT Intensity Rating also shows acceptable agreement with Catapult's PlayerLoadTM calculation. Lower level athletes and coaching staff may find these units a suitable and more affordable alternative to the industry standard of external load monitoring within team sport participants.

THE EFFECT OF PHYSICAL FATIGUE ON TACKLE TECHNIQUE IN RUGBY UNION PLAYERS

DAVIDOW, D.1, REDMAN, M.1, LAMBERT, M.1, BURGER, N.1, DEN HOLLANDER, S.1, JONES, B.2, SMITH, M.3, HENDRICKS, S.1,2
1: UNIVERSITY OF CAPE TOWN, SOUTH AFRICA 2: LEEDS BECKETT UNIVERSITY, UNITED KINGDOM 3: NEWCASTLE UNIVERSITY, AUSTRALIA

INTRODUCTION: Proficient tackle technique in rugby union has been associated with a reduced risk of injury and higher likelihood of tackle success. Tackle technique proficiency has been shown to decrease in the second half of matches. These findings suggest that physical fatigue may influence tackle technique. However, no study has tested the effect of physical fatigue on tackling technique in rugby union players. To improve training for safe and effective tackles, a better understanding of the effect of fatigue on tackle technique is required. Therefore, the purpose of this study was to determine the effect of physical fatigue on tackle technique in rugby union players.
METHODS: Nineteen rugby union players participated in a randomised cross-over study design with a physical fatigue condition and non-physical fatigue condition (control). During each condition, each player performed four sets of 6 tackles (set 1=baseline; 3 tackles on each shoulder) on a contact simulator (total of 24 tackles). Between each set of tackles in the physical fatigue condition, players performed the prolonged high-intensity intermittent running ability test, which lasted 8 minutes. Between each set of tackles in the control condition, players passively rested for 8 minutes. Each condition was separated by at least 72 hours. Each tackle was video recorded and analysed using a standardised list of tackling technical criteria. The technical criteria outlines a list of observable actions, and a player is awarded either one point or zero depending on whether a particular action is performed or not. The sum of these points is subsequently used to represent the technical proficiency score of the player.
RESULTS: For dominant and non-dominant shoulders combined, physical fatigue did have an effect on tackling technique. The difference between conditions were significant (p=0.007) at set 3 (fatigue mean 7.28, 95%CI 7.12-7.45 vs. control 7.53, 95%CI 7.387.69, out of a total score of 9). For the non- dominant shoulder, there was a difference between the fatigue and control at set 2 (fatigue mean 7.34 95%CI, 7.09-7.59 vs. control mean 7.60, 95%CI 7.41-7.85, p=0.06) and at set 3 (fatigue mean 7.29, 95%CI 7.04-7.53 vs. 7.72 95%CI 7.50-7.94, p=0.006). In the non-dominant shoulder control condition, players tackling technique scores improved over the sets (baseline mean 7.40 95%CI 7.19-7.62 vs. set 3 7.72 95%CI 7.50-7.94, p=0.05).
CONCLUSION: This study showed that physical fatigue had an effect on tackle technique in rugby union players. The effect of fatigue on tackling technique seemed to be more influential when tackling with the non-dominant shoulder. Also, in the control condition, players tackling technique improved as the session progressed. The findings of this study can be used to design and develop tackle training programmes to better prepare players for match tackle demands, with the ultimate goal of reducing the risk of injury while improving tackling performance.
sharief.hendricks01@gmail.com
@Sharief_H

Mini-Orals

MO-BN02 Neuromechanics of sports and training

INFLUENCE OF A PROPRIOCEPTIVE SESSION ON SHOOTING TECHNIQUE IN BASE-CLASS BASKETBALL PLAYERS

NIETO, A., SOLANA TRAMUNT, M., MORALES, J.
FPCEE BLANQUERNA RAMÓN LLULL UNIVERSITY

INTRODUCTION: One of the qualities considered most important for the proper technical execution of athletes is proprioception, which is measured the degrees of error between the requested position and the one made, i.e., repositioning error . Few studies have tried to apply analytical proprioceptive training to improve the awareness of joint position; therefore, the aim of this article was to investigate how a proprioceptive training session affected the ER of the elbow and knee in a basketball shot.
METHODS: This quasi-experimental study of pre- and post-intervention measures included 40 basketball players, aged from 8–14 years, who volunteered to participate in the study. The proprioception in the knee and elbow was evaluated before and after a proprioceptive session that focused on the shooting technique or a conventional basketball training technique .
RESULTS: We found significant differences between the ER obtained before and after the test , with the following average for each group: infantile experimental -4 vs. -0.8 , -11.9 vs. 2.9 ; fry experimental -4 vs. -0.5 , -4.4 vs. 2.8 ; prebenjamin experimental -1.7 vs. -0.2 , -2 vs. 4.6 ; and control -3.3 vs. 0.1 , -0.7 vs. 4.6 .There were no differences between the groups measured, except between the experimental infantile group and the control that obtained significant differences in the elbow .

CONCLUSION: No correlations were found between the high success rate in a shot and the position of the segments in space. Nevertheless, it is suggested that the variability and control of movement in the shot, to a certain extent, is determined by afferent proprioceptive processes. This study is an example of how afferent stimulation on a specific joint position has led to improvements in the perception of the position of the elbow and knee joints.

INTERRELATIONSHIP BETWEEN KOREAS SHOTGUN SHOOTING ATHLETES' HIGH HEAVY METAL BLOOD CONTENT AND THE STATUS OF SELF-RATED HEALTH AND HYGIENE EVALUATION

NAM, S., CHUN, H., PARK, N., CHO, I.

KOREA NATIONAL SPORT UNIVERSITY

INTRODUCTION: Athletes training environment is the utmost priority for the best health and safety conditions for the players. Shotgun shooting uses the shotgun to aim at the clay pigeon which emits detrimental and hazardous chemical dust particles transmitted through the players breathing, skin, and hair. However, very little scientific research is conducted and the available source for improvement is very scarce.
METHODS: For this research, based on the training environment of 33 shotgun shooting players officially registered in the 2017 Korea Shooting Federation, high metal level content(ICP-MS) and index of liver damage(AST(aspartate aminotransferase), ALT(alanine aminotransferase), γ-GT(γ-glutamyl transferase)) were conducted through modified IFCC UV and enzymatic colorimetric assay measurement from the 10ml of blood collected from the brachial vein of all 33 players at stable conditions. The blood samples were taken after the players had given written informed consent.
High metal content in open air was measured by using the portable air sampler to collect the bullet dust(air flow-0.78l/min) and ICP-MS and SEM-EDS for other collective data. In addition, shotgun shooting players completed a questionnaire assessing demographics, self-rated health status(Todai Health Index), personal hygiene behaviors, preventive awareness and education.
RESULTS: The research study showed that the shotgun fume emitted relatively higher level of Antimony(Sb) and Lead(Pb) thereby making the athletes heavy metal blood content also above upper limit(3.27mg/dl, which is 97.5%ile value of 306 normal Korean). Furthermore, shotgun shooting players heavy metal blood content positively correlated with the number of training, training hours, smoking, and more specifically, the average number of training per week and daily training hours were the crucial deciphering factors. In addition, AST, ALT and γ-GT showed a tendency to increase depending on higher heavy metal blood content and longer years of training.
Through self-rated health status evaluation overall feeling of sluggish arm, leg and neck was more apparent among the younger players and players with less years of training and no relevance was found between the average weekly hours of training. Examining the state of hygiene, sex and gender was not a significant factor whereas blood high metal content was relative to the players consumption of snacks without washing their hands and failure to use individual utensils.
The most important area of hygiene awareness needed was maintaining clean and sanitary hand, hair after the training. Higher heavy metal blood content level was proportional to the less experience of education and deteriorated willingness to participate in education about their training environment and personal hygiene. Contrastingly, players with longer years of training experience manifested notably higher blood heavy metal content level, but also showed higher level of preventive awareness and experience of education for their training environment and personal hygiene.
CONCLUSION: In summation, Koreas shotgun shooting players heavy metal blood content is relatively above upper limit which is the direct result of their overall training environment. The level of heavy metal blood content but no relevance to the awareness of their personal health and hygiene. The need for significant improvement and enhancement of players training environment, continuous medical examinations and health and hygiene awareness is vital.

THE ANALYSIS OF PENALTY SITUATIONS IN SOCCER WHERE THE REFEREE MAKES AN INCORRECT DECISION

JOHANSEN, B.T.

UNIVERSITY OF AGDER

THE ANALYSIS OF PENALTY SITUATIONS IN SOCCER WHERE THE REFEREE MAKES AN INCORRECT DECISION
Bjørn Tore Johansen & Martin Kjeøen Erikstad, University of Agder, Norway
Introduction: The psychological demands for excellent performance among soccer referees are substantially increasing (Slack et al., 2013). However, referees can and do make mistakes (Mascarenhas et al., 2009), and sometimes that may influence the match result (e.g., penalty situations). The aim of this study was to investigate characteristics of penalty situations where top referees in soccer make an incorrect decision.
Methods: Two expert panels, consisting of four top-class referees and four top-class players respectively, assessed 98 potential penalty situations in Norwegian premier league. The situations in which both expert panels considered that the match referee made an incorrect decision (N = 14) were then analyzed based on recommended technical refereeing criteria and guidelines (i.e., the referees distance to, angle to, and insight into these penalties situation; UEFA, 2017),
Results: The results indicated that the referee had an extended distance to the penalty situation than recommended in 12 of the 14 situations. Furthermore, results revealed that the referee had a good angle in three situations and good insight into three situations. Teams of high status playing at home ground received all three penalties that were awarded, while teams of low status were the attacking team in seven of the remaining 11 situations where no penalty were awarded.
Discussion: The match referee had a poor starting position (Mallo et al., 2012) to assess the penalty situations where they landed on a wrong decision. The referees' positioning in the field of play may have caused uncertainty, and in their fear of failure they have landed on a "no penalty" decision (Haselton & Nettle, 2006). Discussed in the framework of error management theory and social impact theory, we argue that referees may have been influenced by social pressure, as teams of high status derived advantage of mistakes in 10 of the 14 situations. Findings may be considered as an argument in favour of the introduction of Video Assistant Referee system, as referees error are not distributed equal across distinct teams. Apropriate positioning combined with improved self-confidence seems warranted for referees to correctly award a penalty kick in soccer.
References: Haselton, M. G., Nettle, D. (2006). Pers and Soc Psy Rev, 10, 47-66.
Mallo, J., Gonzalez Frutos, P., Juarez, D., Navarro, E. (2012). J of Sports Sci, 30, 1437–1445.
Mascarenhas D. R. D., Button, C., O'Hare, D., Dicks, M. (2009). The Open Sport Sci J, 2, 1–9.
Slack, L. A., Maynard, I. W., Butt, J., Olusoga, P. (2013). J of App Sport Psy, 25, 298-315.
UEFA (2017). Refereeing. www.uefa.com.
Contact: bjorn.t.johansen@uia.no

INCIDENCE AND RISK FACTORS OF LATERAL ANKLE SPRAIN IN MALE YOUTH SOCCER PLAYERS –PROSPECTIVE STUDY–

MURATA, K.

WASEDA UNIVERSITY

INTRODUCTION: Lateral ankle sprain (LAS) is a trauma with high occurrence frequency and recurrence rate in soccer [1]. Previously, epidemiological studies and prospective investigation of risk factor in LAS have been mostly conducted with adult players [2,3]. Thus, the risk factors of LAS in youth soccer players is still unclear. Based on this background, this study aims to investigate prospectively risk factor of initial LAS for youth soccer players.
METHODS: The chronological age, height, weight, competition history, history of LAS, and the incidence of the initial and recurrent LAS were recorded for 195 male youth soccer players (ages 10 to 15 years old). The peak height velocity age (PHVA) was estimated using Auxal (Scientific Software International, Inc.). The subjects were then divided into three groups with the following criteria; Pre (< PHVA-1yr.), Average (PHVA±1yr.), and Post (> PHVA+1yr.). Measurements included: arch height ratio, leg heel angle (LHA), forefoot angle (vs. rearfoot), ankle dorsi / plantar flexion, foot internal rotation in ankle plantar flexion, weight-bearing dorsi flexion, navicular-medial malleolus distance, lateral side hop distance, side hop test time, and Y-balance test results. Then, a logistic regression analysis was performed for analyzing risk factor of LAS using all measurements as independent variables. One-way ANOVA was conducted between the three groups [Sprain Foot (SF) group, No Sprain Foot (NSF) group and the control (C) group]. The statistical significance level was set at 0.05.
RESULTS: The incidence of initial and recurrence LAS was 7.4% and 17.6%, respectively. The incidence rate was higher in Post (11.1%) than that of Pre (8.6%) and Average (4.8%). Risk factors of the initial LAS group were short competition history [odds ratio (OR) 0.95 (95% CI: 0.92-0.99)] and the lack of ankle dorsiflexion ROM [OR 0.91 (95% CI: 0.84-0.99)]. In comparison among the three groups, LHA was significantly eversion in the NSF group compared with C and SF group ($p < 0.05$). Forefoot angle was significantly inversion in the NSF group compared with the C group ($p < 0.01$). Ankle dorsiflexion was significantly smaller in the NSF group compared with the C group ($p < 0.05$).
CONCLUSION: The recurrence rate of LAS in youth soccer players was higher than that of adult players [3]. These results imply that youth soccer players need more appropriate rehabilitation for preventing recurrent LAS. In addition to the internal risk factors such as lack of ankle dorsiflexion ROM and the relative inversion alignment of ankle, short competitive history was the possible risk factor. These results may imply that players with inadequate skills are vulnerable to LAS. Thus, developing specific soccer skills as well as improving ROM and alignment of ankle are warranted for preventing LAS of youth soccer players.
Reference
1) Swenson DM. Clin J Sport med, 2013. 23(3): 190-6.
2) Fousekis K. Am J Sports Med, 2012. 40(8): 1842-50.
3) Kobayashi T. Orthop J Sports Med, 2013. 1(7): 2325967113518163.

CONCUSSION REPORTING BEHAVIOURS AND ATTITUDES IN IRISH AMATEUR AND PROFESSIONAL JOCKEYS

CULLEN, S.1, WARRINGTON, G.2, WHELAN, G.3, MCGOLDRICK, A.3, O'CONNOR, S.4

1: WATERFORD INSTITUTE OF TECHNOLOGY, IRELAND 2: UNIVERSITY OF LIMERICK, IRELAND 3: THE TURF CLUB, KILDARE 4: DUBLIN CITY UNIVERSITY, IRELAND

INTRODUCTION: Under-reporting of concussions is a serious concern in sport, with concussion understanding and attitudes potentially impacting on reporting (Kroshus et al., 2010). Concussions are frequent in both professional and amateur horse racing (O'Connor et al., 2017), however concussion reporting behaviours and attitudes in these athletes have not yet been investigated. This study aimed to investigate concussion reporting behaviours and attitudes among Irish professional and amateur jockeys.
METHODS: Licensed amateur and professional jockeys (n=119) were recruited to complete an anonymous questionnaire which was distributed through emails sent to jockeys, over social media and during professional and amateur race meetings. Questions were included on basic demographics, past personal concussion history and attitudes towards concussion.
RESULTS: Despite not being medically diagnosed, amateur (32.4%) and professional (19.6%) jockeys suspected that they did sustain a concussion. This was not apparent in professional flat jockeys. If a concussion occurred during riding out or if an important race was coming up within the following week, 52.8% and 63.8% of jockeys would not report a suspected concussion respectively. However, if they felt they were unable to ride the next horse to the best of their ability, three quarters of jockeys would report a suspected concussion. Reasons for not reporting a suspected concussion and continuing to ride included not considering it serious (85.7%); under pressure at risk of losing the ride (84.0%); not wanting to let owner down (77.8%); considered as a sign of weakness (74.1%); unsure if a concussion was present (60.0%); needed money (48.1%) and an important race (44.0%).
CONCLUSION: Attempts have been made in the Irish horse racing industry to improve jockey knowledge and understanding of concussion through the distribution of factsheets to each license holder annually as well as displaying these at all race tracks. In addition, a mandatory medical assessment by a Turf club approved medical doctor is required following any fall at a race-track in the attempt to deter under-reporting. Despite this, under-reporting of concussions does still occur. The reasons provided by jockeys for under-reporting suggest there is a need to educate the wider racing community and jockey support network on the adverse health implications of concussion as well as appropriate management to encourage reporting of suspected concussions by jockeys.

NO ADAPTATIONS IN MUSCLE ARCHITECTURE AFTER 12 WEEKS OF STATIC STRETCHING IN YOUNG HEALTHY PARTICIPANTS

LONGO, S., CÈ, E., BISCONTI, A.V., LIMONTA, E., RAMPICHINI, S., SHOKOHYAR, S., CORATELLA, G., ESPOSITO, F.

UNIVERSITÀ DEGLI STUDI DI MILANO

INTRODUCTION: Muscle architecture is one of the main determinant of muscle function and performance. Adequate mechanical stimuli (e.g., strength training) can induce modifications in muscle architecture. However, whether long-term stretching provides a sufficient stimulus for bringing architectural changes is still controversial. Therefore, the aim of the present study was to assess possible changes in muscle architecture after 12 weeks of static stretching (SS) in young healthy participants.
METHODS: Twenty-eight participants were randomly divided into two groups: stretching (STR, n=16, 7 females and 9 males; mean±SD: age=23.5±1.0 yrs; stature=1.75±0.08 m; body mass=69.8±8.9 kg) and controls (CTR, n=12, 6 females and 6 males; mean±SD: age=24.2±2.4 yrs; stature=1.70±0.06 m; body mass=65.5±7.2 kg). STR underwent 12 weeks of SS for both pantarflexors (PF) and knee extensors (KE) muscles. CTR did not undergo any training intervention. SS was performed five times per week. One session consisted in 5

sets of 45-s SS each (15-s rest in-between). A total of four exercises were executed: two for PF and two for KE of the right lower limb. All participants kept a file record of the training sessions performed. Ultrasound images of the medial head of the right gastrocnemius (GM) and vastus lateralis (VL) muscles were obtained at 50% muscle length before, at six weeks, and the end of the 12 weeks in both groups. Fascicle length (Lf), pennation angle (PA) and muscle thickness (MT) were measured offline by using an open source software. A 3x2 mixed-model ANOVA was used to assess possible differences over time and between groups in all architectural parameters for each muscle group. Significance was set with $p<0.05$.
RESULTS: Lf, PA and MT did not change significantly in STR over time ($p>0.05$ for all parameters) in both PF and KE. No significant differences were found between STR and CTR over time ($p>0.05$ for all parameters at any time point) in both PF and KE. No time x group interactions were found ($p>0.05$ for all parameters) in both PF and KE.
CONCLUSION: 12 weeks of SS did not induce architectural changes in the mid portion of the GM and VL muscles. These results suggest that common SS exercises for the PF and KE do not provide a sufficient mechanical stimulus for structural adaptations of GM and VL, respectively, despite the protocol duration (12 weeks). However, regional adaptations cannot be excluded.

TRAINING EFFECTS OF ALTERNATED AND PULSED CURRENTS ON FAT MASS OF COMPETITIVE ATHLETES

OLIVEIRA, P., MODESTO, K., BOTTARO, M., BABAULT, N., DURIGAN, J.

UNIVERSITY OF BRASÍLIA/FEDERAL INSTITUTE OF BRASÍLIA

INTRODUCTION: Neuromuscular electrical stimulation (NMES) is widely used for strength training in healthy individuals and athletes. Previous studies have shown that alternated mid-frequency currents (MF) and low-frequency pulsed currents (PC) have similar effects on quadriceps evoked strength and level of discomfort in this population. However, little is known about the effects and best parameters of NMES to induce fat mass loss. The aim of the study was to evaluate the effects of 6 weeks training with different neuromuscular electrical stimulation (NMES) currents (medium alternated and low frequency pulsed current) on fat mass of competitive athletes.
METHODS: A double-blind controlled and randomized experimental study was carried out with 33 athletes (22.2 ± 2.6 yrs, 74.7 ± 9.8 kg, 176.8 ± 6.0 cm), divided into 3 groups: mid-frequency current (MF, n=12), pulsed current (PC, n=11) and control group (CG, n=10). Fat mass percentage was assessed before and after the interventions through a body composition bio-impedance scale (BC-418 Segmental Body Compostion Analyzer, Tanita Corporation of America Inc., Illinois, USA). NMES training was performed 3 times per week and consisted of 18 sessions, 15 min/session (36 involuntary isometric contractions per session), 6s duration in each contraction interspersed with 18s rest. Data were expressed as means ± standard deviation (SD) and normality was checked using the Shapiro-Wilk test. A two-way analysis of variance (ANOVA) with repeated-measures and Tukey post-hoc test were used to analyze data (group and time effects). Statistical significance was accepted with $p < 0.05$.
RESULTS: After the training period, fat mass percentage did not change in any group (PRE: PC = 14.2 ± 3.5 %, MF = 15.4 ± 3.8 %, CG = 15.0 ± 5.1 %; POST: PC = 14.3 ± 3.5 %, MF = 15.0 ± 4.1 %, CG = 14.7 ± 3.9 %; $p > 0.05$). All currents produced similar evoked torque and levels of discomfort ($p > 0.05$).
CONCLUSION: Quadriceps NMES training applied through alternated or pulsed currents produced similar effects and did not change fat mass composition in competitive athletes.

CORTICAL AND MOTOR NEURONE EXCITABILITIES VARY WITH THE RATE OF FORCE DEVELOPMENT OF THE SUBSEQUENT CONTRACTION

GOUVERNEUR, Y., BAUDRY, S., DUCHATEAU, J.

UNIVERSITÉ LIBRE DE BRUXELLES

INTRODUCTION: Previous work indicates that, in leg muscles, the increase in corticospinal excitability prior to ballistic (BAL) contractions (high rate of force development) was delayed compared with ramp (RAMP) contractions (low rate of force development) (1), suggesting that corticospinal excitability during the preparatory period of a contraction may be specifically tuned depending on the rate at which force is developed during the subsequent contraction (2). To further document this possibility, this study investigated the modulation of cortical and spinal excitability during the preparatory period of BAL and RAMP contractions.
METHODS: Seventeen young adults performed isometric contractions with the right ankle dorsal flexor muscles. Subjects had to match a template displayed on a monitor with the force of the ankle dorsiflexor muscles. The template represented a RAMP (1500-ms duration) or a BAL (150-ms duration) contraction developing the same level of force (force associated with the maximal rate of force development during BAL contraction). Transcranial magnetic stimulation was applied over the left motor cortex to induce motor evoked potential (MEP) in the tibialis anterior, in a 500-ms window preceding the onset of the contractions (n=17). In 6 subjects, paired-pulse stimulations (2-ms interval) were used to assess short-interval intracortical inhibition (SICI, %). Peripheral nerve stimulation was used to assess motoneurone excitability by recording the occurrence of F wave (n=8).
RESULTS: MEP amplitude increased significantly ($p<0.05$) between each 100-ms window (+18.7%, +25.58%, +48.7%) from 500ms to the onset of the ramp contraction, whereas it increased (+85%) only in the last 200-ms prior to BAL contractions ($p<0.001$). In contrast, SICI (-50.8±23.4% prior to BAL and -46.4±19.5% prior to RAMP) did not change within the preparatory period, regardless of the contraction type ($p>0.05$). The F-wave occurrence increased progressively ($p<0.05$) from 500ms (18%) to 100ms (34%) prior to the onset of the RAMP contraction, whereas it did not change significantly over the same epoch preceding the BAL contraction (~20%; $p>0.05$).
CONCLUSION: These data suggest that prior to a BAL contraction, the motor neurones excitability is depressed up to the onset of the contraction to achieve a non-refractory state leading to greater motor units discharge rate during the subsequent contraction (3).
REFERENCES: 1. Kagamihara et al. (1992) Neurosci Res 14:1-11
2. Nielsen and Petersen (1995) J Physiol 484:777-89
3. Van Cutsem and Duchateau (2005) J Physiol 562:635-644
CONTACT: Yannick.Gouverneur@ulb.ac.be

Mini-Orals

MO-BN04 Rehabilitation and prevention

IDENTIFICATION OF INTRAMUSCULAR TISSUE OEDEMA AND CHANGES IN MUSCLE CONTRACTILE PROPERTIES INDUCED BY DRY NEEDLING

MARTÍN RODRÍGUEZ, S.1, PIQUERAS-SANCHIZ, P.2, BAUTISTA, I.J.3, BARAJA-VEGAS, L.4

1. UNIVERSITY OF VERONA, ITALY; 2. SPORT PLUS CENTER, SEVILLA, SPAIN; 3. FISIOSALUD ELITE, HEALTH, TRAINING & INNOVATION, UNIVERSITY OF GRANADA, GRANADA; 4. CATHOLIC UNIVERSITY OF VALENCIA, VALENCIA

INTRODUCTION: Myofascial trigger points are a common cause of clinically observed local muscle pain and tenderness. The improvement associated with the muscle relaxing effect (reduction of muscle stiffness) produced by dry needling (DN) is still not well understood. In this regard, it is believed that the regeneration of tissue destroyed by dry needling through the inflammatory process should do with the return to normality of muscle contractility. A contractility marker (muscle belly displacement, Dm) has been associated with changes in muscle stiffness (increase in Dm = decrease in stiffness and vice versa). The aim of this study was to identify via magnetic resonance imaging (MRI) if the local inflammatory response is immediately induced by DN as well as changes in Dm of asymptomatic patients.
METHODS: 18 asymptomatic patients participated in the study. We used an inter-group research design to investigate the regional-signal differences of MRI measurements in the gastrocnemious medialis (GM), before and after 1h DN. The research unit of analysis was the GM. The GM that presented more pain to pressure and reported by visual analogue scale was used for further analysis. The contralateral GM was used as a control group (CG) while the other one was considered the experimental group (EG). MRI Short tau inversion recovery (STIR, signal intensity) was used to identify signal changes due to by local inflammation. Changes in contractile muscle properties were assessed by tensiomyography using the key parameter: Dm (mm). An ANOVA was performed to analyse the influence of DN on the STIR variable and a t-test for dependent samples was performed to compare the pain perception after the DN.
RESULTS: The STIR (signal intensity) increased 128.97 % after the DN. The interaction effect showed significant differences (F(1,34) =235, p =0.0001, r =0.93). Bonferronis post hoc tests showed significant differences [mean differences and 95% confidence interval (95% CI) =198 (172 – 224)] signal intensity (F (1,34) =236, p =0.001; r =0.93; d =5.03). The difference between the CG vs. EG in Dm variable was 24.04 % after the DN. In addition, there was a significant effect of the group variable (i.e., CG vs. EG) after controlling the effects with the pre- variable (F(1,33) = 9.95, p =0.003, r =0.48, d =1.10. In relation to pain perception, a significant reduction (t(17) = 12.40, p =0.001, r =0.65, d =1.71) were found. Pearsons correlation did not show correlation between any variable.
CONCLUSION: Intramuscular oedema appears immediately after (1h) of the application of DN, therefore indicating an inflammatory process with unexpected reduction in the pain perception. A loss of muscle contractility measured by Dm did not correlate with changes in the STIR. Our results are in line with others found in mice showing signs of an inflammatory response after DN. Our research was limited for the lack of subsequent measurements of MRI to detect when the edema was removed.

THE EFFECTIVENESS OF ANTI-PRONATION TAPING IN LOWER EXTREMITIES STIFFNESS TO LOW MEDIAL LONGITUDINAL ARCH PEOPLE DURING LANDING PHASE

LIN, C.F., CHIOU, C.W.

NATIONAL CHENG KUNG UNIVERSITY

INTRODUCTION: Flat foot is one of the most common foot deformities. Possible risks factors for the development of flat foot include obesity, muscle unbalance or foot structure deformity. The low-dye taping (LDT) was first used to help athletes with flat foot to improve their performance. Furthermore, some studies used it on flat foot patients and showed improvement in pain and walking ability. However this study showed the short term effect in ankle joint with LDT. Furthermore, according to the kinematic chain, the flat foot may also affect upper joint by rotating the tibia & hip. Those changes will lead hip and knee joint suffer more stress. Therefore, this study aims to find out if the LDT taping would affect landing impact through LE joint.
METHODS: Fourteen participants between 20 to 30 years old were recruited from Tainan area. Low longitudinal arch (low arch) subjects were randomly assigned to 2 groups, intervention group or placebo group. All participants met the inclusion criteria of having a low foot arch- the Navicular drop test over 8mm, Visual Analog Scale below 6. Participants are free of substantial lower limbs injury in the 6 months before the study, such as a sprain and other symptoms that would affect landing tasks.
Navicular drop test (NDT) was using the navicular drop height to evaluate the severity of flat foot. The 3D motion data and vertical ground reaction force (vGRF) collection were conducted before and after intervention using 8 infrared cameras (Eagle camera system, Motion Analysis Corporation, USA) and two kistler force plates. The whole body marker set was used for COM calculation. There were 3 different jump tasks that including double legs forward landing (DLL), single leg forward landing (FL), and single leg side landing (SL). Those single leg landing tasks mentioned above concluded both right and left jump landing tasks. These tasks were performed in a random order. The outcome measure is lower extremity stiffness, calculated as (maximum vGRF)/range of center of mass (COM). The higher lower extremity stiffness (LES) means body landing with a stiffer way.
RESULTS: The LES in intervention group showed a decreasing trend. LES during double leg landing before and after taping are 0.298/0.265. LES during forward single leg landing before and after taping are 0.354/0.195. LES during sideward single leg landing before and after taping are 0.329/0.224. In the placebo group, the LES values in two conditions are similar. The decreased lower extremity stiffness may show that the anti-pronation taping skill could improve support ability in flat foot population. Furthermore, the lesser stiffness means lower extremity joints can suffer from lesser force during landing.
CONCLUSION: The changes in lower extremity stiffness shows that there must be landing mechanism differences during these tasks. However, the relationship between kinematic data and kinetic data in this study need further study to explain the mechanism behind.

IMPACT OF A STRENGTH INTERVENTION PROGRAM ON CHANGE IN HAMSTRING:QUADRICEPS RATIO

HAMMEROVA, T., KRALOVA, T., CACEK, J., KALINA, T., HLAVONOVA, Z., ONDRACEK, J.

MASARYK UNIVERSITY

INTRODUCTION: The most common knee joint injury is the rupture of the anterior cruciate ligament (ACL). When the H:Q (hamstrings:quadriceps) ratio is too low, the risk of ACL injury increases (Holcomb et al, 2007). The H:Q ratio can be expressed based on mus-

cle contraction. The conventional HCON:QCON ratio compares maximal hamstrings strength to maximal quadriceps strength during concentric contraction. The functional HECC:QCON ratio expresses maximal hamstrings strength at eccentric muscle contraction and maximum quadriceps strength at concentric contraction (Delextrat et al., 2010). The purpose of this study is to assess the impact of a strength intervention program on the conventional H:Q ratio, which is one of many factors related to ACL injuries.
METHODS: The work was achieved using the inter-individual research strategy of experimental character. Fifty male participants were randomized into 5 groups (4 experimental, 1 control): for EX1: high-bar back squats with 90% of 1RM (one-repeatition maximum); EX2: squat jumps with 30% of 1RM; EX3: high-bar back half squats with 90% of 1RM, EX4: half squat jumps with 30% 1RM. The intervention took place twice per week for 2 months. The control group did not participate in any exercises. Subjects were tested using a method of isokinetic dynamometry (Humac Norm, CSMI, Stoughton, USA) at an angular rate of 60°/s and then 300°/s. Two-way ANOVA with repeated measures was used for statistical analysis.
RESULTS: Pre-test and post-test comparison did not showed a significant improvement of H:Q ratio ($p>0.05$) for EX1, EX2, EX3 and EX4.
CONCLUSION: The results show that strength intervention involving various modifications of the squat and half squat does not affect the H:Q ratio. This may be because the intervention increases both quadriceps and hamstrings strength. It is important to note that squatting does not decrease the H:Q ratio, so squats can be safely included in exercise programs, where emphasis should be placed on correct execution of the squat and on the individual needs of trainees.
REFERENCES:
Delextrat A, Gregory J, Cohen D. (2010). Int J Sports Med, 31(3): 192–197.
Holcomb, WR, Rubley, MD, Lee, HJ, Guadagnoli, MA. (2007). J Strength Cond Res, 21(1): 41–47.

WILL DYNAMIC STRETCHING OF HAMSTRING ON FEMALE ATHLETES CHANGE KNEE JOINT BIOMECHANICAL CHARACTERS DURING SIDE-CUTTING TASK?

CHEN, B.Y., LEE, H.J.
NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: Anterior cruciate ligament injuy was one of the common sport-related injuries. Athletes were prone to injury during side-cutting task and the incidence of ACL tear. Female athletes were 3 times higher than male athletes suffering ACL injury. Hamstring has been known could help to stabilize the knee joint. Dynamic stretching could enhance joint range of motion and muscle activations . The purpose of this study was to investigate the influence of dynamic stretching of hamstring on knee joint biomechanical characters during side-cutting tasks .
METHODS: There were 10 female collegiate athletes with no lower extremity injury within 6 months volunteered for this study. During the experiment, participants were asked to perform SC as the pretest and then perform HDS as the intervention, finally perform SC for post-test. Kinematics, kinetics and EMG data were collected by 8 VICON cameras at 250Hz, 1 Kistler force plate at 1000Hz and 2 Delsys wireless EMG sensors at 2000Hz placed on semitendinosus and biceps femoris during SC. One-way Anova was used for statistical analysis.
RESULTS: Subjects demonstrated significantly greater hamstring activation <9%> and lesser knee varus angle at initial contact after HDS intervention in pre-contact phase. Subjects showed significantly greater hamstring activation <12%> and a significant lesser peak knee valgus moment <0.023N·m/BW> after HDS intervention in deceleration phase. During SC, knee varus angle was significantly lesser after HDS intervention .
CONCLUSION: The knee valgus moment were predictors of ACL injury . Therefore, decreasing knee valgus moment during SC could reduce possibility of ACL injury. The current study found that HDS could increase hamstring activation in pre-contact phase, which may help knee joint to land at less knee varus angle during SC. In the deceleration phase, HDS could also increase hamstring activation, which may help knee joint to decrease knee valgus moment. These findings suggest that dynamic stretching of hamstring might be a good method to cooperate in warm-up which could prevent occurrence of ACL injury.

RESPONSIVENESS OF THE IDFAI-BRAZIL QUESTIONNAIRE IN SUBJECTS WITH FUNCTIONAL ANKLE INSTABILITY

MARTINEZ, B.R.1, SAUERS, A.D.L.2, SOUZA, V.T.O.C.1, OLIVEIRA, J.C.1, SILVA, J.B.1, DOCHERTY, C.L.3, YI, L.C.1
1: FEDERAL UNIVERSITY OF SÃO PAULO , 2: A.T STILL UNIVERSITY , 3: INDIANA UNIVERSITY .

INTRODUCTION: The Identification of Functional Ankle Instability (IdFAI) Questionnaire has been recommended as the best self-reported instrument to use when identifying a patients ankle stability status. Recently, the IdFAI was translated to Brazilian-Portuguese language and has shown to be a valid and reliable tool to evaluate functional ankle instability (FAI). Therefore, the aim of this study was determine the responsiveness of the IdFAI-Brazil in patients with FAI.
METHODS: Twenty-five college students (23,12 ± 2,80 years) with FAI were enrolled in the study. For responsiveness measurement, the IdFAI-Brazil and 11 anchor-based approaches were used before and after an eight-week treatment period. The assessments were: Visual Analog Scale for instability; Cumberland Ankle Instability Tool; Strength of dorsiflexors, plantarflexors, inverters and everters; Star Excursion Balance Test; Lunge test; Single Hop test; Triple Crossover Hop test and Side Hop test. The internal responsiveness was tested with the paired t-test, effect size and standardized response mean.
RESULTS: When analyzing the clinical changes in volunteers with FAI after a physiotherapeutic intervention, the IdFAI-Brazil showed high responsiveness ($p< 0,001$) with values of 1.34 for effect size and 1.28 for standardized response mean (values ≥0.80 = high responsiveness).
CONCLUSION: The translation and cultural adaptation of the IdFAI to other languages and different countries helps to improve the diagnosis and to standardize the definition of FAI. This was the first study of responsiveness analysis of the IdFAI questionnaire and from the anchor-based approaches, it was possible to identify clinical consistent changes in the IdFAI score. The Brazilian version of the IdFAI questionnaire has been shown to be responsive in identifying clinical changes in patients with ankle functional instability undergoing physiotherapeutic intervention and it may be used in clinical and scientific fields.
References: Martinez, B. R., Sauers, A. D., Ferreira, C. L., Lugli, L. C., Turchetto, P. C., Docherty, C. L., & Yi, L. C. (2018). Phys Ther Sport, 29, 1–8.
Simon, J., Donahue, M., & Docherty, C. (2012). Foot Ankle Int, 33(9), 755–763.
Simon, J., Donahue, M., & Docherty, C. L. (2014). Phys Ther Sport, 15(2), 97–100.
Contact: E-mail: brunareclusa@gmail.com

EFFECTS OF MYOFASCIAL RELEASE OF THE ANKLE PLANTAR FLEXORS ON STATIC POSTURAL BALANCE OF YOUNG MEN

MEDEIROS, F., BOTTARO, M.1, LAURENÇO, D.F.R.1, MARINHO, E.B.A.1, PIMENTEL, M.O.C.1, GONÇALVES, M.S.1, FERREIRA-JUNIOR, J.B.2, CARVALHO, J.C.1

UNIVERSIDADE DE BRASILIA

INTRODUCTION: Myofascial release (MR) is a type of massage that consists in compression of myofascial tissue. It has been hypothesized that MR stimulate the somatosensory and proprioceptive system leading to improvement on postural balance (Kumka et al., 2012). However, MR has been performed on the plantar fascia, despite it is known that the ankle flexor muscles are the main responsible for the control of static postural balance (Noda et al., 2006). Furthermore, controlled studies on the effects of MR on postural balance are lacking. Therefore, the aim of this study was to investigate the effect of MR of the ankle plantar flexor muscles on static postural balance of healthy young men.
METHODS: Fifty young men were randomly exposed to two different manipulation techniques on ankle plantar flexors: 1) MR group (n = 25), the MR was administered by using a roller massager with a controlled force of 8.5±5.0 kgf, and perceived muscle soreness of 5), and 2) Sham group (n = 25), the sham was performed with a turned off ultrasound probe using light slip movements. Both techniques were applied bilaterally at 60bpm frequency during 5 min. The bipodal static postural balance test was performed before and 2 min post both interventions on a force plate with eyes closed during the test. Subjects performed 3 sets of 30-s with 1 min of rest. Mean values of displacement area (area95) and center of pressure velocity (COPvel) was used for analysis.
RESULTS: The Sham group obtained 21.4±8.2 cm2 in the pre-test and 20.3±7.3cm2 in the post-test for area95 and 5.3±1.0 cm.s-1 and 4.9±1.2 cm.s-1 in the pre-test and post-test, respectively, for COPvel. The MR obtained 20.6±6.4 cm2 and 19.5±6.7 cm2 in the pre- and post-test, respectively, for area95 and 5.0±0.8 cm.s-1 in the pre-test and 4.5±0.6cm.s-1 in the post-test for COPvel. Area95 did not differ between groups or between pre- and post-test ($p>0.05$). COPvel decreased on post-test in both MR and sham group ($p<0.05$), but there was no difference between them ($p>0.05$).
CONCLUSION: There was no difference between MR and Sham intervention on the variables investigated. However, both techniques acutely improved the static postural balance. This improvement may be related to mechanical and positive effects on somatosensory system induced by massage (Kumka et al., 2012). Previous studies reported that COPvel is more sensible than area95 to assess postural balance (Raymakrs et al., 2005), this would explain significant COPvel decreased on post-test observed in the present study.
References: Kumka M., J. Bonar, Fascia: a morphological description and classification system based on a literature review., J. Can. Chiropr. Assoc. 56 (2012) 179–91.
Noda M., S.-I. Demura, Comparison of quantitative analysis and fractal analysis of center of pressure based on muscle fatigue, Percept Mot Ski. 102 (2006) 529–542.
Raymakrs JA, Amson, Verhaar HJ. The assesssment of body sway and choice of the stability parameter (s). Gait Posture. 21 (2005) 48-58
Contact: medeiros.flaviaphd@gmail.com

ASSOCIATION BETWEEN GLENOHUMERAL AND HIP ROTATIONAL RANGE OF MOTION IN TWO DIFFERENT HIP POSITIONS: A CROSS-SECTIONAL STUDY IN HEALTHY MIDDLE-SCHOOL BASEBALL PLAYERS

YUSUKE, S.

HOSEI UNIVERSITY

INTRODUCTION: Every joint in the body contributes to the completion of the throwing motion. The glenohumeral joint (GHJ) and hip joint rotational range of motion (ROM) are large and are essential for proper throwing mechanics. Previous studies showed an association between GHJ and hip ROM in adult baseball players. The throwing mechanics are different at each age level; however, these associations have not been investigated in younger individuals. In addition, hip rotational ROM, which was used in these studies, was examined in only one measurement position. The purpose of this study was to investigate the association between glenohumeral and hip rotational ROM at two different hip positions in healthy middle-school baseball players.
METHODS: Out of 33 middle-school baseball players, 23 were included (10 players with hip or GHJ injuries were excluded). Rotational ROM was measured using a goniometer. ROM for the GHJ internal rotation (IR) and external rotation (ER) in the dominant side was assessed with the arm abducted at 90-degree angle. Hip rotational ROM was measured in two hip positions: 0 and 90 degrees of hip flexion. The Pearsons correlation was used for statistical analysis; the level of significance was set at 0.05.
RESULTS: An association between GHJ IR and hip joint rotational ROM was not found. A moderate positive correlation was found between GHJ ER and the non-throwing-side hip joint ER ($r=0.53$ $p<0.001$) and the throwing-side hip joint IR ($r=0.51$ $p=0.013$) at 90 degrees of hip flexion. Although there was no significant difference, throwing-side hip joint ER and non-throwing-side hip joint IR also showed a low to moderate correlation with GHJ ER ROM. The association between GHJ ER and hip joint rotational ROM at 0 degrees of hip flexion was not found.
CONCLUSION: There was no relationship between GHJ IR and hip rotational ROM. Hip rotational ROM was related to GHJ ER not at 0 degrees of hip flexion, but at 90 degrees of hip flexion in healthy middle-school baseball players.

EFFECT OF A TWENTY-FOUR-WEEKS STRENGTH TRAINING PROGRAM ABOUT PAIN INTENSITY AND INTERFERENCE WITH DAILY ACTIVITIES IN TWO DIFFERENT GROUPS OF WOMEN DIAGNOSED WITH FIBROMYALGIA.

MAESTRE-CASCALES, C.1, PASTOR, D.2, ROJO-GONZÁLEZ, J.J.1

1. LFE RESEARCH GROUP ; 2. SPORT RESEARCH CENTER – MIGUEL HERNÁNDEZ UNIVERSITY

Introduction: Fibromyalgia (FM) is a chronic disease characterized by widespread pain and other associated symptoms. It has a relevant impact on physical fitness and the ability to perform daily living tasks. Among the physical impairments of FM patients, we found the low levels of strength, endurance, and loss of handgrip strength (1,2). The objective of the study was to compare the effect of a strength training program in women ≤ 55 years, and woman ≥56 years, and how it affects in the pain intensity and interference daily life.
Methods: A total of forty-one women diagnosed of FM participated in the study. Participants were divided into 2 groups taking into account the age, the first (n=17;≤55yrs)(47.54±7.99yrs; 64.69±15.46kg;161.66±6.09cm) and the second (n=24;>55yrs)(61.81±5.68yrs; 70.54±12.72kg; 158.72±5.24cm). The physical condition was measured with Senior Fitness Test battery (SFT) and the handgrip strength was assessed by manual dynamometry (T.K.K.5101). All participants completed the Brief Pain Inventory. We used Student's t-test to analyze the differences pre-post training program and the clinic effect size was interpreted according to Cohen (1988).

Results: In the first group (≤55yrs) we obtained statistically and clinical differences in pain intensity (p=0.01;d=0.93) and with the interference activities daily we found a high clinic effect (p=0.058;d=0.68). To the contrary, we found in the second group a clinic effect higher in interference activities daily (d=1.00) than pain intensity (d=0.76). In relation to the physical condition, we found statistically and clinical differences in all test of both groups (p<0.01;d>1.0) being the highest effect in the second group, as to AC (d=2.43) and 30" CST (d=1.54).
Discussion: The evolution of the levels of strength in the upper and lower limbs was significant in both groups producing a series of changes. In elderly women diagnosed FM affected to a greater extent the ability to perform the activities of daily life compared with early ages, where the effect was smaller. Therefore, supporting authors (1), new patients with this condition tend to age before if we did not stop the loss of physical condition. On the other hand, the intensity of pain decreased at the end of the program in both groups, producing a greater effect in the group of older women. In conclusion, the decrease in pain produces greater benefits in physical capacity in older women when it comes to daily activities than in more early ages.
References: 1. Alvarez-Gallardo, I. C., Carbonell-Baeza, A., Segura-Jimenez, V., Soriano-Maldonado, A., Intemann, T., Aparicio, V. A., Ortega, F. B. (2017). Scand J Med Sci Sports, 27(11), 1477-1488.
2. Aparicio, V. A., Ortega, F. B., Heredia, J. M., Carbonell-Baeza, A., Sjostrom, M., & Delgado-Fernandez, M. (2011). Arch Phys Med Rehabil, 92(1), 83-88.
Contact: Cristina.maestre@upm.es

Mini-Orals

MO-BN08 Gait and balance

MENTAL FATIGUE INCREASES GAIT VARIABILITY DURING DUAL-TASK WALKING IN OLD ADULTS

BEHRENS, M.1, MAU-MOELLER, A.1, LISCHKE, A.2, KATLUN, F.1, GUBE, M.1, ZSCHORLICH, V.1, SKRIPITZ, R.3, WEIPPERT, M.1
1: INSTITUTE OF SPORT SCIENCE, UNIVERSITY OF ROSTOCK, 2: DEPARTMENT OF PSYCHOLOGY, UNIVERSITY OF GREIFSWALD, 3: ROLAND-KLINIK AM WERDERSEE, BREMEN

INTRODUCTION: Mental fatigue is a psychobiological state induced by sustained periods of demanding cognitive activity and is characterized by feelings of tiredness which are common in everyday life. Recently, it has been hypothesized that mental fatigue might have an impact on gait performance in old adults. Therefore, the effect of mental fatigue on gait performance under single- and dual-task conditions was investigated in young and old participants.
METHODS: Spatio-temporal gait parameters of 16 young and 16 old healthy participants were measured using a photoelectric system during single- and dual-task walking (motor + cognitive interference task) before and after a randomly assigned mental fatigue (performing a stop-signal task for 90 min) and control intervention (watching a video for 90 min), respectively. Changes in subjective fatigue, wakefulness, mood, arousal and psychophysiological workload (heart rate variability (HRV) indices) were assessed.
RESULTS: Psychometric measures indicated increased subjective fatigue and arousal as well as decreased mood and wakefulness after the mental fatigue task. HRV indices revealed a higher psychophysiological workload during the mental fatigue intervention in old compared to young participants. Gait measures (coefficient of variation of speed, stride length and stance time) indicated impaired dual-task walking performance following the mental fatigue intervention only in old participants.
CONCLUSION: Data indicate that mental fatigue, induced by sustained cognitive activity, can impair gait performance during dual-task walking in old adults. Structural alterations of the brain, e.g. in the prefrontal areas, have been observed with aging. This factor has been identified as a contributor to decreased gait performance under dual-task conditions in older people. Challenging these brain areas by means of a mental fatiguing task seems to increase gait variability during dual-task walking in the old age. This effect of mental fatigue on gait variability during dual-task walking was not observed in young participants. These results indicate that young adults can cope with the cognitive interference task in a mental fatigued state without attenuating (i) processing capacity for the motor task (central capacity sharing model) and/or (ii) sequential neural processing of the motor and cognitive interference task (bottleneck model). The susceptibility to mental fatigue could be a new intrinsic risk factor for falls in older people and should be taken into account when dual-task gait analyses are performed.

SPECIFICITY OF BALANCE TRAINING EFFECTS AFTER SIX WEEKS OF SLACKLINE TRAINING

RINGHOF, S., ZEEB, N., ALTMANN, S., NEUMANN, R., WOLL, A., STEIN, T.
KARLSRUHE INSTITUTE OF TECHNOLOGY

INTRODUCTION: Balance is vitally important for most sports and activities of daily living. Therefore, balance training is commonly employed to improve postural control as well as to prevent injuries or falls . A special and challenging type of balance training is slacklining, which has been suggested to improve proxies of balance and neuromuscular performance . However, recent studies have provided evidence for the task-specificity principle of balance . Therefore, this study aimed to investigate the generalizability of slackline training effects. In particular, we studied whether six weeks of slackline training can elicit transfer effects to either more or less similar balance tasks as well as to neuromuscular performance tests.
METHODS: Participants were 21 female handball players who were matched to a slackline training or a control group based on their initial slackline performance. The intervention comprised twelve sessions of slackline training <~10 min> on single and double slacklines. Pre and post intervention, dynamic balance tests and static balance tests were performed using biomechanical motion analyses. In addition, neuromuscular performance parameters time> were assessed.
RESULTS: Two-way ANOVAs revealed a significant group × time interaction for slackline standing time with larger training effects in SLT than in CON. For the remaining dynamic and static balance tests, no significant interaction effects were apparent. With regard to neuromuscular performance tests, a significant group × time interaction in favor of SLT was found only for CoD time .
CONCLUSION: The study showed that slackline training induced large performance enhancements in the trained slackline task. However, slackline training did not improve balance in a general way, as was evident by lack of transfer effects. This adds further evidence to the task-specificity principle of balance, suggesting that generalizability and transfer effects – even between very similar balance tasks – are limited. Besides, the addition of slackline training to the usual handball training seems to contribute to improve CoD performance. These findings contain practical implications for future balance training studies, highlighting the significance of selecting appropriate training protocols and balance tests.

REFERENCES:
Hrysomallis C <2007>. Sports Med, 37, 547-566
Jager T, Kiefer J, Werner I, Federolf PA <2017>. Eur J Sport Sci, 17, 1021-1028
Kummel J, Kramer A, Giboin LS, Gruber M <2016>. Sports Med, 46, 1261-1271
CONTACT:
steffen.ringhof@kit.edu

COMPARISON OF THE EFFECTS OF A SHORT-TERM VIRTUAL REALITY-BASED AND CONVENTIONAL BALANCE TRAINING ON BALANCE IN HEALTHY WOMEN

KIM, A.R.1, YOO, K.T.1, LEE, S.A.2, LEE, H.S.2

1. NAMSEOUL UNIVERSITY 2. DANKOOK UNIVERSITY

INTRODUCTION: Virtual reality (VR) can be defined as an approach to user-computer interface that involves real-time simulation of an environment, scenario or activity that allows for user interaction via multiple sensory channels (Burdea, 2003). Many disciplines of healthcare now rely on VR, such as for training surgeons, delivery of cognitive therapy, and delivery of post-traumatic stress disorder therapy. The use of VR for sensorimotor training is a promising addition to its already broad utility in healthcare (Adamovich et al., 2009). However, rigorous randomized studies regarding its efficacy, safety, and applicability with individuals are lacking. In this study, we aimed to investigate the comparison of the effects of a short-term virtual reality (VR)-based balance training and conventional exercises on balance ability in healthy woman.
METHODS: Twenty healthy women were divided to VR-based balance training group (VRG, n = 10), and conventional balance exercise group (CON, n = 10). The VR-based balance exercise that challenged balance (eg, rope crossing adventure, tunnel race) performed while standing. The conventional balance exercise performed one leg standing and threw and catch ball with unstable surfaces. The training consisted of 30 minute/day, three times a week for a 4-week period. Objective outcome measures of static and dynamic balance were assessed before, and 4-week after training each group.
RESULTS: According to the static and dynamic balance test conducted to examine the effects of the training, both the area covered by the bodys center of pressure movement, and movement distances per unit area of the bodys center of pressure envelope significantly improved in the VRG and CON ($p < .05$, respectively). Although there were no significant differences between the two groups after the intervention.
CONCLUSION: Similar improvements were found in static and dynamic balance with VR-based balance training and conventional balance training in the healthy women. Results from the current study will provide important evidence for the use of low-cost, accessible VR-based balance training as an adjunct intervention to increase balance ability. The motivating and enjoyable attributes of VRT may increase exercise dosage, leading to improved function and optimal results from increase of balance ability.

THE INFLUENCE OF THE 3D SOUND IMAGE MOVEMENT ON THE MOVEMENT OF THE CENTER OF PLANTAR PRESSURE OF THE STANDING POSTURE

INOUE, Y., TANAKA, R.

OSAKA INSTITUTE OF TECHNOLOGY

INTRODUCTION: It is known that visual information influences controlling the standing posture. However, there are not many studies on how the auditory stimulus affects the center of plantar pressure (COP) when the eyes are closed, that is, when there is no visual information. Some previous studies have reported that the traveling distance of the COP movement with sound image movement tends to be longer than with no sound (Miura et al., 1991, Nara et al., 2000). Auditory stimulation has two types: dynamic sound source and static sound source. The speakers are fixed in a position, but in the former the source is virtually moving (it sounds as if it is moving) and in the latter it actually sounds still. This research examines how the speed and direction of the 3D sound image movement affect the COP movement of the standing posture.
METHODS: 16 male college students were participated in the experiment on two cross-cutting dimensions. One dimension was four conditions for changing the direction of sound image movement: front to rear (F-R), rear to front (R-F), left to right (L-R), right to left (R-L). The other was four conditions for changing the speed of sound image movement: 0, 10, 15 and 20m/s. The participants were made to hear a one-second pure tone on 16 conditions and control condition (no sound condition) twice. A 3D sound image was presented through 5.1 channel virtual surround speakers. They were instructed to stand on the plantar pressure measurement plate (Footscan 2D, RS International) with their eyes closed.
RESULTS: The total distance of the COP movement was shown to be significantly longer in the R-F, L-R, and R-L conditions than in the control condition ($P<0.05$). Regardless of the direction in which the sound image was moving, the COP tended to move forward as the sound approached. Compared on the four speed conditions and the control condition, the total distance of the COP movement on the control condition tended to be the shortest.
CONCLUSION: From the results, we could conceive two factors. First, it is difficult to lean back due to the structure of the body. Second, as the sound image passes by, there is a tendency to move the COP forward to get rid of the object. Therefore, the direction of sound image movement does not matter when the COP moves forward. In other words, the COP normally moves forward even though the sound comes in any direction.
REFERENCES:
Misawa H, Sasaki T, Ozaki H, Suzuki H. (1991). Proceedings of Sensory Substitution Symosium, 17, 125-128.
Nara H, Matsuo R, Ino S, Onda Y, Ifukube T. (2000). Transactions of the Virtual Reality Society of Japan, 5, 447-450.
CONTACT:
[yumiko.inoue@oit,ac,jp]

TOWARDS A BALANCE ALGORITHM TO DETERMINE FORWARD AND BACKWARD LEANS IN SKIING

VENEK, V.1, BRUNAUER, R.1, BUCHECKER, M.2, JAHNEL, R.2, STÖGGL, T.2

1: SALZBURG RESEARCH, 2: PARIS LODRON UNIVERSITY SALZBURG

INTRODUCTION: Keeping balance is a crucial skill of alpine skiing (Lesnik et al., 2017; Hrysomallis, 2011). Skiers are advised to prepare with balance exercises to prevent self-inflicted falls and injury (Cigrovski et al., 2017). To assess tendencies towards unwanted backward and

forward leans, the influence of the ski boot on balance performance must be considered (Mildner et al., 2010). We present a study on a novel concept for balance assessment by comparing pressure sensors integrated into ski boots towards a force plate system. We aimed at developing a balance algorithm displaying back and forward leans based on pressure distribution over the feet to provide a proof-of-concept for in-store application and a pre-study for balance on-ski.
METHODS: Readings from two pressure sensors positioned at the ski boots' forefoot and heel were weighted to result in balance values ranging –1 and +1 reflecting maximal backward and forward lean. To determine reference data, two expert skiers performed a sequence of alternating forward and backward leans according to the natural range of motion during skiing on a force plate (AMTI) with boots clipped on skis. By placing markers onto each ski boot and the force plate edges, the center position of the ski boots on the plate was obtained. The center of pressure (CoP) course in anterior-posterior axis from the force plate was adapted to the center position of the boots. Then the maximal values of the forward and the backward lean were determined to normalize the CoP signal to the range of –1 and +1. Finally, the sensor-based balance results were optimized using the reference data to align the weights of the pressure sensors to detect the leans.
RESULTS: The comparison of the sensor-based balance values with the reference data revealed that there are not common weights to map the pressure sensor values to the whole balance range since there are two ways for how to perform forward and backward leans. One subject performed as expected; the extreme leaning positions coincided with the maximal pressure on the corresponding feet area, i.e. forward lean was produced by maximal pressure on the forefoot and backward lean vice versa. The other subject applied a torque in the opposite direction, i.e. the maximal pressure was applied over the heel during forward leans instead of over the forefoot and during backward leans vice versa.
CONCLUSION: During the study, an unexpected result occurred because there are at least two patterns for extreme forward and backward lean performances. This already overexerted the sensor-based balance algorithm. The identification of subtypes of forward and backward lean in skiing supports the further development of the algorithm and the application on more subjects to confirm these two types. Simultaneously, a further development of the reference data generation (e.g. force binding system) and balance understanding for on-piste conditions is warranted to monitor the CoP during skiing and compare to the pressure distribution over the feet.

THE INFLUENCE OF IMPROVED COGNITIVE CONTROL AFTER NON-PHYSICAL TRAINING ON MOBILITY-RELATED OUTCOMES IN HEALTHY AND PHYSICALLY ACTIVE ELDERLY: A RANDOMIZED CONTROLLED TRIAL

MARUSIC, U.1,2,3, PISOT, R.1, MAHONEY, J.4

1-SCIENCE AND RESEARCH CENTRE KOPER; 2-ALMA MATER EUROPAEA-ECM; 3-UNIVERSITY OF PRIMORSKA; 4-ALBERT EINSTEIN COLLEGE OF MEDICINE

INTRODUCTION: Gait and cognition have shown to be interrelated, especially in late life (Montero-Odasso et al., 2012). Our recent research revealed a positive influence of non-physical intervention on several complex functional outcomes (e.g., walking while talking) in frail older adults (Marusic, Verghese & Mahoney, 2018). The aim of the current study was to determine the efficacy of the same computerized cognitive training (CCT) intervention on healthy, active and independently living older adults.
METHODS: Forty members (mean age = 66 years, mean MoCA score = 27) of the Center for Daily Activity Koper (Slovenia) were carefully selected and randomized into one of two groups: Experimental group (EXP) receiving 24 sessions of CCT in 2 months or control group (CON) receiving only pre- and post-measurements. Primary outcomes were self-selected gait speed in normal and dual-task conditions, and fast-paced gait speed in the normal condition. The 2x2 ANOVA was used to assess the interactions at $p<0.05$.
RESULTS: Our preliminary results reveal that at post-measurements, EXP manifested significant improvements in both the fast-paced walking condition ($p=0.021$) and the self-selected dual-task walking condition ($p=0.009$) compared to the CON. However, no significant interaction was found for self-selected walking condition ($p=0.148$).
CONCLUSION: Our results suggest that CCT can improve mobility outcomes also in a population of active, healthy and independently living older adults and as such represents a novel tool for cognitive and motor decline prevention. Future studies should examine the CCT-related neural adaptations as well as long-term retention effect.

EFFECTS OF 4 WEEKS SLACKLINE TRAINING ON ANKLE JOINT KINEMATICS.

SCHAEFER, T., DEBOECK, G., SOBCZAK, S., FAORO, V.

FACULTY OF MOTRICITY SCIENCE

INTRODUCTION: Balance training takes more and more place in athletic preparation in order to increase performances and reduce injuries risks. Balance exercise on slackline have been shown to improve postural control even if transfer to other conditions is limited in agreement with "task-specificity principle". Previous studies showed positive slacklining effects on muscular strength, muscular activation and preactivation, on spinal reflex and supraspinal control. Although ankle is one of the most injured joints, the effects of slackline on ankle joint kinematics remain unclear.
METHODS: Twenty-two healthy young subjects were randomly devided in two groups; training group (n = 11, 24 ± 1 years; 4 females) and control group (n = 11, 24 ± 2 years; 1 female). Training consisted in 2 slackline sessions of 45min a week during 4 weeks. The control group did not follow any balance training. Ankle joint angular velocity (AV) and angular acceleration (AA) of the dominant leg were measured during a unipodal standing 30s test before and after intervention in all subjects.
RESULTS: Slackline training improved ($p<0,05$):
- Angular velocity of pronation (pre: 13,9 5,1 deg/s ; post: 9,9 3,3 deg/s), supination (pre: 9,8 5,1 deg/s ; post: 5,8 3,6 deg/s), plantar flexion (pre: 7,8 2,4 deg/s ; post: 5,8 1,8 deg/s) and dorsal flexion (pre: 3,7 2,5 deg/s ; post: 1,9 1,7 deg/s).
- Angular acceleration of pronation (pre: 206,7 93,7 deg/s2 ; post: 126,0 54,2 deg/s2), supination (pre: 214,6 106,2 deg/s2 ; post: 125,7 53,3 deg/s2), plantar flexion (pre: 90,9 30,9 deg/s2 ; post: 65,7 25,5 deg/s2) and dorsal flexion (pre: 86,7 33,9 deg/s2 ; post: 60,6 24,9 deg/s2)
No change has been observed on control groups kinematics parameters between pre and post-test.
The decreased ankle kinematics parameters suggest a better ankle stability after slackline balance training.
CONCLUSION: A decreased ankle angular velocity and acceleration of the pro/supination and plantar/dorsal flexion motion following slackline training reflecting increased joint stability highlights the interest of this type of training to prevent risks of ankle injury.

ALPINE SKIINGS ENVIRONMENT, AND THE EFFECTS ON THE POSTURAL STABILITY: STRATEGIES TO IMPROVE THE BALANCE PERFORMANCE

BRIGHENTI, A., SCHENA, F., MOUROT, L.
UNIVERSITÉ BOURGOGNE FRANCHE-COMTÉ

INTRODUCTION: Alpine skiing is a popular activity practiced either for leisure or competition. The postural control, in particular the management of the balance despite of all the forces that act on the skier, is widely considered as one of the factors that limit the race performance in this sport. Alpine skiing is characterized by the environment where is practiced: high mountain on the snow i.e. lack availability of oxygen and cold.
METHODS: Our literature search included the electronic databases Pubmed and Google Scholar (1987-March 2018). In total, 59 studies met the inclusionary criteria for review
RESULTS: Findings from our literature review shows that, the hypoxic (hypobaric and normobaric) and hypothermic nature of alpine skiing, cause an impairment of the postural control during static and dynamic tasks.
CONCLUSION: Perform high intensity resistance exercises, is a well investigated method to insert into the warm-up tool in order to stimulate the postactivation potentation (PAP) that, it has been demonstrated, increase the strengths level, the power, the speed and improve the performance in several sports. The two main effects on the contractile muscular performance of the PAP are an increase of the rate of force development and the facilitation of the Hoffmans reflex.
These two above cited effect, could lead an enhancement of the balance performance and consequently the race performance, making the muscles more responsiveness to maintain the stability despite the perturbation that the skier suffers.

THE INFLUENCE OF ACTIVITY-DEPENDENT STIMULATION DURING GAIT RETRAINING ON DUAL-TASK COST IN CHRONIC STROKE SURVIVORS: A PILOT STUDY.

WATSON, J., WELMAN, K., SEHM, B.
STELLENBOSCH UNIVERSITY

INTRODUCTION: Walking is recognised as a complex skill, involving dual-tasking. Dual-task paradigms have been used to assess the real-world effects of cognitive-motor interference; dual-task cost (DTC) is particularly sensitive in the swing and stance kinematics of gait in chronic stroke survivors. Additionally, there is emerging research for the benefits of transcranial direct current stimulation (tDCS) for gross motor skill learning post-stroke. It is hypothesized that a combination of gait re-training and tDCS may yield benefits for cognitive-motor interference on certain gait kinematics. Consequently, this study endeavoured to compare the efficacy of gait re-training during real and sham stimulation on swing and stance asymmetry in chronic stroke survivors.
METHODS: A randomized double-blinded case study, whereby 10 chronic stroke survivors (≥6 months) were divided into either an attention-matched control group (n=4), or an 8-week task-specific gait re-training program with concurrent tDCS over the primary motor cortex (1mA; 20 minutes; n=2) or with Sham stimulation (20 minutes; n=3), was implemented.
Gait kinematics were measured pre- and post-intervention by using the two-minute walk test and the APDM mobility lab™.
RESULTS: Dual-task cost decreased for swing (M= 0.73; IQR= 0.46) and stance (M= 0.82; IQR= 0.37) assymetry in participants who received real stimulation, compared to participants who received sham stimulation; where DTC increased for swing (M=-4.45, IQR= 6.79), and stance (M=-10.98, IQR= 14.15) assymetry. Additionally, DTC for swing (M= -0.70, IQR= 0.53), and stance (M= -0.77, IQ = 0.38) assymetry increased in the attention-matched control group.
CONCLUSION: These preliminary data show the potential benefits of an 8-week task-specific gait re-training program with concurrent tDCS, on DTC in gait symmetry in chronic stroke survivors.

Mini-Orals

MO-PM22 Sleep

ASSOCIATION OF EARLY SLEEP-WAKE LIFESTYLE WITH INCREASED BODY FATNESS INSTEAD OF DAILY TOTAL PHYSICAL ACTIVITY IN JAPANESE OLDER MEN

MURATA, H.1, ZHANG, Q.1, NAGANUMA, S.1, ITO, T.1, KAWAKAMI, R.1, SAKAMOTO, S.1, TORII, S.1, SHIBATA, S.2, HIGUCHI, M.1
WASEDA UNIVERSITY

INTRODUCTION: Evening chronotype has been reported to be associated with body fatness and metabolic disorders in middle-aged adults. However, little information is available on the relationship between circadian phenotype and body fatness in older people. This study aimed to clarify characteristics of circadian phenotype and to examine the relationship between these phenotypes and body fatness in older people.
METHODS: We performed a cross-sectional study consisting of 200 older adults (men: n=84; women: n=114; age: 60–79 yrs) who were classified into chronotype groups based on their scores on the morningness - eveningness questionnaire (MEQ) as follows: "definitely morning type (DMT)," "moderately morning type (MMT)," "neither type (NET)." The participants were asked to report their daily rhythms of behavior such as meal time and sleep-wake cycle. Additionally, their physical activity was measured using a uniaxial accelerometer (Kenz Lifecorder EX, SUZUKEN, Nagoya, Japan). Energy intake was assessed using a brief self-administered diet-history questionnaire.
RESULTS: Among men, BMI in the DMT group (25.2±2.7 kg/m2) was significantly higher than in the MMT group (23.2±2.5 kg/m2) and in the NET group (22.6±2.1 kg/m2), respectively (P<0.05), whereas no significant differences were found among the three groups in women. Breakfast time in the DMT group (6:00 am) was earlier than in other groups (median MMT: 7:00 am, NET: 8:00 am); however, lunch time (median DMT: 12:00 noon, MMT and NET: 0:15 pm) and dinner time (median all groups: 7:00 pm) were similar in all groups. The DMT group had a significantly shorter interval between dinner and bedtime than the other two groups (median DMT: 2h 00 min, MMT: 3h 30 min, NET: 4h 00 min in men, DMT: 3h 30 min, MMT: 4h 00 min, NET: 4h 30 min in women, respectively, P<0.01). Total energy intake did not indicate significant differences between the three groups for men and women respectively. The interval duration between dinner and bedtime for the DMT group was shorter than for the other two groups and physical activity between dinner and bedtime for this group

was smaller than in the other two groups (mean DMT: 4.2±2.1 METs*h, MMT: 5.5±1.8 METs*h, NET: 7.2±2.1 METs*h, P<0.01). According to Pearson's correlation coefficients, BMI in men was negatively correlated (r = -0.405, P<0.01); however, BMI in women was positively correlated (r=0.196, P<0.05) with physical activity from dinner to bedtime.
CONCLUSION: In conclusion, this study demonstrated that the DMT group with early sleep-wake lifestyle had higher BMI and that a shorter interval duration from dinner to bedtime was associated with increased body fatness in older men, but not in women. Elderly men with DMT should eat dinner earlier and have a longer interval between dinner and bedtime, and old women with NET should have a shorter interval between dinner and bedtime to prevent obesity.

AN EXPERIMENTAL STUDY OF SLEEP QUALITY IN UNIVERSITY ATHLETES - THE EFFECT OF A RELAXATION TRAINING

KOTYSKO, M.1, LITWIC-KAMINSKA, K.2

1: UNIVERSITY OF WARMIA AND MAZURY , 2: KAZIMIERZ WIELKI UNIVERSITY

Introduction: Autogenic training (AT) involves suggestions based on passive concentration of bodily perceptions of heaviness and warmth, which are supposed to induce a state of relaxation. According to Stetter and Kupper's (2002) meta-analysis, it can be stated that AT is an effective method of solving problems with sleep. However, there is a lack of reports related to sportspeople. Thus, the main aim of this research was to evaluate the effect of the AT on sleep quality in a group of university athletes.
Methods: The experiment included 31 university athletes from different sport disciplines (students of physical education who were involved in sport: trained in a sport clubs, under academic sport association or had an individual training routine) with lower sleep quality measured with the Pittsburg Sleep Quality Index - PSQI. The participants were divided into an experimental (EG, n = 16) and a control group (CG, n = 15). The study used the Ecological Momentary Assessment (EMA). During two weeks the actigraphic measurements (with Actiwatch 2) and electronic daily logs (by Android application) were gathered to check the sleep parameters and athletes' daily activity. The EG was supposed to perform a relaxation training every day (based on the AT method), in a form of an audio recording implemented in the Android application. In contrast, the recording used in the CG contained only background music without suggestions. Additionally, two measurements, before and after carrying out relaxation trainings, were made using the PSQI.
Results: Both groups presented similar sleep length measured with actigraphy (EG, *M* = 403.5; CG, *M* = 401.09; *t* = .118, *p* = .907), and mean sleep quality measured by daily log (EG, *M* = 3.57; CG, *M* = 3.63; *t* = -.277, *p* = .784). The significant difference in Pre and Post PSQI results were noted only in the EG (Pre, *M* = 5.56; Post, *M* = 4.56; *t* = 2.74, *p* = .015; *d* = .68).
Discussion: AT is considered effective in improving the subjective quality of sleep, the time needed to fall asleep or the sleep duration (Robinson, Bowden, & Lorenc, 2010). Our study only partially confirms these reports. Athletes after AT declare generally higher sleep quality, but there is no effect on sleep habits. Reasons can be traced in the duration of the training. AT is a long-term process requiring regularity to automate the reactions being practiced. After two weeks only the first effects of the exercises may have occurred.
References: Stetter F, Kupper S. (2002). Appl Psychophysiol Biofeedback, 27(1), 45-98.
Robinson N, Bowden A, Lorenc A. (2010). Eur J Integr Med, 2, 57-62.
Contact: k.litwic@ukw.edu.pl, martyna.kotysko@uwm.edu.pl

EFFECT OF EXERCISE INTENSITY ON SUBSEQUENT NIGHTS SLEEP IN WELL-TRAINED RUNNERS

THOMAS, C., JONES, H., WHITWORTH-TURNER, C., LOUIS, J.

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Observational studies have shown sleep quality in athletes is reduced after training and competition. As such, this period is considered a big obstacle to athletes' recovery, which could hinder future performances. Exercise intensity is one of several factors that may explain this phenomenon. Yet, no research has studied the impact of a single bout of exercise on sleep within a well-trained cohort, making it impossible to discern whether exercise intensity has a positive or negative effect on sleep. This study investigated the effect of exercise intensity on subsequent night's sleep in well-trained runners. We hypothesised high intensity interval running would elicit a greater percentage of slow wave sleep (recovery sleep) compared to a no exercise condition.
METHODS: Two well-trained male runners (age: 25.5±6.4yrs; height: 176.4±2.1cm; weight: 70±5.6kg and VO2 max: 58.5±2.8ml.kg-1.min-1) completed three experimental trials in a randomised, crossover design. Following a standardised afternoon meal (2g CHO.kg-1BM) participants either performed: i) a 1h high intensity interval running session (6x5 min @60% VO2 max interspersed with 6x5 min @90% VO2 max); ii) a 1h low intensity running session (45% VO2 max); iii) no exercise. Exercise sessions were performed at 18.00h prior to a fixed bedtime of 22:30h. Sleep stages were assessed in a temperature controlled laboratory using overnight polysomnography.
RESULTS: The percentage of slow wave sleep was higher ($p < 0.05$) and the percentage of rapid eye movement sleep was lower ($p < 0.05$) than the no exercise condition after high intensity interval running. In addition, total sleep time was increased ($p < 0.05$) and total wake time was reduced ($p < 0.05$) after the high intensity interval running session compared to no exercise. There were no changes in sleep following the low intensity running session.
CONCLUSION: 1h high intensity interval running improves sleep duration and sleep quality over no exercise in well trained runners. It should be considered that poor sleep on the night following a single training session or competition day is not caused by exercise intensity. Future research is warranted to determine if multiple exercise sessions per day, a regime used by many athletes to induce physiological adaptation, leads to sleep disruption.

AN INVESTIGATION OF THE SLEEP AND RECOVERY PRACTICES OF ATHLETES.

DOHERTY, R., MADIGAN, S., WARRINGTON, G., ELLIS, J.

SPORT IRELAND INSTITUTE/LETTERKENNY INSTITUTE OF TECHNOLOGY

INTRODUCTION: Athletes train at high intensity to maintain or improve sport specific physical qualities such as speed, strength, power and technique. Training followed by optimum recovery strategies can induce favourable physiological and psychological adaptations resulting in improved performance. The repetitive demanding nature of a competitive season can test athletes physiological and psychological capacity. Athletes must maintain a balance between stress and recovery and adopt recovery modalities that manage fatigue and enhance recovery. Sleep has been accepted as a primary mode of recovery following both training and competition. Post-exercise recovery is vital for all athletes, the balance between training stress and physical recovery must be managed to maximise the adaptation from, and performance in subsequent training sessions or competition. Sleep has a restorative effect on the immune system and the endocrine system, facilitates the recovery of the nervous and metabolic cost of the waking state and has an integral role in learning,

memory and synaptic plasticity. The classic view of sleep is as a recovery process of both body and brain. It has been hypothesised that sleep, especially slow wave sleep (stages 3-4 of Non Rapid Eye Movement (NREM) sleep) are vital for recovery, due to the relationship between growth hormone release and slow wave sleep.
METHODS: A convenience sample of comprising of athletes (n=338; elite n=115 [male n=74; female n=41] and sub-elite n=223 [male n=129; female n=94]) were recruited from both Ireland and the United Kingdom. The data was collected using an online questionnaire included questions relating to age, gender, sport, phase of season, normal training time and number of hours trained per week and a battery of reliable and valid questionnaires:
• EuroQOL (5-level version): assessment of health state.
• Pittsburgh Sleep Quality Index (PSQI): Subjective sleep quality, sleep latency, sleep duration and habitual sleep efficiency.
• Epworth Sleepiness Scale (ESS): daytime sleepiness.
• Recovery Stress Questionnaire (REST-Q Sport): measured general stress and recovery scales along with sport-specific stress and recovery scales.
• Athlete Morningness/Eveningness Questionnaire (AMES): classification of chronotype.
• Consensus Sleep Dairy – Core (CSD-C): sleep diary.
Participants also completed a three-day food diary (two training/competition days and one rest day). Participants were instructed to record all meals, snacks, supplements and beverages consumed each day.
RESULTS: The data collection period was completed on 31/12/17, preliminary results are currently available and data analysis will be completed prior to the conference. The athletes were at different phases of their season; Preseason (n=88), Competition (n= 180) and Off-Season (n=70). Phase of the season affected sleep duration, quality and recovery-stress balance. Both groups reported poorer sleep quality on competition days compared to rest days. While longer sleep durations were reported on, 'Rest Days' compared to 'Competition Days.' Preliminary analysis has shown training before 8am was associated with a reduction in total sleep time and poorer sleep quality (higher PSQI score). While training during the day (8am-5pm) was associated with better sleep quality.
CONCLUSION: Improving athletes' sleep would enhance the recovery process, which could improve athletic performance and both mental and physical health. The results of this study indicate that there is scope for investigation of functional food based interventions designed to enhance sleep quality and quantity or promote sleep health, training adaptations and/or recovery.

A CROSS-SECTIONAL STUDY TO EXAMINE THE ASSOCIATION BETWEEN SELF-REPORTED SLEEP AND THE FREQUENCY, DURATION AND INTENSITY OF EXERCISE

LITLESKARE, S., VAKTSKJOLD, A., BARENE, S.
INLAND NORWAY UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Insufficient sleep is associated with increased risk of several health concerns. Although physical activity is generally considered to improve sleep, the influence of different levels of exercise frequency, duration and intensity respectively, has not been sufficiently examined to allow specific recommendations to the general population. Therefore, our aim was to evaluate the association between different levels of the three cardinal characteristics of exercise and sleep disturbance.
METHODS: Data were collected through a Norwegian comprehensive self-report survey. A total of 3763 respondents (46 % males) with an average age of 47.9 years (range 15-93) completed the questionnaire. The exercise characteristics were measured on a 6 to 8-item Likert scale. Sleep disturbance was measured on a 4-item Likert scale and then merged into a dichotomous variable ("good sleepers" and "poor sleepers"). Binominal logistic regression was used to calculate odds ratios (OR). Respondents reporting an exercise frequency of "never" were considered sedentary and were used as the reference category. ORs were adjusted for age, gender, alcohol consumption and nicotine use.
RESULTS: Respondents reporting intermediate levels of exercise frequency, duration and intensity, respectively, had a significantly lower occurrence of sleep disturbance compared to respondents with a sedentary lifestyle. No statistical difference in sleep disturbance was observed between respondents performing exercise corresponding to the lowest and highest levels of the three exercise characteristics and those who were sedentary.
CONCLUSION: The lack of positive association between the lowest and highest levels of the cardinal exercise characteristic and reduction in sleep disturbance in the present study support a recommendation of intermediate levels of exercise frequency, duration and intensity for preventing sleep disturbance in the general population.

MIGRAINES IN UNIVERSITY STUDENTS: PREVALENCE, TRIGGERS AND SELF-REPORTED EFFECTS ON EXERCISE

TAMULEVICIUS, N., SHAH, D.M., WADHI, T., AGUADO LOI, C.X., MARTINASEK, M.P.
THE UNIVERSITY OF TAMPA

INTRODUCTION: Migraines, or migraine headaches are a primary headache disorder. The prevalence of migraines in university students globally is approximately 16% <1>. The most common triggers of migraines are stress, lack of sleep, fasting, alcohol or excessive caffeine consumption, cigarette smoking, and hormonal changes in women <2,3>. Of these, stress is one of the highly-observed triggers among migraine sufferers <3>. The aim of this study was to investigate migraine prevalence, triggers and self-report of effects on exercise in university students.
METHODS: 439 university students <20.7 +/- 4.6 y.o.> participated in a cross sectional online survey. The instrument was a 26-close ended questionnaire composed of questions to identify migraine prevalence, trigger factors, impact of migraine in students exercise or daily life, and exercise profile. Headache Impact Test , a validated questionnaire, measured the impact of migraine headaches on functional abilities and daily lifestyle and activities.
RESULTS: Of the participants, 84.7% had self-reported migraine headaches, with stress being the most common trigger factor, followed by lack of sleep, and skipping meals. The mean HIT-6 score was 3.1 +/- 1.2 . About 57.2% of the participants rated a 4 on the impact of daily living, implicating a severe impact according to HIT-6 scoring.
Interestingly, although the majority of participants reported that exercise did not reduce migraine occurrence, 52.9% reported not having migraines within 24 hours post exercise. Our study also found that there was no significant correlation between the type of exercise , physical activity and the prevalence of self-reported migraines which is in line with multiple previous studies <4>.
CONCLUSION: Our study found that migraine headaches are prevalent in university students with stress, lack of sleep and skipping meals as the most common triggers. While most do not believe exercise would reduce the frequency of their migraines, our data suggests that more than half of the students report not having migraines within 24 hours post exercise. Further research is required to directly measure the impact of exercise on migraine through intervention studies for more conclusive evidence.

References:
1. Wang, X. et al. <2015>. The prevalence of migraine in university students: A systematic review and meta-analysis. Eur J Neurol European Journal of Neurology, 23<3>.
2. Karli, N. et al. <2005>. Comparison of pre-headache phases and trigger factors of migraine and episodic tension-type headache: Do they share similar clinical pathophysiology? Cephalalgia, 25<6>.
3. Fukui, P. T. et al. <2008>. Trigger factors in migraine patients. Arq. Neuro-Psiquiatr. Arquivos De Neuro-Psiquiatria, 66<3a>.
4. Ahn A.H. <2013>. Why does increased exercise decrease migraine? Curr Pain Headache Rep., 17<12>.

Mini-Orals

MO-PM23 Children and Youth

RELATINOSHIP BETWEEN MATERNAL HEALTH AND PHYSICAL FITNESS OF THEIR PRESCHOOL CHILDREN

KUNO-MIZUMURA, M., KAWANO, Y., SHIONOYA, Y., YOSHIDA, M.

OCHANOMIZU UNIVERSITY

INTRODUCTION: It is indicated that maternal health would influence children`s health, since previous studies reported that maternal obesity would be associated with their children`s obesity. However, little is known about the relationship between maternal health as an environmental factors for physical fitness of their children especially for preschool children. So the purpose of this study was to investigate maternal both physical and mental symptoms including perceived stress and their relationship with their children`s physical fitness level.
METHODS: Forty-nine mothers and their children aged five-to-six years old participated in this study. All participants lived in urban area of Tokyo, Japan. All mothers completed questionnaire asking their demographics, both physical/mental symptoms and perceived stress scale (PSS) (Cohen et al., 1986) by Japanese version of PSS-10 (Washimi, 2006). For preschool children, physical fitness measures were evaluated by the battery test for preschool children in Japan such as the performance of standing long jump, 25-m run, throwing the soft ball, ball-catching task, repetitive small jumps, sustaining the balance with their arms and sit-and-reach test. Person correlation was used to evaluate the relationship between maternal general symptoms or PSS-10 and physical fitness measures of their children.
RESULTS: Significant and the highest positive correlation between maternal general symptoms and PSS scores (r=0.91) was obtained. Significant positive correlation between maternal general symptoms and only one physical fitness measure of their children that is catching performance. Significant positive correlation was also obtained between maternal PSS-10 and the catching performance of their children. There was no significant correlation between maternal health and maternal age or the number of children they were taking care of.
CONCLUSION: From the results of our study, there was close relationship between general symptoms and perceived stress scale in mother. Previous study had reported that perceived stress would be influence by age for older females aged up to 65 (Osmanovic-Thunstrom et al, 2015). However, for the age group in this study, perceived stress would not relate closely to their age. Significant positive correlation between general symptoms or PSS in mother and the catching performance of their children was only obtained. If mother who suffer from higher general negative symptoms or perceived stress, it would not be easy for them to play with their children for long time or go out during weekends or after kindergarten. To improve catching performance, children need somebody to play a ball with or some places to play with a ball. Maternal health would be one of effective factors for preschool children to improve their motor development such as catching performance.

MOVING WELL-BEING WELL

PEERS, C., BEHAN, S., BELTON, S., ISSARTEL, J.

DUBLIN CITY UNIVERSITY

INTRODUCTION: As appropriate to each individual, physical literacy can be described as a disposition to capitalise on our human capability, wherein the individual has: the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for maintaining purposeful physical activities throughout life. Recent research suggests that Irish adolescents are not displaying the attributes of physical literacy that would see them adopt purposeful physical pursuits as an integral part of their lifestyle (Belton et al, 2014). The objective of this research was to build on previous work by assessing the current level of physical literacy in Irish primary school children (5-13 years).
METHODS: Cross-sectional data on physical literacy constructs (Whitehead, 2010), perception of body figure (Collins, 1990), well-being (KIDSCREEN-27, 2006), and fundamental movement skill proficiency (TGMD-2, Ulrich, 2000) of 958 children (50.6% male, 9.17 ± 2.04 years) were collected. Additionally, physical activity levels (using self and proxy reports, and accelerometers) and anthropometric characteristics were acquired to supplement.
RESULTS: Findings indicate that the majority of children (85%) were not accumulating the minimum 60 minutes of physical activity recommended daily for health, with 77.5% classed as below average or very poor for fundamental movement skill proficiency.
Findings highlight that self-efficacy, intrinsic motivation, and physical ($p < 0.01$) and relational ($p < 0.05$) wellbeing scores were significantly different between low (0-3 days), moderate (3-5 days) and high (5+ days) active participants. Comparison of body image discrepancy scores (Ideal - Self) revealed that children, both male and female, selected figures for Ideal that were significantly thinner than selections for Self ($p < .05$).
CONCLUSION: According to a physical literacy framework the earlier we learn to move competently and confidently, the more likely we are to be motivated to be physically active for life (Whitehead, 2010). Results of this study highlight that a large number of Irish children are insufficiently active to benefit their current and future health (only 15% meeting PA guideline for health). Worryingly this is lower than a slightly older age group (Belton et al, 2014). Given the consistently reported decline in activity with age the need for intervention to address these low levels reported for children is evident.
Consistent with physical activity reviews (Biddle et al 2005; Bauman et al, 2012), analysis of psychological physical literacy constructs reveals an association with physical activity level, this was evident for self-efficacy and motivation. Meanwhile, both active and inactive children had a poor knowledge and understanding of why it is important to value and take responsibility for engagement in physical activities for life. Considering the results, the Moving Well-Being Well physical literacy intervention will target the psychological constructs of physical literacy.

SIX MINUTE WALK DISTANCE: REFERENCE VALUES IN HEALTHY ITALIAN CHILDREN.

CORREALE, L.1, VANDONI, M.1, PUCI, M.1, GALVANI, C.2, CODELLA, R.3, TOGNI, F.4, LA TORRE, A.3, CASOLO, F.2, PASSI, A.5, ORIZIO, C.4, MONTOMOLI, C.1

1UNIVERSITÀ DI PAVIA, 2UNIVERSITÀ CATTOLICA DEL SACRO CUORE DI MILANO, 3UNIVERSITÀ DEGLI STUDI DI MILANO, 4UNIVERSITÀ DI BRESCIA, 5UNIVERSITÀ DELLINSUBRIA.

INTRODUCTION: The 6-minute walk test (6MWT) is a simple assessment tool to evaluate exercise capacity. The result of the test is the distance that a subject can walk at a constant and normal pace within 6 minutes (6MWD) and reflects walking function at a submaximal level (Crapo RO et al., 2002). Use of 6MWT on healthy children has been relevant to assess exercise tolerance (Rostagno C., 2003) and to compare it to pathological conditions (Paridon SM et al.,2006). Our aim was to find reference values for the 6MWT in healthy Italian children.
METHODS: The 6MWT was performed by 5614 children between 6 and 11 years, following the instructions outlined in the ATS guidelines (Crapo RO et al., 2002). Summary statistics are expressed as means and standard deviations or percentages, as appropriate. Age-related percentiles (mean±SD of 3rd, 10th, 25th, 50th, 75th, 90th and 97th centiles) of the 6MWD were developed for males and females. Pearsons correlation coefficients were calculated between 6MWD and demographic data. A multiple linear regression model was assessed to predict expected 6MWT performance. All analyses were conducted using STATA/SE, a p-value of less than 0.05 was considered significant.
RESULTS: Males walked longer distances than females, respectively 598.8±83.9 m vs 592.1±77.6 m (p=0.0016). Values ranged between 513.3±60.4 m for 6 years old children to 656.1±71.6 m for 11. The 50th percentile values resulted in 511 m, 554 m, 603 m, 624 m, 649 m and 670.8 m for boys aged 6 to 11 years old, respectively. Differently, the 50th percentile values resulted in 512 m, 543 m, 597 m, 620 m, 643 m and 655 m for girls aged 6 to 11 years old. A moderate correlation was found between 6MWD and age, weight and height (respectively rho=0.58; 0.32; 0.52; p<0.0001). In regression analysis, we found that age, gender and height were positively related to 6MWD, while weight was negatively related with 6MWD [6MWD=107.91 + 25.02× age (years) +7.52× gender (M) +2.62× height (cm) −2.25× weight (Kg)].
CONCLUSION: Reference values were established for the 6MWT in Italian healthy children. The 6MWD percentiles according to age provided a useful tool in the assessment of capacity in children aged 6-11 years.
REFERENCES: Crapo RO, Casaburi R, Coates AL, et al. ATS statement: Guidelines for the six-minute walk test. Am J Respir Crit Care Med. 2002;166(1):111-117. doi:10.1164/rccm.166/1/111.
Rostagno C, Olivo G, Comeglio M, et al. Prognostic value of 6-minute walk corridor test in patients with mild to moderate heart failure: comparison with other methods of functional evaluation. Eur J Heart Fail. 2003;5(3):247-252. http://www.ncbi.nlm.nih.gov/pubmed/12798821.
Paridon SM, Alpert BS, Boas SR, et al. Clinical Stress Testing in the Pediatric Age Group: A Statement From the American Heart Association Council on Cardiovascular Disease in the Young, Committee on Atherosclerosis, Hypertension, and Obesity in Youth. Circulation. 2006;113(15):1905-1920. doi:10.1161/CIRCULATIONAHA.106.174375.

EFFECTS OF A CONGESTED FIXTURE SCHEDULE ON MUCOSAL IMMUNITY AND INTERNAL LOAD IN YOUTH SOCCER PLAYERS

MORTATTI, A., OLIVEIRA, R., PINTO, J., GALVÃO, N., MOREIRA, A.

FEDERAL UNIVERSITY OF RIO GRANDE DO NORTE

INTRODUCTION: The effects of congested fixture schedules on immune and match load markers of youth players are still relatively unclear (Moreira et al., 2016). Given the importance of extending current knowledge, the aim of this study was to analyse the effects of a congested match schedule on mucosal immunity and internal match load in youth soccer players.
METHODS: Twelve male soccer players (16.6 ± 0.5 yr.; 175 ± 8cm; 65 ± 8kg) volunteered for this study. They completed 4 official matches within a 4 day-period with a 24h recovery interval between the matches. All assessed matches begun at 3:00 p.m. Saliva samples were collected 30 min before the first match (pre-match 1) and 22h post-match four (post-match 4), and tested for salivary immunoglobulin A (SIgA) and salivary flow rate. Internal match load (IML) was determined using the session-RPE method. The players completed the CR-10 scale, 20-25 min after each match; the match strain (MS) and monotony index (MI) were also analyzed. An ANOVA with repeated measures was used to compare the session-RPE and IML for the assessed matches. Bonferronis post hoc was used to locate the differences. Student's t-test was used to compare SIgA concentration and salivary flow rate at the pre-match 1 and post-match 4. Cohens "d" or partial eta squared (η^2) was used to estimate magnitudes of differences. Spearmans correlation coefficient was used to analyze the association between the IML and the MI with the percentage changes in SIgA (ΔSIgA).
RESULTS: There were significant differences in IML across the matches ($F(4.33) = 6.299$, $p < 0.000$, $\eta^2 = 0.66$). A higher IML was observed for match 3 (312±182 AU) compared to match 2 (463±239 AU) and 4 (496±175 AU). SIgA concentration decreased from pre-match 1 (67.88 ± 45.2 pg/ml/min) to post-match 4 (46.18± 34.7 pg/ml/min) ($t(11) = 2.744$ $p = 0.01$, $d = 0.84$), while no change was observed for salivary flow rate (pre and post) ($t(11) = 0.1010$, $p = 0.921$, $d = 0.03$). There was large within-individual correlations between ΔSIgA and MI and MIL ($r = 0.68$: $p<0.05$ and $r = 0.67$: $p<0.05$, respectively).
CONCLUSION: The current findings suggest that young players participating in a congested match schedule may present a decrease in mucosal immunity function that might lead to increased risk of upper respiratory tract infections. In addition, the identification of the internal load variability (MI) as well as the global stress given by the IML may be used as valuable markers for monitoring competition load during congested fixture schedules.

HEART RATE RECOVERY IN YOUNG ATHLETES AFTER MAXIMAL AEROBIC AND ANAEROBIC TESTS

RODRIGUES-FERREIRA, M.A.1,2,3, VENCESBRITO, A.M.1,2,3

1: SPORT SCIENCES SCHOOL OF RIO MAIOR, POLYTECHNIC INSTITUTE OF SANTARÉM , PORTUGAL; 2: LIFE QUALITY RESEARCH CENTRE , PORTUGAL; 3: UIIPS, PORTUGAL

INTRODUCTION: Young athletes regularly perform maximal aerobic and anaerobic efforts during training and competition and it is important to understand how they recover. Heart rate recovery (HRR) is characterized by the parasympathetic reactivation and sympathetic withdrawal by the autonomic nervous system. The aim of this study was to investigate HRR in young athletes after maximal aerobic and anaerobic tests.

METHODS: Twenty-eight pubertal male participated in this study and were divided into 3 groups according to sport practice: 10 footballers (age 14±0.94 yrs., height 171±9.08 cm, weight 62±8.97 kg), 10 swimmers (13.9±1.10 yrs., 168±6.18 cm, 56±10.22 kg), and 8 participants not involved in any regular sport practice but physically active (13.9±1.13 yrs., 168±13.25 cm, 68±16.18 kg). All participants completed two maximal tests: a continuous progressive treadmill protocol where the participants ran until exhaustion (Technogym Runrace Treadmill HC1200, Italy), and the Wingate anaerobic test (Monark 839E, Vansbro, Sweden). The active recovery in the treadmill was set at 3 km·h-1 during 3 min and in the cycloergometer was between 40 to 50 rpm during 3 min. Heart rate (HR) was assessed, during the tests and the recovery phase, using the Polar S 610ws (Finland). HRR was calculated as the rate of decline of HR from end of exercise to rates 1, 2 and 3 min after cessation of maximal aerobic and anaerobic tests (HRR1, HRR2 and HRR3). Normality (Shapiro-Wilks test) and homogeneity (Levene's test) were assumed. A one-way analysis of variance (ANOVA) was used with significant level of $p<0.05$ (SPSS 17.0).
RESULTS: The footballers showed a significantly higher HRR2 (60.6±9.61 vs. 45.9±11.27 b·min-1; p=0.005) and HRR3 (71.7±9.61 vs. 53.4±13.09 b·min-1; p=0.001) after the maximal aerobic test compared with the control group. Swimmers presented a higher HRR3 (63.8±5.98) than the control group, but failed to reach the significant level (p=0.055). During the recovery after the maximal anaerobic test, it was observed a significantly higher HRR3 in swimmers (63.2±7.60 vs. 50.63±11.22 b·min-1; p=0.035) than control group.
CONCLUSION: Maximal HR and HRR1 were not significantly different between groups showing similar recovery between young athletes and pubertal male not involved in any sport practice in the first minute of post-maximal aerobic and anaerobic tests. Although, significantly differences were found between young athletes and control group during the second and third minutes of recovery after maximal aerobic test in footballers and during the third minute after maximal anaerobic test in swimmers. Additionally, the footballers and swimmers tended to present lowest values of HR during the recovery phase showing adaptations of cardiovascular system to aerobic and anaerobic efforts. Further research is needed to assess the HRR in larger samples and in other sports, trying to understand training adaptations in young athletes.

PECULIARITIES OF ADAPTATION TO EXERCISE LOADS IN YOUNG SOCCER PLAYERS

BERDNIKOVA, A.N., TIMOKHINA, V.E., MEKHDIEVA, K.R., ZAKHAROVA, A.V., BLYAKHMAN, F.A.
URAL FEDERAL UNIVERSITY

INTRODUCTION: Taking into consideration multifactor nature of soccer it is affected by various physiological factors. In terms of intensive training schedule it is important to prevent functional reserves reduction and development of sports related pathologies (Urbina E. et al., 2010). The study was focused on investigation of young soccer players' adaptation to exercise loads.
METHODS: Thirty young soccer players born in 2004 (height 158.14±7.87m, weight 46.06±7.40kg), with more than 6 years soccer experience were recruited for the study. Hemodynamics measurements with the use of MARG10-01 ("Microlux", Russia) and exercise testing with gas exchange measurements (RAMP-protocol) with the use of cycle ergometer (Schiller, Switzerland) and metabolic analyzer FitMatePro (COSMED, Italy) (Zakharova A. et al., 2016) were conducted.
RESULTS: All subjects were players of the same team and performed the uniform of the sports training. However, 33% (n=10) of athletes had lowered heart volume (end-diastolic index 89.5±6.92 ml/m2, N>100, stroke volume index 56.1±4.36 ml/m2, N>70). Moreover, in comparison with the main group (n=20), these athletes had significantly higher heart rate at rest (p=0.00003), lower peripheral vascular resistance (p=0.0005), higher resting systolic blood pressure (p=0.03) and resting pulse pressure (p=0.02). Notably, the external parameters of exercise performance had no significant differences with the parameters of the main group. In particular, measured parameters during stress test were as follows: VO2max – 56.3±7.21 ml/kg/min, maximal relative attained power during stress-test – 4.7±0.37 W/kg, maximum heart rate – 186.5±7.37 bpm.
CONCLUSION: Peculiarities of adaptation to physical loads found in some athletes may both serve as a risk factor for the development of cardiovascular pathologies, as well as limit physical working capacity. To prevent adverse consequences, an individual approach to the training process is essential, taking into account age-related features of the development of cardiovascular system and focus on increasing the efficiency of adaptation. Analysis of hemodynamics indices allowed to reveal the internal physiologic features of cardiovascular system of these athletes.
References: Urbina EM., Srinivasan SR., Berenson GS. (2010) Epidemiology of Essential Hypertension in Children: The Bogalusa Heart Study. In: Flynn J., Ingelfinger J., Portman R. (eds) Pediatric Hypertension. Clinical Hypertension and Vascular Diseases, 179-208. Humana Press.
Zakharova A, Mekhdieva K. (2016) Technologies of Effective Training Control in Amateur Triathlon - Non-Invasive Hemodynamic Measurements and Exercise Testing for Accurate Training Prescription. In Proceedings of the 4th International Congress on Sport Sciences Research and Technology Support, 83-88.
Contact varvaratim@yandex.ru

THE IMPACT OF BIOLOGICAL MATURATION IN THE SELECTION OF YOUNG ATHLETES IN DIFFERENT SPORTS

UTCZÁS, K., TRÓZNAI, ZS., SZABÓ, T.
UNIVERSITY OF PHYSICAL EDUCATION

INTRODUCTION: Biological age is an important aspect in the selection of athletes in youth teams and academies. The relationship between biological and chronological age provides information on the rate of maturation or tempo of growth. Starting from early childhood, the more mature children usually have higher chances for selection than the less mature children of the same age. Two of the methods to assess maturity status are the estimation of the morphological age and of the bone age. The former describes the development of several body dimensions, whereas the latter describes the development of the skeleton system. Our aim was to examine the impact of these two methods in the selection pattern of young athletes in different sports.
METHODS: 254 Hungarian boys were measured, aged from 13 to 15 years. The athletes participated in three different sports at an elite level in their respective age group: soccer (N:46), handball (N:59) and basketball (N:49). Morphological age was estimated based on the Mészáros-Mohácsi method (1983). This method estimates the morphological age based on growth charts from body size measures (body weight and body height), and from the body structure indicator (plastic index) by comparing the athlete's maturity to the developmental status of the Hungarian children of the same age. Bone age was determined using a Sunlight BoneAge ultrasonic instrument. Descriptive statistics were analyzed in Statistica 13.2 software.
RESULTS: Both skeletally and morphologically retarded athletes showed the highest frequency among soccer players (on average 10-12 percent). The proportion of skeletally accelerated children increases with age in soccer (from 29 to 53 percent), but their percentage is still lower compared to the other two sports. Besides the highest frequency in morphological maturation in all examined age groups, handball players also demonstrated high frequency (>80 percent) in skeletal maturation as well. Among basketball players, the proportion of

skeletally-developed children increases (from 44 to 90 percent), while the proportion of the morphologically more mature decreases with age (from 28 to 10 percent).
CONCLUSION: The impact of skeletal maturity in the selection of young athletes was more evident in handball and in basketball at the age of 13 years as this was revealed by their high frequencies in both sports. In soccer the effect of skeletal maturity in the selection is demonstrated only after the age of 15 years. Among the three sports, in handball, along the bone development, the morphological development seems also to be an important aspect in the selection. Our results suggest that, although at different ages, but for all three sports, skeletal development has a significant effect in the selection.

Mini-Orals

MO-BN03 Biomechanics of jumping and squatting

THE INFLUENCE OF GLUTEAL ACTIVATION IN LOWER LIMB BIOMECHANICS DURING SINGLE LEG LANDING

LOU, C.W., LEE, H.J.

NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: The injury of lower extremity always occurred in the sports competitions which required the athletes to perform jumping and landing. The gluteal muscle was a key character in sports injury prevention. Therefore, the aim of this study was to investigate if the gluteal activation exercise can improve the landing strategy during single-leg drop landing in females.
METHODS: Three female collegiate recreational athletes have participated in this study. All the participants needed to perform 5 successful trials of 30-cm single leg drop landing before and after five gluteal activation exercises (Bridge, Side-lying hip abduction, Quadruped with contralateral arm/leg lift, Single limb squat, Lateral band walks). One set of 10 repetitions was performed for each exercise. 8 VICON cameras were used to capture the dthree-dimensional motion and surface EMG was used to capture the gluteal maximus and medius muscle activity 100ms before and after the initial contact during each trial. The kinematic data of hip and knee were sampled at 250Hz. EMG signals were sampled at 2000Hz. A two-way mixed-design ANOVA was performed on selected variables.
RESULTS: There were significant differences in muscle activities and the hip and knee ROMs. After gluteal activation exercise, gluteal maximus and medius increased significantly in muscle activity 100ms before and after the initial contact. Biceps femoris and semitendinosis increased significantly in muscle activity only at the time of 100ms before the initial contact. Hip flexion and knee flexion angle were significantly increased at initial contact and at the moment of peak knee flexion. Hip adduction angles were significantly reduced at initial contact and at the moment of peak knee flexion.
CONCLUSION: At the time of 100ms before the initial contact, the gluteal maximus, medius, biceps femoris and semitendinosis had increased their muscle activities. Studies have demonstrated that pre-contraction of lower limb muscle could help to absorb ground impacts and prevent excessive joint ROMs. Gluteal maximus and medius could control the hip flexion, adduction, and internal rotation eccentrically. The increasing of muscle activity indicated that they might improve the neuromuscular control so that it could increase the range of motion during landing. Due to the mechanism of non-contact ACL injury was lesser hip flexion, excessive hip adduction and internal rotation angle during landing, we observed that gluteal activation had increased hip and knee flexion, reduce hip adduction angle during landing, which meant they could utilize more on the muscle instead of the non-contractile soft tissue to absorb the force, so as to reduce the probability of soft tissue injury.

THE EFFECTS OF SHOE WEIGHTS ON LOWER EXTRIMITY LOADINGS DURING LANDINGS

GU, C.

NATIONAL DONG HWA UNIVERSITY

INTRODUCTION: During landing, shoes act as a buffer between feet and contact surfaces to reduce impact forces. Shoe weights have been deemed an important factor (Steinberg, Waddington, Adams, Karin, & Tirosh, 2016). Studies focus mainly on running and confirm a corelation between shoe types and running-related biomechanics and injuries (Cauthon, Langer, & Coniglione, 2013; Miller et al., 2014). Landing,were not discussed as much; this study aims at exploring the relationship between shoe weights and impact forces.
METHODS: Prior to the experiment, participants were notified of the detail of the experiment and signed a consent form.20 minutes before the experiment, participants arrived at the laboratory, put on shoes, and ran on the treadmill for 5 minutes to warm up.After the warm-up drill, participants practiced 5 times to familiarize themselves with the required movements. Ground reaction forces were recorded using Two AMTI force plates and standardized by participants' weights.Platforms of different heights (30cm、40cm、50cm) and shoes of different weights (255g、335g、415g) were selected; therefore, the experiments were conducted under 9 combinations.The analysis was based on two-way ANOVA (α=.05) using data collected from 3 successful jumps for each comnination.
RESULTS: The interaction effects from (platform heights*shoe weights) for dominant and non-dominant legs are insignificant ($p>0.05$). The main effect of platform heights is significant ($p<0.05$) with H30 The interaction effects from (platform heights*shoe weights) for dominant and non-dominant legs are insignificant ($p>0.05$). The main effect of platform heights is significant ($p<0.05$) with H30>H40>H50 (dominant legs H30: 94.04 ± 13.30 ms, H40: 71.32±6.75 ms, H50: 61.12±3.62 ms; non-dominant legs,H30: 93.48±13.14ms, H40:73.37 ±6.25 ms, H50: 63.60±3.80 ms).
CONCLUSION: Lower extrimity loading and injuries have been found linked to platform heights. As the platform heights increase, so do the vertical reaction forces; the higher the platforms the sooner the peak values appear (Wang, Liang, & Wang ,2011) . Our analysis corresponds with conventional wisdom. Furthermore, we have discovered that heavier shoes on non-dominant legs cause peak impact forces to appear sooner, which increase the tension in ACL (Bates et al., 2013). This implies that the risk of injury for non-dominant legs increases with heavier shoes. Non-dominant legs are in nature weaker, which may cause irregular patellar tilt (Kernozek et al., 2005).

THE EFFECTS OF SKIPPING WITH A ROPE AND HOPPING FREQUENCY ON LEG STIFFNESS OF EXPERIENCED ROPE-SKIPPERS AND UNTRAINED SCHOOL CHILDREN

CHENG, K.C.1, LAU, Y.P.1, HA, A.S.1, NG, J.Y.Y.1, KONG, P.W.2

1: THE CHINESE UNIVERSITY OF HONG KONG , 2: NANYANG TECHNOLOGICAL UNIVERSITY,

INTRODUCTION: Rope-skipping as a form of physical activity has shown much health benefits. Previous works on the biomechanics of hopping and jumping has shown that leg stiffness tends to increase with the demands of the jumping task due to increased co-contraction of knee and ankle muscles (Hobara et al. 2007). With higher leg stiffness, individuals can resist the collapse of the lower extremity upon landing and enable the muscles to develop higher force and power at takeoff (Arampatzis et al. 2001). However, having an optimal amount of leg stiffness in various jumping tasks is important because excessive or insufficient leg stiffness may lead to increased risk of developing bony or soft tissue injuries, respectively (Butler et al. 2003). Although hopping-in-place and rope-skipping both involve similar jumping mechanism, it is possible that the presence of a skipping-rope would alter the control of leg muscles, especially for untrained individuals. Therefore, the objective of this study is to investigate how the presence of a skipping rope would alter the control of leg stiffness in experienced rope-skippers and untrained school children.
METHODS: Experienced rope-skippers (>5 years of training and competition experience) and untrained grade 7 to 9 school children aged 11 to 15 were recruited from local schools to participate in this study. All participants were asked to jump two-legged at two different frequencies (1.5Hz and 2.2Hz) with and without a skipping rope on a force plate. Participants were asked to perform 2 trials of 15 jumps for each condition (frequency: fast vs. slow; rope: with vs. without). Using peak vertical ground reaction force measured by the force plate and center of mass displacement measured by a 3D motion capture system, leg stiffness normalized relative to body mass was calculated with the spring-mass model (Hobara et al. 2007). The middle five consecutive hops (6th to 10th hop) were used for data analysis.
RESULTS: Preliminary results with 10 experienced rope-skippers and 10 untrained school children have shown that the presence of rope (rope: 0.304 (0.028) vs. no rope: 0.258 (0.015) kN/m/kg; $p=0.029$) and jumping frequency (fast: 0.332 (0.022) vs. slow: 0.230 (0.020) kN/m/kg; $p<0.001$) had significant main effects on leg stiffness. Moreover, significant group*frequency interaction revealed that experienced rope-skippers were better at maintaining their leg stiffness at different jumping frequency.
CONCLUSION: Experienced rope-skippers may be trained to optimize their leg stiffness to enhance their jumping performance and reduce injury risk.
ACKNOWLEDGEMENT:
The CUHK Direct Grant of Research (4058029).
REFERENCES:
1. Hobara HK, et al. (2007). Neurosci Lett, 418, 55-59.
2. Arampatzis A, et al., (2001). J Electromyogr Kinesiol, 11, 355-364.
3. Butler RJ, et al. (2003). Clin Biomech, 18, 511-517.
CONTACT:
kchengc@cuhk.edu.hk

EFFECT OF COUNTERMOVEMENT DEPTH AT DIFFERENT GROUPS ON MAXIMUM JUMP HEIGHT IN VERTICAL JUMPS

SUZOVIC, D.1, BORISAVLJEVIC, A.1, JARIC, S.1,2

1 FACULTYOF SPORT AND PHYSICAL EDUCATION, 2 DEPARTMENT OF KINESIOLOGY AND APPLIED PHYSIOLOGY AND BIOMECHANICS AND MOVEMENT SCIENCE GRADUATE PROGRAMUNIVERSITY OF DELAWARENEWARKUSA,

INTRODUCTION: When testing maximum vertical jumps, it is typically presumed that the subjects are able to select the movement pattern that maximizes the height of the maximum vertical jump, and to reproduce it over a series of consecutive trials. As a consequence, a possible effect of the countermovement depth (Hdep) on the jump height can be seen by various mechanisms. Some studies have shown that there is a stable form of muscular activation during jump performance, although there are somewhat sensitive to changes in the height depth (Bobbert & van Soest, 2001). Note that muscle length also changes with Hdep and the same applies to the muscle stretch-shortening cycle. All of that can considerably influence the tested muscle power. Namely, when performing CMJ, subjects descend more than at the SJ (Kirby, et al., 2011). The aim of this study was to analyze the relative contributions of the spontaneous Hdep on the jump height.
METHODS: The research involved forty subjects divided into four groups. Two groups consisted of male and female basketball players, while the other two groups consisted of age matched college students and sedentary subjects. All of them performed a set of 12 countermovement jumps without arm swing on a force plate. The sole task was to try to achieve a higher jump height than in the previous attempt. The value of the achieved jump was reported as a feedback to the subjects immediately after each attempt.
RESULTS: Obtained results revealed consistent Hdep and jump height at the basketball male and female groups (31.97±0.72 cm; 57.83±1.82 cm and 40.33±0.70 cm; 23.33±0.66 cm respectively), while other two groups gradually increased Hdep during the set of jumps (from 34.51 to 38.63 and from 30.81 to 35.47 cm; $p\leq0.05$) trying to achieve higher jump height at the next attempt.
CONCLUSION: A regression models revealed a presence of optimum Hdep for maximizing jump height, for basketball players with only small changes of Hdep. The preferred Hdep proved to be optimal for achieving the maximum jump height along the set of attempts. Therefore, it was concluded that although the optimum Hdep should exists, the magnitude of its effect on maximum jump height should be only weak for experienced athletes who use this type of jumps on a daily basis. The less experienced subjects try to achieve a higher jump height by increasing the Hdep. The locomotor apparatus is best shown in everyday activities in the conditions that the person is exposed to for a long period of time and according to which has been adapted (Jaric & Markovic, 2009).
REFERENCES:
Bobbert, M. F. & van Soest, A. J. (2001). Why do people jump the way they do, Exerc Sport Sci Rev, 29 (3), 95, 102.
Jaric, S. & Markovic, G. (2009). Leg muscles design: the maximum dynamic output hypothesis. Med Sci Sports Exerc, 41 (4), 780-787.
Kirby, T. J., McBride, J. M., Haines, T. L. & Dayne, A. M. (2011). Relative net vertical impulse determines jumping performance. J Appl Biomech, 27 (3), 207-214.

LONGITUDINAL CHANGES IN THE QUADRICEPS FEMORIS MUSCLE AND JUMP PERFORMANCE IN JAPANESE ADOLESCENT BOYS

SEKINE, Y.1,2, HOSHIKAWA, S.3, HIROSE, N.2

1: TEIKYO HEISEI UNIVERSITY, 2: WASEDA UNIVERSITY, 3: EDOGAWA UNIVERSITY

INTRODUCTION: The quadriceps femoris muscle (QF) is an important muscle for athletes, because the power generated in the lower extremity is an important factor in athletic performance. The QF head shows varying growth rates related to differing roles or functions in each muscle heads (Sekine and Hirose, 2017). However, it is unclear how to increase the QF and develop jump performance in an individual. This study aimed to examine the longitudinal changes in the QF and jump performance in Japanese adolescent boys based on the age at peak height velocity (APHV).
METHODS: Twenty-five Japanese male adolescent male basketball players (aged 12-15 years) volunteered to participate in this study and were divided into Before PHV (<1 year from PHV, n=6), APHV (within 1 year from PHV, n=7) and After PHV (>1 year from PHV, n=12) according to the predicted APHV calculated with the BTT model (Auxal 3.1). The muscle thicknesses (MTs) of the vastus medialis (VM), rectus femoris (RF), vastus intermedialis (VI), and vastus lateralis (VL) were measured in the dominant leg using real-time ultrasonography. Cross-sectional images were obtained and analysed using a software. The countermovement jump (CMJ) measurement was performed with Vertec equipment. These measurements were performed again at 12 months after the first measurement. The MTs and CMJ were compared among groups and time using the repeated two-way (groups × times) analysis of variance followed by the Bonferroni post hoc test.
RESULTS: Significant interaction was observed for the CMJ ($p=0.002$), and significant increases were recognized in the Before PHV ($p<0.001$) and APHV ($p<0.001$) groups. Significantly increased main effects (time) were recognized for all subdivided QF muscles ($p= 0.05$-0.001). In the Before PHV group, the MT of VM ($p=0.005$), RF ($p=0.02$), and VL ($p=0.02$) increased significantly, which was not seen in the APHV and After PHV groups except for the MT of VM (APHV: $p<0.001$; After PHV: $p=0.01$).
CONCLUSION: The result of notable improvement in jump performance between the Before PHV and APHV groups and the age corresponds with those of a previous study (Philippaerts et al., 2006). The QF may increase in the Before PHV group; however, VM (activated during weight-bearing) was increased in the APHV and After PHV groups. Our results showed that the increasing QF and improvement of jump performance occurs during the moment of peak height velocity.
References:
Philippaerts, R. M., Vaeyens, R., Janssens, M., Van Renterghem, B., Matthys, D., Craen, R., . . . Malina, R. M. (2006). The relationship between peak height velocity and physical performance in youth soccer players. J Sports Sci, 24(3), pp. 221-230. doi:10.1080/02640410500189371
Sekine, Y., & Hirose, N. (2017). Cross-sectional comparison of age-related changes in the quadriceps femoris in Japanese basketball players. Int J Adolesc Med Healthdoi:10.1515/ijamh-2017-0117

KNEE KINEMATICS AND KINETICS IN DIFFERENT LANDING TASKS AND SINGLE-LEGGED SQUATS

KAGAYA, Y.1,2, TSURUIKE, M.2, WATSON, M.M.2

1:SHOWA UNIVERSITY , 2: SAN JOSE STATE UNIVERSITY

INTRODUCTION: Anterior cruciate ligament (ACL) injury is one of the major concerns in women's basketball players. Many researchers have conducted the screening test for ACL injury prevention using double-legged jump tests. We have developed a two-dimensional (2D) screening test using single-legged tasks (Kagaya, 2015). It has yet to identify differences in kinematics and kinetics between the double-legged and the single-legged tasks. The purpose of this study was to investigate the differences between these two tasks.
METHODS: Twelve National Collegiate Athletic Association Division I women's basketball players (age: 18.9 ± 1.4 years, height: 177.2 ± 6.6 cm, weight: 72.1 ± 9.9 kg) agreed to participate in this study. All subjects performed single-legged squats (SLSQ) and three different landing tasks: 1) single-legged drop landings (SLDL), 2) double-legged drop landings (DLDL), 3) double-legged jump-landing for the Landing Error Scoring System (LESS). The SLSQ was performed by bending the knee of the supporting leg to 60 degrees. All the landing tasks were landed on a force plate from a 31-cm height box. In the LESS, the subjects jumped vertically as high as possible immediately after landing on ground. All procedures were recorded using two digital video cameras in the frontal and sagittal plane. Knee flexion and valgus angles were analyzed using 2D video image. Knee joint angles and ground reaction force in each task were compared using repeated-measures analysis of variance and Tukey's test at an alpha level of 5 % ($p < 0.05$).
RESULTS: The mean values of maximum knee valgus angle in DLDL, LESS, SLDL, and SLS were -6.9 ± 6.3, 1.1 ± 7.7, 6.6 ± 5.6, and 11.3 ± 7.6 degrees, respectively. The means of maximum knee flexion angle in each task were 76.2 ± 4.2, 80.1 ± 6.6, 63.1 ± 4.7, and 69.1 ± 3.8 degrees, respectively. The mean values of peak vertical force normalized by body mass in DLDL, LESS and SLDL were 25.3 ± 7.0, 25.3 ± 6.8, 43.2 ± 6.3 N/kg, respectively. No difference in the maximum knee flexion angle and the peak vertical force were observed between DLDL and LESS. However, we observed a significant difference across each of the double-legged tasks and single-legged tasks.
CONCLUSION: This study demonstrated that the single-legged task was larger knee valgus angle and vertical ground reaction force than the double-legged task, although the SLDL produced knee flexion angle smaller than the double-legged task. The results of this study were consistent with the previous report using a three-dimensional motion analysis (Heebner, 2017). It is plausible to suggest that clinicians and researchers consider kinematic and kinetic differences between the double-legged and single-legged tasks when they conduct a screening tests for ACL injury prevention.

THE EFFECTS OF GENDER AND APPROACH SPEED ON LOWER LIMB BIOMECHANICS DURING 90° SIDE CUTTING

XU, Y.L.1, YUAN, P.1, WANG, D.2, CHEN, W.1

1. JIANGSU RESEARCH INSTITUTE OF SPORTS SCIENCE; 2.NANJING UNIVERSITY OF CHINESE MEDICINE

INTRODUCTION: ACL injury often occurs in sports involving deceleration movements such as cutting. Female athletes suffer ACL injury at a 4-6 fold greater injury rate than their male counterparts. Although several mechanisms have been proposed to explain gender disparity in ACL injury rate, biomechanical mechanism has received more attention than the others. It may be attributed to the modifiable nature of this mechanism compared to the others. Previous studies found that gender may affect biomechanical mechanism. Further, biomechanics needed in cutting was also affected by approach speed. Therefore, the purpose of this study was to investigate the effects of gender and approach speed on lower limb biomechanics during cutting.

METHODS: Eleven female (17.45±1.25yrs; 1.79±0.08m; 74±7.40kg) and 12 male (17.33±2.15yrs; 1.91±0.06m; 80.08±6.63kg) young basketball players were recruited to perform 90°side cutting at approach speeds of 3, 4 and 5ms-1. 3D kinematical trajectories were collected using eight-camera motion capture system (Qualisys, Switzerland) at 200Hz. 3D kinetic data were synchronously collected using force platform (Kistler, Switzerland) at 1000Hz. Visual 3D was used to process 3D kinematic and kinetic data. Kinematical trajectories and kinetic data were low pass filtered using 4th order Butterworth filter with cutoff frequency of 12 and 50 Hz, respectively. The repeated measures ANOVA followed by LSD post hoc test was performed for statistical analysis (α=0.05).
RESULTS: Gender significantly affected knee flexion angle at initial contact (p=0.001), peak knee flexion angle (p=0.005) and moment (p=0.002). Specifically, knee flexion angle at initial contact (p<0.05) and peak knee flexion angles (p<0.05) in females were less than males at 3, 4 and 5ms-1, respectively. However, peak knee flexion moments (p<0.05) in females were greater than males at 3, 4 and 5ms-1, respectively.
Approach speed significantly affected peak VGRF (p<0.001), peak knee flexion (p<0.001) and abduction (p<0.001) moments. Specifically, peak VGRF and at 5ms-1 was significantly greater than that at 3ms-1 in females (p=0.011), and peak knee flexion moment at 5ms-1 was significantly greater than that at 3ms-1 in males (p=0.007). Furthermore, peak knee abduction moment at 5ms-1 was significantly greater than the moments at 3 (p<0.001) and 4ms-1 (p=0.001) in males.
CONCLUSION: Gender differences in lower limb kinematics and kinetics might help explain gender disparity in ACL injury rate. Furthermore, ACL injury risk might increase with increasing approach speed. These findings implicated that neuromuscular prevention program should consider the specific effect of gender and movement intensity on lower limb biomechanics.

AN ALTERNATIVE ANALYTICAL APPROACH FOR UNDERSTANDING LANDING STRATEGIES DURING ACL REHABILITATION

STEPHENS, J.M., CHAPMAN, D.W., TATE, K., WARMENHOVEN, J.

AUSTRALIAN CAPITAL TERRITORY ACADEMY OF SPORT

INTRODUCTION: Anterior cruciate ligament (ACL) injuries are a common traumatic athletic injury leading to a lengthy rehabilitation and reducing an athlete's dynamic postural stability. Discrete variables such as time to stabilisation (TTS) following drop landings have been proposed as useful functional measurements for athlete monitoring during the rehabilitation process (DuPrey, 2016). However, it is unclear whether this approach is informative for monitoring and evaluating the complete landing strategy before an athlete returns to competition. The present study sought to explore the possibility of using functional principal components analysis (fPCA) of the vertical ground reaction force (vGRF) during landing as an athlete monitoring tool with the intent of assessing changes representative of the landing strategy of a single athlete post ACL injury.
METHODS: Data from one female netball athlete was used in this case study. This athlete was tested on single left leg drop landing (3 per session) over 6 sessions pre-injury and 3 sessions post-ACL injury, leading to a total of 27 landings. Landings were performed using a step off from a 0.3 m box. vGRF was collected during each landing and cropped to 0.5 s post maximum vGRF. Each vGRF time-series was fitted (n=27) using B-Splines prior to application of fPCA. Each fPC score was further compared to identify differences in landing strategy pre- and post-ACL injury.
RESULTS: Five functional principal components (fPCs) explained 86% of all variation in the original 27 landings, with each fPC describing a different pattern of variation in the landing vGRF. fPC scores for all healthy landings (n=18) were used to build a regression model for healthy landing behaviour. fPC scores for all post-surgery landings (n=9) were tested for deviations from this regression model using concepts taken from magnitude-based inferences (Hopkins, 2017).
CONCLUSION: A modified landing strategy after ACL surgery was identified by fPC4, indicating the presence of higher force following the initial contact peak force and shock absorption phase of the landing. This demonstrated that further evaluation of this athlete was warranted before a return to competition. The use fPCA has the potential to highlight changes in movement strategies that may have occurred post-injury, which conventional discrete variables will not detect.

A SYSTEMATIC AND META-ANALYSIS ON THE EFFECT OF NOVEL KNEE REHABILITATION TECHNIQUES DURING SQUATTING ON ACUTE VASTUS MEDIALIS MUSCLE ACTIVITY IN HEALTHY INDIVIDUALS: IMPLICATIONS FOR PATELLA FEMORAL

ALQASEER, D.1 VALENTIN, S.1 BAKER, J.1 SANDERSON, M.1

UNIVERSITY OF THE WEST OF SCOTLAND .

INTRODUCTION: The imbalance between Vastus Medialis (VM) and Vastus Lateralis (VL) muscle activity is a major cause of PFPS which leads to patellar maltracking by placing anatomical components of the knee joint under strain (Ryan & Rowe, 2006). This imbalance can be addressed by using selective exercises that aim to increase VM muscle activation relative to VL activation. To date there is a lack of evidence relating to novel treatments performed during squatting on VM muscle activation as no extensive meta-analysis has been completed on this topic. The aim of this review was to evaluate which novel rehabilitation techniques increase acute VM muscle activation during squatting. The findings of this review will have fundamental implications for future research and rehabilitation strategies in PFPS patients.
METHODS: This review followed evidence-based PRISMA guidelines. The following electronic databases were searched; CINAHL, PubMed, Science Direct, Web of Science and Medline for; Vastus Medialis, muscle activation and PFPS. Risk of Bias (RoB) was assessed.
RESULTS: A total of 11 repeated measures studies with 16 different novel exercises and a total of 234 participants were included. Whole body vibration (WBV) stimuli showed a positive effect on VM activation in healthy individuals; standard mean effect size (d)=2.50, 95% confidence interval [CI] ([0.72 to 4.28]; p<0.05). Hip adduction and elastic band exercises appeared to have a positive effect on VM activation in PFPS but not healthy populations (d=0.52, 95% CI [0.07 to 0.97]; p<0.05). Squatting on unstable surfaces appears ineffective for VM activation (d=0.24, 95% CI [-0.12 to 0.60]; p>0.05).
CONCLUSION: WBV stimuli appears to have a positive impact on VM muscle activation which is supported by the finding of higher VM activation during rubber platform squatting versus harder surface (Hyong & Ho, 2013). Although VM activation in PFPS patients appears to be higher during combined squat with hip adduction and resistance exercise; these interventions need to be re-evaluated by further research using more robust study designs. In addition, combined interventions appears to be a new recommended approach in PFPS management (Crossley et al., 2016).

This systematic review and meta-analysis provides an insight into novel rehabilitation techniques which aim to increase VM activation during squatting in healthy and PFPS populations. Evaluation of these novel interventions is essential to provide evidence based practice in a clinical setting.
REFERENCES: Crossley KM, van Middelkoop M, Callaghan MJ, Collins NJ, Rathleff MS, Barton CJ (2016). Br J Sports Med. 50 (14), 844–852.
Hyong IH, Ho J (2013). J of physical therapy Sci. 25, 915–917.
Ryan CG, Rowe PJ (2006). Physiother Theory Pract. 22 (6), 309–315.
CONTACT: Dalal.Alqaseer@uws.ac.uk

Mini-Orals

MO-SH06 Sport management , media and spectatorship

RESEARCH ON COMMUNITY SPORT DEVELOPMENT IN CHINA

WANG, Y.

CHINA SPORT INFORMATION CENTER

Introduction: China has entered the decisive stage in building a moderately prosperous society in all respects. Community sport plays an important role in promoting well-rounded human development and all-round social progress in China.
Methods: This paper tries to summarize and analyze the status quo of community sport in China, and come up with some suggestions accordingly. The methods of literature research, expert interviews and comparative analysis are applied in this paper.
Results: The past decades have witnessed huge improvement in community sport development in China. However, there still exist some problems. For example, the development levels among different regions are unbalanced; there is still a lack of fitness building facilities in most communities; the number of professional instructors can't meet the need of community residents, etc.
Discussion: A few suggestions for further enhancing the participation level of community sport in China have been proposed. Firstly, it is better to apply differentiated development strategies to different groups of community residents. Secondly, while the construction of more community sport facilities is needed, the focus of government should be on the provision of comprehensive public services. Thirdly, the role of various levels of social organizations should be given full play. Fourthly, the training of specialized talents should be accelerated to organize more creative community sport events and instruct more community residents.

ANALYSIS OF THE DOPING CONTROL TEST RESULTS IN INDIVIDUAL AND TEAM SPORTS FROM 2003 TO 2016

AGUILAR-NAVARRO, M., MUÑOZ-GUERRA, J., PLATA, M., DEL COSO, J.

CAMILO JOSE CELA UNIVERSITY AND FRANCISCO DE VITORIA UNIVERSITY

INTRODUCTION: Since the creation of the World Anti-Doping Agency (WADA) in 1999, one of the main objectives of the international anti-doping community has been to reduce the gap between the "forces" that act in favour of doping in sports and the procedures employed by the anti-doping authorities to assess the use of prohibited substances and methods.
The prevalence of doping has been assessed in several sports but the information is scarce and the athletes' samples and the methodologies employed to assess the prevalence of doping in each sport preclude an objective comparison among sports disciplines. The aim of the present investigation was to assess the differences in the prevalence of doping among sports by analysing the frequency of adverse/atypical findings reported by WADA accredited laboratories over the course of 14 years.
METHODS: The data included in this investigation have been gathered from the Testing Figures Reports made available annually from 2003 to 2016 by WADA. These Testing Figures Reports can be accessed from the WADA website and they contain information about the number of samples analysed, the percentage of adverse and atypical findings and the most commonly found drugs in urine and blood samples, among other analyses.
RESULTS: A total of 1,132,143 samples were analysed from the individual sports selected for this investigation from 2003 to 2016 with an overall frequency of adverse/atypical findings of 2.0 ± 1.0%. In the team sports examined, the number of samples analysed was 757,011 while the frequency of adverse/atypical findings was significantly lower than in individual sports (1.6 ± 0.6%). Specifically, athletics was the sport with the highest number of samples analysed per year, followed by cycling, aquatics and weightlifting. Cycling, weightlifting, and boxing were the sports with the highest proportion of adverse/ atypical findings.
Football was the team sport with the highest number of samples analysed per year, followed by rugby and basketball. Regarding the percentage of adverse/atypical findings, ice hockey, rugby, and basketball presented a higher proportion.
CONCLUSION: The prevalence in the use of doping substances was not uniform in all sports disciplines from 2003 to 2016 with a higher overall proportion of banned substances found in individual vs. team sports. Furthermore, some specific sports had higher proportions of adverse/atypical findings that suggests a greater prevalence of doping related to their idiosyncrasy rather than other physiological explanations. This information may be valuable for national and international anti-doping organisations to improve the policies used to reduce the prevalence of doping in sports and to detect specific sports with a higher risk of doping misconduct. Specifically, this information could aid in obtaining a more informed athlete population and the implementation of test distribution plans adapted to the sport disciplines that will lead to the establishment of muchmore "intelligent" testing policies.

CLASSIFICATION OF THE NATIONAL FEDERATIONS BY FOCUSING ON THE RELATIONSHIPS WITH THE NATIONAL DISABILITY SPORT ORGANIZATIONS IN JAPAN

AOYAMA, M.1, YAMAGUCHI, Y.2

1: RESEARCH FELLOW OF JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE, KOBE UNIVERSITY , 2: KOBE UNIVERSITY

Introduction: In recent years, the integration between the National Federations (NFs) and the National Disablity Sport Organizations (NDSOs) has been progressing internationally. In Japan, NFs joining both committees of National Olympic Committee (NOC) and National Paralympic Committee (NPC) are only 2 NFs of "All Japan Taekwondo Association" and "Japan Triathlon Union". Besides, the relationships between the rest of NFs and NDSOs are unclear. The purpose of this study was to classify the National Federations by focusing on the relationships with the National Disability Sport Organizations in Japan .

Methods: Data were collected from the archival materials, documents and interviews with the staff members of the eight NFs. Comprehensive content analysis with a triangulation method by two researchers was undertaken.
Results: The main results of this study were as follows. The NFs in Japan were classified into four groups. The first group (28 out of 54 NFs) did not have any corresponding NDSOs on their sports. The second group (22 out of 54 NFs) had corresponding NDSOs. For nine of those, multiple NDSOs (e.g., intellectual, mental and physical disability) were existed. Also, there were 13 NFs with only one NDSOs. The third group (two out of 54 NFs) had intermediate organizations between NFs and multiple NDSOs. "Japan Football Association" and "Japan Swimming Federation" were included in this group. The last group (two out of 54 NFs) consisted of NFs that had already integrated as mentioned above.
Discussion: In Japan, there were many cases that NDSOs were divided by disability types. Before the integration of NFs and NCSOs, it is first required to integrate multiple NCSOs, or it is necessary to place intermediate organizations between NFs and multiple NDSOs. As a result of the interviews, it became clear that the necessity of integration was influenced by the relationship between International Federations (IFs) and International Paralympic Sport Federations (IPSFs). When IFs coexisted with IPSFs, it mattered little if they were divided at NF level. When the IFs had been integrated with IPSFs, several problems occurred at the administrative level. In this case, it may be required to consider the integration with NDSOs even at the NF level. In addition, the Disability Discrimination Act was not enacted in Japan. Prior to hosting the Paralympic Games in UK, Canada and Australia, it was already enacted in those countries (Sasakawa Sports Foundation, 2017). In order to promote the integration and inclusion of the disability sport, enactment of the Disability Discrimination Act is urgently required.
References: Sasakawa Sports Foundation (2017). Investigation on the sport environment for the disabled in UK, Canada, and Australia. Sasakawa Sports Foundation Press, Tokyo.
Contact: 164d201d@stu.kobe-u.ac.jp

THE UNEVEN PROFESSIONALIZATION OF TEAM SPORTS

LÄMSÄ, J.

KIHU - RESEARCH INSTITUTE FOR OLYMPIC SPORTS

Introduction: Modern sport is claimed to reflect the ideas of professionalization, commercialization and commodification, which are in turn reinforced by pressure from mass media. To be professional means both state of art knowledge or skills as well as rational and efficient model of organization. However, professionalization is an uneven process. Not all sports are able to attract resources outside their own participant base needed to even start the professionalization process. Therefore, the aim of this study is to analyze the differences of professionalization processes of four team sports (ice-hockey, football, Finnish baseball, floorball) in Finland.
Methods: The data of this study were gathered by doing structured interviews with five team sport experts and by studying official and unofficial documents from both local level (elite clubs) and national level (national governing Bodies) organizations. The different data sources were not used for triangulation but to gain a more detailed interpretation.
The level professionalization is dependent heavily on the overall resources of the sport. Therefore, the number of professional athletes and coaches, number of paid staff both at the local and at the national were analyzed between year 2001-2017. Secondly, financial resources of different sports and existence of the professional league, and its relation to the broader structure of sport was, studied.
Results: Ice-hockey, with 700 professional players and 260 coaches, is clearly the only advanced professional sport in Finnish context. The annual turnover of 15 league teams was altogether 93 m compared to 17 m of 12 teams in the football league. Finnish baseball has been able to professionalize by being popular on smaller municipalities and not competing directly with the bigger sports.
Conclusion
These results show that the nature of the professionalization processes of four different Finnish team sports is uneven and asynchronous. Only one sport, ice-hockey, is fully professional and have adopted a mixture of the European and American models of organizing professional sport.
References: Dowing M, Edwards J, Washington M. (2014). Sport management review, 17, 520-529
Leeds M.A, von Allmen, P (2015). The Economics of Sports. Routledge; New York.
Contact: jari.lamsa@kihu.fi

HOW DID THE PARALYMPIC GAMES BE IMAGINED IN JAPAN? FROM DISCOURSE ANALYSIS FOCUSING ON MEDIA COVERAGE

WATARI, T.

JUNTENDO UNIVERSITY

1. Background and purpose
In Japan, a lot of people are paying attention to the Paralympic Games in 1964 . So, how did we talk about the Paralympic Games in Japan from the Paralympic Games in 1964 to the present?
In this research, by analyzing text data mainly of newspapers, we will examine how the Paralympic Games have been imagined in Japan. Especially, from the comparison of the social image towards the disability sports at the time and the current, we argue that how Japanese society changed to see the disability sport and the disabled people. And we would like to think about the continuity / disconnection of Japanese history of the disability sport.
2. Method
To analyze the article, we use the KH Coder which is a free software for statistically analyzing text type data. We prepared code for classifying article content and note the collocation (co-occurrence relation) of articles related to the code and words. The target newspapers are the Asahi Shimbun, the Yomiuri Shimbun, the Mainichi Shimbun and other various discourse materials. From the search results of the database, we selected articles related to the disability sports and paralympics. Although the word of Paralympic Games is included in the article, the content itself is not directly related to sports, disability sports and Paralympic Games, excepted from the Analysis.
3. Results: Here we show only what is relevant to the 1964 articles. Around 1964, almost articles are not related to the result of the competition, but the announcement and explanation of the event itself occupies the center. In particular, some articles of disability sports since 1965 tended to be reported in relation to the Imperial family.
Meanwhile, articles of the Paralympic Games in recent years tends to be clearly reported in association with the results of individual players. As a whole, there is also a tendency to be reported in relation to the athletes competitive results, and it can be said that the appearance of other phrases such as the social problem for the athletes with impairments are decreasing.

4. Discussion: Media coverages of the 1964 Tokyo Paralympic Games focused the announcement of the event rather than the competition result. In some articles, it was pointed out that Japans disability welfare efforts were delayed by referring to the situation of foreign players. In around 1964, the articles mainly visualized the existence of Sports event for the disabled. Also, especially during the period from 1965 to the 1980s, articles of disability sports were reported only in relation to the Imperial family.
Recent coverages of the Paralympic Games, for example the coverages of the Rio Paralympic Games in 2016, tend to be focused on the achievement of individual players. On the other hand, social problems such as inclusive society are rarely reported. In other words, it turns out that the Paralympics was understood as an event with news value completely independent from other social phenomena.

Mini-Orals

MO-SH05 Effects of exercise of stress, cognition and health

AN ACUTE BOUT OF EXERCISE DIMINISHES SYSTOLIC BLOOD PRESSURE RESPONSES TO STRESS, BUT INCREASES FEELINGS OF THREAT AND STRESSFULNESS.

GINTY, A.T., TROTMAN, G.P., VELDHUIJZEN VAN ZANTEN, J.J.C.S., WILLIAMS, S.E.

BAYLOR UNIVERSITY; UNIVERSITY OF BIRMINGHAM

INTRODUCTION: Exercise is beneficial for cardiovascular health and managing stress. Research examining the impact of exercise on subsequent cardiovascular and psychological responses to acute psychological stress has produced mixed results. Few studies have simultaneously examined the effects of exercise on both the cardiovascular and psychological responses to the same stress task. The aim of this study was to examine whether exercise prior to acute psychological stress could attenuate blood pressure and negative appraisals of stress.
METHODS: Forty participants (50% female, Mean age = 19.95, SD = 1.93 years) completed three laboratory visits. The first visit assessed participants' VO2 max with an incremental exercise test. The second and third visits were counterbalanced and consisted of either mental stress or exercise and mental stress. The stress only condition consisted of a resting baseline period and standardized mental stress task. During the exercise and stress condition, participants undertook 10 minutes of cycling at 70% of VO2 max, a baseline period followed by the same stress task. Participants' systolic blood pressure was measured at baseline and during the stress task. In each condition, participants also rated how threatening and stressful they found the stress task.
RESULTS: A 2 condition (stress only, stress following exercise) x 2 time (baseline, stress) ANOVA demonstrated that there was a significant main effect for time $F(1, 37) = 48.74$, $p < .001$, $eta2 = .568$, and a significant visit × time interaction for systolic blood pressure, $F(1, 37) = 6.26$, $p = .017$, $eta2 = .145$. Although the mental stress task significantly increased systolic blood pressure in both conditions, the systolic blood pressure response was attenuated in the stress following exercise condition compared to the stress only condition. Paired samples t-tests (stress only, stress following exercise) indicated participants found the stress following exercise condition to be significantly more threatening ($t(39) = -3.63$, $p = .001$) and stressful ($t(39) = -2.89$, $p = .006$) compared to the stress only condition.
CONCLUSION: Exercise prior to stress may be effective in reducing blood pressure responses to stress which may have cardiovascular health benefits. However, exercise prior to stress may be detrimental to the psychological interpretations of the stressor.

TASK DIFFICULTY OF COMPLEX FULL-BODY EXERCISE AFFECTS ON A PATTERN OF COGNITIVE NEURAL ACTIVATION

KIMURA, K., OKA, F.

TOKYO DENKI UNIVERSITY

INTRODUCTION: Recently, physical exercise has been focused on as being beneficial for maintaining and improving cognitive function. These reports suggested that the unique aspects of task complexity with regard to sports such as dance, tai-chi, ball sports, etc., effectively facilitate neuronal networks responsible for cognitive behavior. The present study was conducted to demonstrate the correlation between task difficulty of a full-body action and neuro-cognitive activation by having participants observe and mentally rehearse a full-body dance performance.
METHODS: Functional magnetic resonance imaging (fMRI) was employed to identify the cognitive neural activation while participants were observing a pre-recorded movie of a dance performance. The participants were asked to observe and mentally rehearse the instructors full-body dance choreographs while watching the video. Immediately after the MRI assessments, participants took part in the dance performance to test if they could correctly follow the instructor's performance. Thus, to determine the task difficulty of each participant's body movements, temporal or special errors of dance steps were counted during the sequence of the dance performance, which was the same dance they while undergoing MRI scanning. We concluded that the lower the difficulty of the dance choreographs, the fewer was number of errors occurred in step sequence, and vice versa. The present study demonstrated that neuro-cognitive activation from mental rehearsing of dance could be accentuated according to the difficulty of the dance task.
RESULTS: In the results, the following areas were activated during observation of the dance: the premotor and supplementary motor cortices, the cingulate gyrus, and the inferior parietal cortices. However, unique correlations were detected between neural activation and task difficulty in those brain regions. Positive correlations were recognized in prefrontal area and anterior cingulate gyrus. While, negative correlations were detected in parietal and temporal areas.
CONCLUSION: The results showed that observing dance performance activated the executive-cognitive network associated with complex dance movements. Moreover, individual difficulty of the dance task might affect the pattern of the neuronal activation within those areas. Notably, the frontal network was utilized more by decreasing the difficulty of the dance task, suggesting that the neural resources could be available for creation/preparation of motor actions. Because the parietal and temporal networks were utilized more for increased dance difficulty, this may suggest that the neural resources would be supplied more with analysis/understanding of dance contents.

TIMING OF ACUTE MODERATE INTENSITY EXERCISE EFFECTS CORRECT BUT NOT FALSE REMEMBERING

MARCHANT, D.1, ELLISON, P.1, CRONIN, L.1, THORLEY, C.2

1: EDGE HILL UNIVERSITY , 2: JAMES COOK UNIVERSITY

INTRODUCTION: Physical exercise can benefit cognitive function, yet research assessing the effects of acute exercise on memory processes is inconsistent. The present study examined how the timing of acute moderate intensity aerobic exercise impacts delayed recall.

The Deese-Roediger-McDermott (DRM) paradigm was used, which examines veridical and false memory through encoding lists of semantically related words associated with a non-presented 'critical lure'. These lures are typically later remembered as frequently as studied words. The aim of this study was to assess the effects of a single bout of moderate intensity exercise performed prior to or after information encoding on long term memory.
METHODS: In a between-subjects design, sixty healthy and regularly active young adults (mean age =19.4 ± 1.1 years; weight = 71.2 ± 11kg; height = 173±8cm; resting HR = 74±10.5bpm-1) were randomly allocated to one of three conditions: Quiet rest prior to encoding (Rest), Exercise pre encoding (ExPre), and Exercise post encoding (ExPost). Exercise was 30 minutes of self-regulated moderate intensity stationary cycling (RPE = 13-15, HRR = 50-60%), whilst quiet rest involved seated reading. Participants studied six neutral DRM word lists. Retention was assessed using free recall and recognition tests one week later. Encoding was completed immediately prior to (ExPre) or post (ExProst) exercise or rest (Rest). Ratings of perceived exertion (RPE), affect and heart rate were measured at 2 minute intervals.
RESULTS: HR and RPE data indicated exercise was undertaken at the intended intensity. Affective valance was positive during exercise. No significant differences were observed in any immediate recall variables. At one-week delayed recall, total correct words recalled was significantly ($p<0.05$) greater for ExPre compared to ExPost and Rest. No differences were found in total critical lures and total errors recalled between each condition. No differences in recognition rates were observed one week later.
CONCLUSION: Performing moderate intensity cycling prior to encoding facilitated encoding processes, by improving the volume of studied information correctly recalled. There were no differences in false memory generation across conditions, suggesting that exercise induced arousal facilitated verbatim memory traces rather than gist-based processing that would promote misinformation effects. This beneficial effect may be associated with the effects of acute exercise on supporting attentional processes and allocation.

THE RELATIONSHIP BETWEEN THE DIFFERENCE OF PLAYING STYLES AND THE COGNITIVE FUNCTIONS IN TENNIS PLAYERS

TOCHIGI, Y., SUGAWARA, Y., HAMASAKI, A., SATO, T., MOMMA, R., PARK, J.Y., TANAHASHI, K., TAKAHASHI, A., MAEDA, S.
UNIVERSITY OF TSUKUBA

INTRODUCTION: Cognitive functions are very important for tennis players as well as technique, physical strength, and so on (Ishihara T. et al, 2016). Several studies showed that the levels of tennis involve in the cognitive functions (Mosoi A.A. et al, 2014). However, the relationship between playing styles of tennis and cognitive functions remains unclear. We classified playing styles into the three groups: baseline-style, net-style, and combination-style, and into the two ones: offensive-style and defensive-style. Then, we investigated whether the differences of the playing styles are related to the cognitive functions.
METHODS: Subjects were collegiate athletes (male=20, female=15), who practiced tennis more than five days a week. The cognitive functions evaluated the reaction time and the interference time to problems using the Stroop test (Samuel J.E.L. et al, 2012), the Spatial Working memory task (Aoki R. et al, 2011), and the Trail Making Test (Tom N.T., 2004). The Stroop test was consisted by four difficulty levels and employed to evaluate attention and information processing speed (MacLeod C.M. et al, 2000). Working memory was important for reasoning and the guidance of decision-making and behavior. The Trail Making Test provides information on visual search, scanning, speed of processing, mental flexibility, and executive functions (Tom N.T., 2004). Subjects answered each problem as fast as possible after they practiced to answer the problems enough. The playing styles of tennis classified using the questionnaire (Yamada Y. et al, 1989).
RESULTS: In the groups of net-style and combination-style, the reaction time of the Spatial Working memory task was significantly faster than in the baseline-style group ($P < 0.05$). When we classified playing styles into the groups of offensive-style and defensive-style, the reaction times of the Spatial Working memory task and the Stroop task relating to the offensive-style were faster than the other one ($P < 0.05$). In the reaction time of the Trail Making Test, there was no significantly difference among all groups.
CONCLUSION: We found that the difference of net-baseline styles and offensive-defensive styles are related to the cognitive function. The result of this study suggests that the tennis players of net-style and combination-style are superior in reasoning and the guidance of decision-making and behavior. Furthermore, we suggest that the offensive-style tennis players are superior in attention and information processing speed, reasoning and the guidance of decision-making, and behavior.

DOES THE SPEEDCOURT REALLY ASSESS REACTIVE AGILITY? RELATIONSHIP BETWEEN OPEN AND CLOSED SKILL MOVEMENTS

RAEDER, C., PRAETORIUS, A., OHMANN, T., SCHOEPP, C.
BG KLINIKUM DUISBURG

INTRODUCTION: The SpeedCourt (SC) has been introduced as a tool for assessing reactive agility since it is composed of change of direction (COD) movements in response to a visual stimulus. Due to the perceptual-cognitive processes during the unplanned COD actions, which can be considered an open skill, one would generally not expect strong associations of these SC agility variables with closed skill performance measures such as jumping or sprinting (preplanned movements). To test this assumption, this study investigated the relationship between SC performance variables and several markers of jump, sprint and COD ability.
METHODS: Using a cross-sectional design, 24 male junior and senior handball players of the 3rd German division (mean±SD; age: 21.1±4.5 yrs) volunteered to participate in this study. The players first conducted two linear sprints followed by two 180° COD sprints turning with either the right or left leg, using a modified version of the 505 test (mod505). The 5m sprint (SP5), 10m sprint (SP10) and mod505 times as well as the COD deficit (mod505-SP5) were collected. Due to organizational constraints, the subjects were then split into two groups. One group performed jump tests including three countermovement jumps (CMJ [height]), 15s multiple rebound jumps (MRJ) using ground contact time (MRJ-GCT) and jump height (MRJ-JH) of the five best reactive strength indices (MRJ-RSI), as well as three bilateral horizontal hops (HOP [distance]). The other group conducted nine consecutive SC protocols with a work-to-rest ratio of approximately 1:3 (~12-15:45s) consisting of about ten multidirectional CODs over a distance of 30m in random fashion. The SC performance variables measured included total time (SC-TT) and time to change direction (SC-TCD). Thereafter, the tests were changed for both groups. For all measurements, the mean was taken for analysis. In mod505, the data were pooled for the right and left leg. All measurements were preceded by a standardized dynamic warm-up followed by sufficient familiarization trials.
RESULTS: The Pearson correlation revealed small to large relationships of SC-TT with CMJ (-.39; 90% CI: -.66, -.03), MRJ-JH (-.41; -.68, -.08), MRJ-GCT (.18; -.20, .51), MRJ-RSI (-.43; -.68, -.08), HOP (-.36; -.64, .00), SP5 (.59; .29, .78), SP10 (.58; .28, .78), mod505 (.29; -.08, .59), and COD deficit (-.26; -.57, .11). There were moderate correlations of SC-TCD with mod505 (.35; -.02, .63) and COD deficit (.32; -.05, .61), while the other measures showed trivial to small associations with SC-TCD (-.19–.20).

CONCLUSION: Most of the closed skill measures showed a small to moderate relationship with SC performance variables. This may indicate the presence of additional required qualities like cognitive stimulus processing probably affecting SC performance. However, linear sprinting seems to have a large contribution to SC performance which may be related to the slight technical delay of the visual stimulus that likely impair the proper assessment of reactive agility.

EFFECT OF COMBINED AEROBIC AND ANAEROBIC EXERCISE TRAINING ON PSYCHO-BEHAVIORAL CHARACTERISTICS IN BINGE EATING DISORDER

GALASSO, L.1, MONTARULI, A.1,2, BRUNO, E.1,3, CALOGIURI, G.4, MULÈ, A.1, CASTELLI, L.1, CAUMO, A.1, ROVEDA, E.1,2, ESPOSITO, F.1,2

1:UNIVERSITY OF MILAN, MILAN, ITALY; 4: INN UNIVERSITY, ELVERUM, NORWAY

INTRODUCTION: Eating disorders are the most common psychological and physical diseases for young women (Hudson et al., 2007). According to the DSM-5, Binge Eating Disorder (BED) is characterized by frequent and persistent episodes of binge eating followed by a loss of control and marked distress in the absence of regular compensatory behaviors (Galasso et al., 2017).
The aim of this study was to investigate the effects of an exercise training intervention on anthropometric and psychological characteristics, aerobic capacity, and muscle strength in BED patients compared to traditional treatment alone.
METHODS: Twenty participants with diagnosis of BED were recruited from the Department of Clinical Neurosciences at IRCCS San Raffaele Turro in Milan, Italy, and were randomized into a treatment and a control groups. All patients kept their individual weekly multidisciplinary therapy during the study, consisting in traditional BED treatment and nutritional program. Psycho-behavioral characteristics (i.e. amount of binges), anthropometric parameters (body mass and BMI), and exercise capacity (6MWT and Squat Test) were assessed before (PRE) and after (POST) six months of intervention, consisting in a combination of aerobic and anaerobic exercises (CAAET) in addition to the traditional therapy (CAAET group), or a same period with only traditional therapy (CTRL group).
RESULTS: In PRE, the groups resulted homogeneous and there were no statistically significant differences for all variables analyzed. In POST, the CAAET group obtained a significant decrease in the amount of binges, in body mass and BMI, accompanied by an increase in 6MWT and Squat Test. A delta analysis showed that these changes in women of CAAET group were significantly larger than the one observed in the CTRL group, except for the exercise capacity.
CONCLUSION: Our study shows that patients attending a CAAET treatment, in addition to a traditional therapy only, obtain higher improvements in psycho-behavioral sphere. This suggests that the addition of combined exercise training to the traditional BED treatment can generate beneficial effects in obese individuals with BED. The incorporation of exercise training intervention is proposed to be a valuable addition for effective treatment in BED.
REFERENCES: Galasso L et al. (2017). Sport Sciences for Health. Article in Press.
Hudson JI et al. (2007). Biological Psychiatry 61:348-358.
CONTACT: Letizia.Galasso@unimi.it

A META-ANALYSIS ON NEUROMUSCULAR VS. AEROBIC EXERCISE TRAINING ON DEPRESSIVE SYMPTOMS

NEBIKER, L., LICHTENSTEIN, E., MINGHETTI, A., ZAHNER, L., GERBER, M., FAUDE, O., DONATH, L.

UNIVERSITY OF BASLE

INTRODUCTION: The NICE guidelines recommend exercise training as a beneficial treatment strategy for depression (NICE, 2013). Previous meta-analytical reviews mainly examined the effect of aerobic exercise on depressive symptoms. Our meta- analysis aimed to a) compare aerobic exercise with neuromuscular exercise training, b) conduct sensitivity analyses reflecting on study quality and c) investigate the influence of relevant training prescriptors such as exercise duration, frequency, intensity and number of exercise sessions (volume) in a meta-regression analysis.
METHODS: A structured literature search along the PRISMA guidelines was conducted in biomedical and psychological databases with a selected search term related to exercise and depression. (Randomized) controlled trials that compared supervised neuromuscular or endurance exercise interventions with an inactive control group (CON) in clinically depressed adults over 18 years were included.
Study quality was evaluated with PEDro scale and standardised mean differences (SMD) were calculated with the adjusted Hedges'g equation as main outcome for the comparison of endurance and neuromuscular exercise interventions vs. CON. Statistical analyses were conducted using random effects inverse-variance model. Multivariate meta-regression analysis was performed in order to examine the modulating effects of exercise training prescriptors on effect sizes.
RESULTS: In total, 25 trials of good study quality (mean PEDro score 6.6) comprising 1'340 participants were analysed. Irrespective of the exercise mode and study quality, large effects in favor of exercise compared to CON were found (SMD: -0.97 (90% CI: -1.26, -0.67); $p < 0.001$, $I2 = 83\%$). Compared to CON, sensitivity analyses revealed a large effect in favor of endurance exercise (SMD: -0.83 (90% CI: -1.24, -0.42; $p < 0.001$, $I2 = 85\%$) and a very large effect size in favor of neuromuscular exercise (SMD: -1.14 (90 CI: -1.57, -0.72); $p < 0.001$, $I2 = 80\%$). These effects decreased to moderate effects for endurance (SMD: -0.52 (90% CI: -0,85 -0.19) and remained large for neuromuscular trial (SMD: -1.19 (90% CI: -1.13, -0.52) when considering studies of high quality (PEDro-score: •6), indicating a significant difference (p=0.03). Multivariate meta- regression revealed that exercise duration in endurance trials and exercise intensity in neuromuscular trials had a significantly moderating effect on the effect sizes.
CONCLUSION: Physical exercise interventions are generally a very effective treatment for depression. Neuromuscular exercise interventions seem to be more effective than endurance exercise interventions, particularly in studies with higher study quality. Interestingly, exercise duration and exercise intensity moderated the effect size meaningfully. This result might be used on exercise in depression to increase efficacy.
References: 1) NICE, 2013. Depression: The Treatment and Management of Depression in Adults (NICE Clinical Guideline 90).

BIGOREXIA SYMPTOMS AFFECT SELECTION OF MEAL PARTNER

DEVRIM, A., BILGIC, P.

ISTANBUL MEDENIYET UNIVERSITY

INTRODUCTION: Bigorexia (muscle dysmorphia) is a psychologic disorder that primarily effects male bodybuilders (Mosley, 2009). Some studies have found that bodybuilders with bigorexia have strict eating rules to gain more muscle (Murray & Touyz, 2013; Strother, Lemberg, Stanford, & Turberville, 2012; Suffolk, Dovey, Goodwin, & Meyer, 2013). Therefore, this strict rules have a negative impact on eating

habits and caused disordered eating behaviors (Jones & Morgan, 2010). This study aimed to determine whether bigorexia symptoms affects selection of meal partner.
METHODS: One hundred twenty bodybuilders (mean age 31.05 ± 10.60) included in this study. Muscle Dysmorphia Disorder Inventory (MDDI) was used to detect bigorexia symptoms. >39.0 of the MDDI scores mean that the bodybuilders have bigorexia symptoms. Self-administered questionnaire was applied to determine selection of eating partner. Questions concerning their selection of meal partner is included to determine if they prefer eating with friends, or eating with all family, or eating with only their partner, or eating with only children, or eating alone. Data taken the study was evaluated by IBM SPSS 23.0.
RESULTS: In this study it was found that % 58.3 of the bodybuilders have bigorexia symptoms (mean MDDI scores 41.0 ± 2.9). Bodybuilders with bigorexia commonly preferred to eat alone (%65.7), while the others commonly preferred to eat with all family together (%42.0). The differences between selected meal partner according to the presence of bigorexia were statistically significant ($p<0.05$). %78.2 of the bodybuilders with bigorexia stated that they prepared their own meals when they asked why they prefer eating alone.
CONCLUSION: Bigorexia causes some disordered eating habits (Jones & Morgan, 2010). Therefore, selection of meal partner were affected by bigorexia symptoms. Both in eating disorders and bigorexia, patients having one of the disorders chose to eat alone and prefer social isolation. Determining whom they eat with could be a diagnostic tool for both in bigorexia and eating disorders.

RELATIONSHIP BETWEEN LIFESTYLE AND SELF-PERCEPTION OF PHYSICAL FITNESS IN RUGBY PLAYERS IN COLOMBIA: FINAL RESULTS.

MARTÍNEZ-RUEDA, R., GUTÍERREZ-GALVIS, A., HERNÁNDEZ CUBILLOS, V., SÁNCHEZ MENDOZA, N., LOZADA BELTRÁN, N.
UNIVERSIDAD MANUELA BELTRAN

INTRODUCTION: Self-perception and lifestyle may be considered as a significant determinant on athletes´ performance. The last years we have focused on study these aspects in Colombian Rugby players, final results are finally presented. The aim of this study was to identifiy the relationship between lifestyle and self-perception of phyisical fitness in Rugby players in Colombia.
METHODS: The FANTASTIC questionnaire (Ramírez-Vélez, R. & Agredo, R., 2012) and the International Fitness Scale, IFIS (Español-Moya, M. & Ramírez-Vélez, R., 2014) were applied to assess lifestyle and self-perception of physical fitness to Rugby players in 7 cities in Colombia. Statistical analysis was performed through central tendency measures, standard deviation, t-student and Chi- Square.
RESULTS: 479 players were surveyed. The age average was 25 (±4,4) years. According to the position on the field, 54% were Backs and 46% Forwards; 68% of the athletes were men. In relation to Lifestyle, the mean of total score was 75.3 (±10,2) classifiying it as "Good"; significant differences were found by position in Nutricion (p= 0,000), Alcohol (0,045), Tobacco toxis (0,033) and the total score of the questionnaire (0,004). Regarding to self-pereception, most of the players perceived their physical fitness and its components as "Good", except Flexibility, which was perceived as "Average". Differences between position were found in Cardiorresspiratory endurance (p=0,015), Strength (p=0,000) and Speed (p=0,001). Differences by sex were also found in Cardiorrespiratory endurance (p=0,001). When total scores of FANTASTIC were contrasted with the IFIS results´, a significant relationship between higher scores of lifestyle and better self-perception of cardiorrespiratory endurance (p=0,000) was found.
CONCLUSION: Our results are consistent with previous studies (F. Chague et al., 2017; Martínez Rueda et al. 2016). It highlights the fact of finding a relationship between better scores of the FANTASTIC and self-perception of Cardiorespiratory Fitness. The differences by position might be explained by the particular characteristics of each pack. Further studies that allow associating these results with the assessment of physical fitness of the players are recommended.
References: Español-Moya, M., & Ramírez-Vélez, R. (2014). Revista Española de Salud Pública, 88(2), 271-278.
F. Chague M. Zeller J. Petit C. Guenancia P. Aviat Y. Laurent A. et al. (2017). European Heart Journal, Volume 38, Issue suppl_1, 512-513
Ramírez-Vélez, R. & Agredo, R. (2012). Revista de Salud Pública, 14(2), 226-237.
Rosmary Martínez Rueda; Adriana R. Guíerrez Galvis; Laura L. Alba Parra (2016). Medicine & Science in Sports & Exercise. 48(5S):278
Contact: rosmaru78@hotmail.com

12:45 - 13:45

Conventional Print Poster

CP-PM13 Soccer and football

AEROBIC FITNESS LEVELS AND MOVEMENT CHARACTERISTICS IN ELITE GAELIC FOOTBALL AND HURLING REFEREES

BRADY, A.J., DURKAN, E., MCDERMOTT, C.M., HURLEY, N., HAYES, C., MOYNA, N.M.
DUBLIN CITY UNIVERSITY

INTRODUCTION: Field-based testing has consistently been incorporated as part of the referee match selection criteria by governing bodies of sport. Numerous field-based tests have been developed with The Yo-Yo Intermittent Recovery Test Level 1 (YIRT1) being the most extensively researched due to its specificity and practicality. The YIRT1 is also the most commonly used test to assess cardiovascular fitness in invasion team sports. No published studies have examined the effectiveness of the YIRT1 as a measure of aerobic capacity in elite Gaelic Football referees (GFR) or hurling referees (HLR) despite it being a part of the GAA selection criteria. The purpose of this study was to investigate the relation between performance in the YIRT1 and both VO2 max and selected movement characteristics during competitive match-play in elite GF and HL referees.
METHODS: A total of 17 elite GFR and 13 elite HLR with a mean (± SD) age of 40.6 ± 4.1 and 40.7 ± 3.8 years respectively, participated in the study. Each participant completed a VO2 max test and the YIRT1 prior to the commencement of the 2016/2017 senior All-Ireland Gaelic Football and Hurling championships. Participants wore a 10-Hz GPS unit (STATSportsTM) during each game they officiated. A total of 52 full game data sets (36 GF and 16 HL) were recorded. The movement variables measured were total distance (TD) in metres, relative distance (RD) in m.min-1, walking (0.0–6.5 km.h-1), jogging (6.6–12.0 km.h-1), low intensity running (LIR; 12.1–15.0 km.h-1), moderate intensity running (MIR; 15.1–18.0 km.h-1), high intensity running (HIR>18 km.h-1), sprints (>18km.h-1 for ≥1 s) and maximum speed (MS) in km.h-1.
RESULTS: There was no significant difference in VO2 max between GFR (57.4 ± 6.3 ml.kg.min-1) and HLR (54.2 ± 5.7 ml.kg.min-1). Distance covered in the YIRT1 was not significantly different between GFR (1675.3 ± 215.4 m) and HLR (1590.8 ± 243.4 m). There was a significant

correlation between the YIRT1 distance and VO2 max in HLR ($r = 0.81$, $p < 0.001$) and GFR ($r = 0.71$, $p < 0.001$). There was no significant correlation between performance in the YIRT1 or the VO2 max and TD for GFR or HLR. Performance in the YIRT1 was significantly related to HIR in HLR ($r = 0.62$, $p < 0.01$) and GFR ($r = 0.41$, $p < 0.01$). There was also a significant correlation between performance in the YIRT1 and sprints in HLR ($r = 0.66$, $p < 0.01$) and GFR ($r = 0.50$, $p < 0.001$). VO2 max was significantly related to HIR ($r = 0.45$, $p < 0.01$) and sprints ($r = 0.50$, $p = 0.001$) in GFR. There was no significant relation between VO2 max and any of the measured movement characteristics in HLR.
CONCLUSION: Elite GFR and HLR have above average aerobic capacity. YIRT1 distance is related to VO2max and to HIR and sprint performance but not TD in elite GFR and HLR.

ISOMETRIC STRENGTH OF KNEE FLEXORS AND EXTENSORS WITH RELATION TO SOMATIC PARAMETERS OF MALE FOOTBALL PLAYERS UNDER 15 YEARS OLD.

PELLA, M.

PALACKY UNIVERSITY OLOMOUC

INTRODUCTION: Panteleimon (2012) proved strong correlation between age, body size and isometric strength (IS) for young male footballers. Thus, the body size and age could be predictors of isometric strength. McGuigan and Winchester (2008) verify that some type of isometric contraction is an efficient method for dynamic strength indication. But Thomas et al. (2015) proved there are no correlation in jump height and isometric strength. Nevertheless, none of them provided tests unilaterally for main flexors and extensors of knee in the same group in relation to their body composition change after a period and in relation to CMJ and SJ parameters. The aim of the study was to compare one sample of footballers after a half year of their active lives and to trace how isometric (unilateral knee flexion and extension) and dynamic (counter-movement jump CMJ, and squat jump SJ) strength of knee react to somatic parameters changes in time. The study has a long-term character.
METHODS: A total of 15 male footballer (13,9±1 y) performed unilateral IS test with 5530 leg extension/curl rehab machine and dynamometer Performance Recorder unit. Dynamic contraction was recorded by Force Platform (all HUR, Finland). However, firstly lower limb dominance was tested using three standard functional limb dominancy tests (step up, step after pushing of the body, and ball kick test). A dominant limb scored in at least 2 tests. Software Statistica 13 and its tests was used (Shapiro-Wilk test for normality verification, paired t-test for normal distributed data and Wilcoxon signed ranks test for other data. The variables comparison was performed by the Spearman´s test and Pearsons test for found correlations). Retesting was performed after 6 months later. Preset significance level was used.
RESULTS: Significant increases during the 6 months were expressed for IS of hamstring (0.23±0.32), weight (3±1.17), height (2.94±1.43), fat free mass (2.67±1.36), skeletal muscle mass (1.62±0.83), fat free mass of dominant lower limb (0.63±0.25) and of non-dominant (0.61±0.28), SJ (2.58±3.12), max power SJ (241.42±244.20), CMJ (2.50±8.67).
CONCLUSION: The process of growing up and getting massive (especially muscle gaining) was the main reason (strong correlation) of an increase in the IS, maximum power for the CMJ, SJ and height of CMJ and SJ. However, the correlation between IS and height of CMJ and SJ were not proved. The limit of the study is absence of bilateral hamstring and quadriceps isometric strength data for statistics. The sums of the unilateral measures could not be used due to bilateral strength deficit (Teixeira et al., 2013).
References:
Panteleimon, N. (2012). Fac Universi: Seri Physic Ed Sport, 10(3), 231-241.
Christopher, T., Jones, A. P., Rothwell, J., Comfort, P., Chiang, Y. Chieh. (2015). J Streng Condit Res, 29(8), 2176-2184.
McGuigan, R. Michael., Winchester, B. D. (2008). J Sport Sci Med, 7(1), 101-105.
Texeira, C. L. A., Narciso, A. C. J., Salomao, T. I., Dias, C. M. R. (2013). J Exer Physio. 16(1), 28-35.

PLAYERS' TECHNICAL PERFORMANCE PROFILES AND TECHNICAL VARIATION IN THE CHINESE FOOTBALL SUPER LEAGUE DURING 2015 TO 2017 SEASON

YI, Q., GÓMEZ, M.A., GONG, B.N., GAI, Y., CUI, Y.X.

FACULTY OF PHYSICAL ACTIVITY AND SPORT SCIENCES, POLYTECHNIC UNIVERSITY OF MADRID, MADRID, SPAIN

The aims of this study were: (1) to establish technical performance profiles of football players and (2) to identify the differences of variation in technical match performance according to 5 playing positions under 5 situational variables in the Chinese Football Super League within 3 seasons. Technical match data of players from season 2015 to 2017 (N=720) were collected by Shanghai Champion Technology Co. Ltd, who owns a validated notational system in collecting and providing football performance statistics. Twenty-two technical performance related match actions or events were chosen as variables in current study and were divided into the following four groups: variables related to goal scoring, variables related to attacking, variables related to defending, variables related to passing and organizing. Technical performance profiles were established by profiling techniques and presented by radar charts, while the coefficient of variation (CV) of each variable within a player was calculated to present the technical variation. Differences of player's match performance and variability of match performance across different positions and different contexts were identified by magnitude-based inferences. Results showed that situational variables had obvious effects on players' match performance and variability of match performance. The match performances and their corresponding variability for players were different among distinct positions and contexts. The differences were mainly in variables related to attacking and variables related to passing and organizing when controlling for different situational variables. The differences of match performance and variability of match performance between wide midfielders and forwards were greater than those among central backs, full backs and central midfielders.

ALTERATIONS IN BIOCHEMICAL MARKERS OF RECOVERY DURING A TYPICAL TRAINING WEEK IN ELITE YOUTH SOCCER

HUGHES, J.D.1, RITSON, D.C.1, LEKUE, J.2, MARTIN GARECHANA, I.2, CALLEJA-GONZALEZ, J.2,3, MOSQUEIRA, M.2, O'DOHERTY, P.4, DE STE CROIX, M.B.A.1

1 UNIVERSITY OF GLOUCESTERSHIRE; 2 ATHLETIC CLUB BILBAO, BILBAO, SPAIN 3 UNIVERSITY OF THE BASQUE COUNTRY, BILBAO, SPAIN 4 STAT SPORTS, DUBLIN, IRELAND

INTRODUCTION: Soccer matches can elicit exercise induced muscle damage (EIMD) which can be attributed to the high magnitude eccentric muscle loading experienced in landing and decelerating to change direction. It has been shown that various potential fatigue measures do not return to baseline levels up to 72 h post-match. With the pressure to re-perform on a weekly basis in soccer, recovery durations may shorter than 72 h due to the need to train during the week leading to subsequent matches. The congested nature of

training and matches may increase the risk of injury incidence in maturing players. Increased incidence of injury has been reported during the later stages of training and competition when fatigue is evidenced. Biochemical markers of EIMD, if collected at time sensitive periods during a typical training week can allow for mitigation of risk and allow to reduce non-contact injuries. Therefore, this study sought to explore the potential time frame for biochemical variables to return to pre-game levels in elite youth players following competitive match-play and during a typical training week.
METHODS: 44 elite male soccer players were split into three age groups according to chronological age (U13 n = 16; U15 = 13; and U17 n = 15). Creatine kinase (CK) and urea were taken pre-, immediately post competitive match-play and pre-training on 3 occasions (48 h, 72 h and 120 h) during the training week and pre- a 2nd match (168 h). Match and training activities were collected using global positioning system (GPS).
RESULTS: Significant time effects were reported for CK ($P < 0.01$). All age groups reported significant increases in CK immediately post-match. There were no significant differences in CK activity in the two pre-match measures for any age group ($P > 0.05$). Significant differences were reported between the U17 and U13 age groups at all time points with U17 reporting greater CK activity at all time points. CK values from post-match 1 and across the training week were all significantly correlated to the number of accelerations and decelerations performed ($P < 0.05$). Significant time effects were reported for urea ($P < 0.01$). Significant differences between pre- and post-match, with further increases at 120 h post-match ($P < 0.01$) were evidenced, there were no significant differences between age groups. There were significantly higher levels of urea reported at pre-match 2 compared to pre-match 1 ($P < 0.05$). CK activity returned to baseline in all age groups but increased urea was evident for all age groups at 168h.
CONCLUSION: In conclusion 7 days may be insufficient for biochemical recovery in youth male soccer players. Therefore, specific monitoring strategies to assess biochemical markers of EIMD between match-play and subsequent training sessions should be considered to track recovery and potentially reduce muscular injury risk.

RPE-LOAD CAN BE USED TO QUANTIFY SOCCER PLAYER ACUTE:CHRONIC WORKLOAD RATIOS ACROSS A SEASON

BACON, C., PETERSEN, C.

UNIVERSITY OF CANTERBURY

INTRODUCTION: Ensuring players optimize their training/match workload is a challenge for soccer club fitness and medical support staff. Commonly global positioning system (GPS) units are used to closely track running volume and intensity of training/matches to determine individual workloads. These workloads can be converted to injury risk probability for each player via the acute:chronic workload ratio (ACWR) calculation. Expensive GPS systems necessitate more financially confined clubs finding more cost-effective solutions to monitor ACWRs. One possibility is using rate of perceived exertion (RPE) load quantified by Impellizzeri et al. (2004). Therefore, the present study investigates the relationship between RPE load and GPS load and hypothesizes that both workload tracking methods will positively correlate.
METHODS: Over 6 months, 24 semi-professional soccer players, (Age: 23.6 ± 4.5 yrs, yoyo IRT L1: 19.7 ± 1.3 laps) were monitored providing a total of 1012 training and 219 match cases. Players wore STATSports Viper Pod v1.0 (10Hz) GPS units in each training session and match and provided a post session Borg-RPE. GPS metrics assessed included; total distance, high speed running, explosive distance and dynamic stress load. ACWR was calculated per individual and GPS metric using Gabbett's (2016) ACWR formula with RPE-load calculated via Impellizzeri et al. (2004) method. A Pearson's correlation test (2-tailed) was conducted on the metrics.
RESULTS: Overall, RPE-load had a large to very large correlation to 75% of the GPS metrics ACWR assessed; $P<0.001$ for total distance ($R = 0.704$), high speed running ($R = 0.586$) and explosive distance ($R = 0.295$). It should be noted that dynamic stress load ACWR did largely correlate with RPE-load for central defenders and central midfielders ($P < 0.05$, $R = 0.692$ and $R = 0.588$ respectively).
CONCLUSION: This research demonstrates that clubs with limited financial resources for GPS monitoring systems can instead effective improvise using the RPE-load to effectively assess player workload across a season. A word of caution, across a macro/meso cycle the RPE-load method standardizes out to give a strong interpretation of player workload, however this RPE scale based method is also highly subjective and sensitive to multiple external factors so interpretation over the smaller micro-cycle period is less precise. Sports scientists can apply these findings to their own players to closely monitor ACWR and minimize injury risk.
References:
Impellizzeri, FM, Rampinini, E, Coutts, AJ, Sassi, A, and Marcora, SM. Use of RPE-based training load in soccer. Med Sci Sports Exerc 36: 1042–1047, 2004.
Gabbett TJ. The training-injury prevention paradox: should athletes be training smarter and harder? Br J Sports Med 2016;50:273–80.
Contact:
Chris Bacon – chris.bacon@pg.canterbury.ac.nz

THE EFFECT OF MATURATION ON MOTION CAPTURE MOVEMENT SCREENING SCORES IN YOUNG SOCCER PLAYERS

LAAS, M., SPEARS, I., PARKIN, G., PORTAS, M.

TEESSIDE UNIVERSITY

INTRODUCTION: Movement screens have been previously suggested as important tools for athlete injury prevention and performance monitoring. When testing with young athletes it is important to select tests and devices to distinguish whether the improvements in scores are not down to maturation. Some screening tools have been linked with a maturation effect previously. There could also be a concern about the accuracy of the manual scoring of movement quality by the tester, especially if the scoring system does not have many options. The aim of this study was to assess the movement capabilities of young athletes using an objective measuring device. A new product using the Kinect camera was designed to analyse fundamental adolescent athletic movements (AMAT Performance, AMAT Performance).
METHODS: Forty six youth male soccer players (age=13.7 ± 1.5 years; maturity offset =0.0 ±1.5 years) across five age groups (U12s, U13s, U14s, U15s, U16s) belonging to an English soccer academy participated in this study. All players were free from injury and medically cleared to participate in training. Written informed consent was obtained from the parents or guardians of the participants. The players undertook their preseason movement screening on the AMAT Performance system. The players had one trial per test and performed a single alternate leg hop for control and maximal distance as well as the back squat. They were also categorised from Peak Height Velocity (PHV) as being pre -PHV [n=17] at-PHV [12] and post-PHV [17] from the maturity offset. The data was analysed looking at the change in the group mean scores on the Hopkins custom-made spreadsheet. Later the probability that a change in the testing scores was beneficial, harmful or trivial, was identified according to the magnitude-based inferences approach. Confidence intervals were set at 90%.

RESULTS: The mean maximum hopping distance (cm) between pre-PHV, at-PHV, post-PHV was from left to right leg (198.9 ± 18.0, 203.6 ± 12.3, 206.5 ± 14.9) and right to left leg (193.4 ± 11.6, 192.5 ± 12.7, 201.7 ± 14.9). The mean hop (cm) for control left to right leg was (163.9 ± 16.9, 171.6 ± 17.3, 171.3 ± 22.8) and right to left leg (171.4 ± 17.1, 169.4 ± 14.8, 171.1 ± 22.5). The mean squat depth (cm) was as follows (39.5 ± 6.5, 45.7 ± 10.8, 39.2 ± 12.2). The comparison data among the means of the maturation groups will be presented in 90% CI. The post-PHV group had small likely higher scores compared to the pre-PHV and at-PHV groups on the maximal distance hop right to left leg 5.8 (2.6-14.1) and 7.9 (1.3-17.1). The post-PHV group had also small likely increments in maximal hop for distance left to right leg against pre-PHV 5.5 (2.1-13.2), the other side was unclear. The data for hopping with control was either unclear or most likely unbeneficial. Regarding the squat comparison, the at-PHV group showed likely small increase in back squat depth distance against the pre-PHV 7.5 (-1.3-13.7).
CONCLUSION: The more mature boys performed better on the single leg maximum hop tests. The hop distance for control did not seem to have any influence from the maturation status. The latter might have been because of the players not estimating their distance to control very well and having only one trial. The depth the players squatted was not clearly influenced by maturation either with the at-PHV group showing the best scores. Maturation had an effect on tests where maximum power effort was needed and not a clear influence on tests where more movement control was necessary. More than one trial is recommended to overcome potential learning effects in tests were controlled movement is required.

THE EFFECTS OF A PROGRAMME-BASED FOOTBALL TRAINING SCHEDULE ON BOYS IN HONG KONG S.A.R., CHINA

OREILLY, J., LU, S.Y.J., HUI, S.S.C.
THE CHINESE UNIVERSITY OF HONG KONG

INTRODUCTION: In keeping with a current global trend, Hong Kong is facing the public health concern of childhood obesity (Hui et al., 2008). Involvement in team sports promotes a more active lifestyle, enhances physical fitness and improves clinical health markers in children and adolescents (Hills et al., 2015). Unfortunately, very few studies in China and Hong Kong have placed emphasis on the use of team sports, such as soccer, among "at-risk" youth groups as an intervention strategy to increase physical activity levels, as well as physical and psychosocial status.
METHODS: Male participants from a 10-month, Hong Kong Football Association (HKFA) Summer Scheme development programme, based in different districts in Hong Kong, were recruited to participate in this study. Classes and age groups from each district were selected at random for the data collection. Each weekly 60 min football training session was administered by a qualified HKFA coach. The Life Satisfaction Ladder; the Physical Activity Questionnaire for Children (PAQ-C); the Physical Activity Rating for Children and Youth (PARCY); Stage of Change, with 5-level statements, and Sport & Physical Activity Questionnaire were all measured to assess the effectiveness of soccer as a tool to enhance various health-related measures. In addition, questionnaires relating to health behavior change, self-perceived football skills, interest and attitude towards sports were adopted and implemented during this study. Data collection took place during the midpoint and end of the programme to assess and observe changes in responses throughout the programme. At least 1 researcher was present for each class, to supervise the questionnaire completion and answer any questions from the participants. All questionnaires were prepared in bi-lingual format.
RESULTS: In total, 194 boys completed both tests, with a mean age of 12.7 years. Results showed improvement in the self-perceived level of football skills (pre: 3.19, post: 3.26), life satisfaction (pre: 7.33, post: 7.44), interest in sports due to the football training (pre: 2.77, post: 2.80), and level of Stage of Change (pre: 3.49, post: 3.54), though not significant. Total football playing time in mins (pre: 298, post: 296), self-reported level of health status (pre: 4.09, post: 4.08), the anticipation levels for the next training (pre: 4.25, post: 4.21), and PARCY score (pre: 7.48, post: 7.47) were all similar between the two time points. A slight reduction in the current level of interest in sports (pre: 5.55, post: 5.31, $p<0.05$) and opinions on the importance of sports (pre: 5.48, post: 5.31, $p<0.05$) were observed.
CONCLUSION: These preliminary results suggest that beneficial effects can be gained from a football training programme in relation to improvement of skill levels, interest in sports and maintenance of health-status among boys in Hong Kong. In addition, playing time and physical activity levels were maintained throughout the study. Limiting factors surrounding the collection of such data in a local context included an overlap with school exam periods. Further analysis of these results and additional investigations into the reasons for playing soccer can serve as a potential indicator for the strategic application of sports-programme promotion among children and adolescents.

Conventional Print Poster

CP-BN01 Neuromechanics of explosure movements

GENDER DIFFERENCES IN LANDING AND JUMPING MOVEMENTS USING PRINCIPAL COMPONENT ANALYSIS OF KINEMATIC DATA

WERNER, I., PEER-KRATZER, M., FEDEROLF, P.
INSTITUTE OF SPORT SCIENCE

INTRODUCTION: The observation of several local movement parameters like the amount of the knee valgus during landing and jumping is used for information about the athletes´ knee injury risk. Using the Principal Component Analysis (PCA) to check for differences in movement patterns provides the possibility taking the whole body movement into account at once and might be a good tool for finding more complex injury risk factors. This study investigates gender differences in bipedal landing and jumping movements using PCA in order to evaluate excessiveness of this approach.
METHODS: 16 young well trained athletes (mean age 15.9y, SD 0.5y, 9 male, 7 female) jumped from a 40cm platform with a smooth landing and subsequent jumping movement to submaximal jumping height. They were all free of knee injuries. To analyze the movement a Vicon system with 8 cameras was used. Participants were equipped with 41 markers on all body segments. Starting from the first ground contact untill leaving the force plate marker positions were centered and normalized to body height. PCA was calculated, scores and score differences over time (principal velocities) as well as velocity differences over time (principal accelerations) (Federolf 2016) were proved for gender differences using t-tests for independent samples.
RESULTS: The PCA revealed an explanation of variance of 98.3% within the first 10 components. Gender differences were seen on the 3rd component ($p=0.004$) which can be characterized by variation in the medio lateral direction (arm swing, trunk position, knee axis). Also principal velocities differ significantly ($p=0.012$) in this component between male and female athletes, additionally in PC2, PC5 and PC6. Only in the latter principal accelerations showed a significant difference, identifying the control of head and leg (knee) position.

CONCLUSION: Results show well known gender differences (e.g. knee valgus, Alenezi et al. 2017) added by combined movement patterns (e.g. dissymmetric arm swing) and offer information about the movement dynamics (e.g. lower score acceleration in male athletes). Bipedal landing and jumping bear a low risk of injury while providing important information about landing patterns and dynamics. For a next step this approach will be used for checking injury risk factors in athletes.
Alenezi F., Herrington, L., Jones, P., Jones, R., Knee valgus and loading across common athletic tasks. British Journal of Sports Medicine 2017 (51) 4:286ff
Federolf, P., A novel approach to study human posture control: "Principal movements" obtained from a principal component analysis of kinematic marker data. Journal of Biomechanics 2016 (49) 3:364-370

BIOMECHANICAL ANALYSIS OF VOLLEYBALL PLAYERS DURING SPIKE LANDING

HUANG, C.
NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: Volleyball competition is a non-contact sport, but it had a high musculoskeletal injury rate after landing. The spike is an offensive skill that results in a higher injury rate than other skills in volleyball game (Ferretti A et al. 1992). Previous studies (Ferretti A et al. 1992, Arendt E, et al. 1995) reported that the females possessed a non-contact ACL injury rate four to eight times greater than males in the same competitions such as basketball, handball, and volleyball. The purpose of this study was to investigate the biomechanical differences between male and female players after a volleyball spike landing.
METHODS: Sixteen university volleyball players, 8 females (age = 21.8 ± 1.0 yrs, height = 171.1 ± 2.7 cm, weight = 60.8 ± 3.8 kg) and 8 males (age = 20.1 ± 0.9 yrs, height = 185.9 ± 4.2 cm, weight = 79 ± 6.2 kg), participated in this study. Two force plates embedded into the floor sampling at 1500 Hz and a 10-camera Vicon system, sampling at 300 Hz were synchronized to collect kinematic and kinetic data.
The standard net was set up at 2.43 and 2.24m for the male and female players. The players were asked to hit the ball with maximal effort from NO. 3 position in the area (4.5×9 m2). The landing was defined from the initial contact with the force plate to the minimal height of the center of mass achieved. The Visual3D software was used to calculate kinematic and kinetic parameters. Frontal and sagittal plane lower extremity joint angles were calculated for the hip, knee, and ankle during the landing phase. A t-test was used to test the biomechanical variables between male and female volleyball players.
RESULTS: The males had a greater jump height 0.71 ± 0.06 m than females 0.51± 0.02 m during the spike action. No difference for the VGRF force for male 4.79 ± 0.94 and female 4.47± 1.1 N/BW players. In the sagittal plane, males showed greater hip flexion angle at peak VGRF 17 ± 8.3 and maximum joint angle 57.9± 16.9 than females 9.5 ± 8, 34.6± 9.8 deg. Also, the female players exhibited greater maximum ankle dorsiflexion 26.9±3.7 than males' 17.9±4.2 deg. In the frontal plane, females have greater knee valgus angle than males at initial contact (M -6.4 ± 2.2, F -9.9 ± 2.2), peak VGRF (M -12.6 ± 4.4, F -17.0 ± 3.4) and max angle (M -18.4 ± 4.3, F -24.5± 4.5 deg).
CONCLUSION: The males have greater hip flexion angle than females at initial contact, time of peak GRF, and at max hip flexion. The females have greater knee valgus angle than males at initial contact, time of peak GRF, and at max knee valgus. These showed that males and females have different strategies for volleyball spike landing. Females showed a less hip flexion and a greater knee valgus angle than males during the spike landing, it may increase the risk of ACL injury. These differences may explain the higher ACL injury rate in female playing volleyball.
REFERENCES: Ferretti A, et al., The American Journal of Sports Medicine. 20(2):203-207, 1992.
American Journal of Sports Medicine. 23(6):694-701, 1995

KNEE EXTENSION TORQUE IS A SIGNIFICANT DETERMINANT OF JUMP HEIGHT OF LAYUP SHOT IN BASKETBALL

FUKUDA, S., UEDA, A., NAKAMURA, Y., KAMIBAYASHI, K., WAKAHARA, T.
DOSHISHA UNIVERSITY

INTRODUCTION: In basketball, layup shot is frequently used in the games. A high jump of the layup shot makes it difficult for the defenders to block the shot. Hence, it is important for players to achieve a high jump height in the layup shot. Sugiyama et al. (2014) examined kinematics of the lower limb during a jump of layup, and reported that a side-to-side difference in the jump height could be attributed to the angle and the angular velocity of the ankle joint during the takeoff phase. Stefanyshyn and Nigg (1998) demonstrated that the ankle joint was the largest energy generator for a jump of the layup among the lower limb joints. However, no studies investigated the biomechanical factors determining the inter-individual differences in the jump height of layup. Therefore, the aim of this study was to investigate determinants of jump height in layup from the viewpoint of kinematics and kinetics of the lower limb.
METHODS: Thirty male collegiate basketball players performed layup with a 4 m approach using a ball. Thirty-four reflective markers were placed on anatomical landmarks of the body. Three-dimensional positions of the markers and ground reaction force (GRF) of the takeoff leg were recorded by a motion capture system and a force platform, respectively. Jump height was defined as the vertical height traveled by the marker attached to the sacral bone from standing position (Sugiyama et al., 2014). Each torque of hip, knee and ankle joints of the takeoff leg was calculated by inverse dynamics during push-off phase [from the instant of lowest center of mass (COM) position to toe-off].
RESULTS: There were significant correlations between jump height in the layup and the vertical velocity of COM at toe-off ($r = 0.786$, $P < 0.01$), and between the velocity of COM and the vertical impulse of GRF during push-off phase ($r = 0.780$, $P < 0.01$). The vertical impulse of GRF was significantly correlated with the peak value of vertical GRF ($r = 0.574$, $P < 0.01$), but not with the duration of push-off phase. The peak value of GRF was significantly correlated with the knee extension torque at instant of peal vertical GRF($r = 0.404$, $P < 0.05$), but not with the hip extension torque or ankle planter flexion torque. The significant correlation between the peak vertical GRF and the knee extension torque may be related to the facts that, at the instant of peak GRF, the knee extension torque was significantly correlated with the moment arm of the GRF at the knee joint ($r = 0.585$, $P < 0.01$), and the moment arm at the knee joint was significantly longer than that of hip and ankle joints ($P < 0.05$). On the other hand, no significant correlations were found between the peak vertical GRF and each of the angle or the angular velocity of hip, knee or ankle joints.
CONCLUSION: The results suggest that the knee extension torque during push-off phase is a significant determinant of jump height of layup in basketball players.

RECTUS ABDOMINIS AND ILIACUS MUSCLE SIZE ARE ASSOCIATED WITH LONG JUMP PERFORMANCE INDEPENDENTLY OF SPRINT RUNNING CAPACITY

TAKAHASHI, K., WAKAHARA, T.

DOSHISHA UNIVERSITY

INTRODUCTION: Long jump performance is primarily determined by the takeoff speed (Hay et al. 1986). To obtain a high takeoff speed, the hip extensors and flexors were suggested to be important (Muraki et al. 2008). On the other hand, it is possible that the trunk muscles also contribute to the attainment of a high takeoff speed by increasing the trunk stability to resist the huge impact force on the trunk during takeoff phase (Luhtanen & Komi 1979). However, less information is available about the association between the size of these muscles and the long jump performance. The purpose of this study was to elucidate the association between the sizes of the trunk and gluteus muscles and the long jump performance.
METHODS: Twenty-three male long jumpers participated in the present study. Their personal best records in the long jump and the 100-m sprint (t100) ranged from 653 to 788 cm (721.6 ± 46.3 cm), and 10.41 to 11.94 s (11.15 ± 0.39 s), respectively. T1-weighted magnetic resonance images of the trunk and hip were obtained to determine the maximal anatomical cross-sectional areas (CSAs) of the rectus abdominis (RA), internal and external obliques and transversus abdominis, psoas major, quadratus lumborum, erector spinae and multifidus, iliacus (IL), gluteus maximus, and gluteus medius and minimus.
RESULTS: The absolute CSA (cm^2) of RA of the takeoff leg side ($r = 0.505$, $P = 0.014$) and the relative CSAs (cm^2/kg^(2/3)) of RA and IL to the body mass of takeoff leg ($r = 0.674$, $P < 0.001$, $r = 0.478$, $P = 0.021$, respectively) and free leg sides ($r = 0.490$, $P = 0.018$, $r = 0.434$, $P = 0.038$, respectively) were significantly correlated with their personal best records for the long jump, whereas the other muscle CSAs were not. Stepwise multiple regression analysis selected relative CSAs of RA and IL of the takeoff leg side and t100 to predict the personal best record for the long jump (SEE = 22.6 cm, adjusted R^2 = 0.763).
CONCLUSION: The results demonstrated that the size of RA and IL was associated with long jump performance independently of sprint running capacity. As RA has a long moment arm of the lumbar spine flexion, it could contribute to the maintenance of trunk posture by resisting the impact force that causes the excessive lordosis during the takeoff phase. The IL may contribute to the generation of the hip flexion torque of the takeoff leg in the later phase of takeoff. The present results suggest that resistance training for hypertrophy of RA and IL may be beneficial to achieve a high performance of long jump.
REFERENCES:
Hay JG, Miller JA, Canterna RW. (1986). J Biomech, 19(10):855-866.
Muraki Y, Ae M, Koyama H, Yokozawa T. (2008). Int J Sport Health Sci, 6:21-32.
Luhtanen P, Komi PV. (1979). Eur J Appl Physiol Occup Physiol, 41(4), 267-274.
CONTACT:
Email: dkituka@gmail.com

DETERMINANT FACTORS OF LATERAL CUTTING PERFORMANCE IN BASKETBALL PLAYERS

KAMEDA, M., KIBA, K., MAEDA, A.

NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA

INTRODUCTION: In a basketball game, a defensive player is often outrun by an offensive player, because the defensive player loses balance when the offensive player changes running direction. Thus, it will be important to clarify the strategy for performing lateral cutting maneuvers under the unanticipated condition for improving performance of the defensive player. This study aimed to investigate the kinematics and kinetics indicators related to performing lateral cutting maneuvers in defensive basketball players.
METHODS: The participants were 14 college basketball players. In the experiment, participants were provided the sigh of an arrow directing either the right or left on a monitor in front of them while moving with side steps toward the right. When the right directed arrow was provided, they moved for 3 m by side steps to the right. Conversely, when the left directed arrow was provided, participants moved for 3 m to the right, performed lateral cutting to the left, and moved back to the starting spot with side step. Participants responded to randomly provided direction of the arrow signal. Coordinates of markers affixed to participant's body were collected using a motion capture system (300 Hz). Moreover, ground reaction force (GRF) data were collected using a force plate at 1500 Hz. The data only in lateral cutting trials were analyzed from the instant of the foot strike on the ground to the instant of the toe-off during lateral cutting. Contact time (CT) was calculated from the GRF. Moreover, impulse was computed by time integration of lateral GRF. To evaluate the lateral cutting maneuvers, mean lateral GRF was obtained by dividing the impulse by the CT. We investigated the relationship between the mean lateral GRF and other variables.
RESULTS: The results showed that negative correlations were found between the mean GRF and the CT during lateral cutting. Moreover, negative correlations were found between the mean GRF and the center of gravity (CG) position, distance from the right foot position to the CG position at the lateral CG velocity when it was zero during lateral cutting. By contrast, at the instant of the foot strike during lateral cutting, negative correlations were not found between the mean GRF and the CG position, distance from the right foot position to the CG position. In addition, the propulsive mean GRF was stronger correlation than that of braking mean GRF.
CONCLUSION: The current results show that, the lower limbs seem to affect the position of CG at the lateral CG velocity when it was zero during lateral cutting and could be important factor for better lateral cutting maneuvers. Moreover, to enhance the propulsive mean force could lead to an improvement performing lateral cutting maneuvers.

BIOMECHANICAL DIFFERENCES DURING DROP JUMPS ON RIGID AND SAND SURFACE

WIRTZ, S., SZWAJCA, S., STELZER, L., ZENTGRAF, K., EILS, E.

WESTFÄLISCHE-WILHELMS UNIVERSITÄT MÜNSTER

INTRODUCTION: A rising number of athletes participate and compete in beach sport. An important performance indictor is vertical jump performance as it is crucial for several athletic situations (Bobbert, 1986). Most beach sports such as Beach Handball and Beach Volleyball highly rely on jumps, resulting in a need for specialized training programs and adequate diagnostics. Therefore, the aim of the study was to detect differences in drop jump performance on rigid and sand surface using a sandbox under laboratory conditions.
METHODS: Eighteen subjects (23.7 ± 3.5 years; 178.3 ± 9.5 cm; 78.9 ± 11.9 kg; mean ± SD, respectively) conducted three consecutive drop jumps from a 40cm box on rigid and sand surface in randomized, counterbalanced order. EMG activity of five muscles of the right leg was recorded with Noraxon electrodes. Force data was collected by using Kistler force plates. Qualysis motion system was used to

obtain data about the jumping height using a marker that was attached to the lower back. Data analysis was conducted with MATLAB and SPSS. Dependent variables were jumping height, ground contact time, force impulse, concentric and eccentric muscle activity which were compared among the conditions.
RESULTS: Jumping height on rigid surface (M= 34.4cm; SD= 5.9cm) was significantly higher (F(1,38)= 7.091, p=.011, η2=.157) than jumping height on sand surface (M= 30.0cm; SD= 5.5cm). There was no significant difference (F(1,38)= 1.56, p=.695, η2= .004) detected in ground contact time between rigid (M= 0.249s; SD= 0.051s) and sand (M= 0.246s; SD=0.067s) condition. However, the force impulse was significantly higher on rigid compared to sand surface. There were no significant differences in muscle activation.
CONCLUSION: Reduced jumping height on sand surface can be explained by the reduced force impulse. The produced muscle energy is stored in the sand and not returned as good as on rigid surfaces (Bishop, 2003).
Training should aim to improve an athletes power output (Giatsis et al., 2004). Implementing plyometric exercises seems beneficial to improve explosiveness (Stojanovic et al., 2016).
References:
Bishop, D. (2003). J Sports Med Phys Fit, 43(4), 418.
Bobbert, MF. et al. (1986). Eur J Appl Phys Occup Phys, 54(6), 566-573.
Giatsis, G. et al. (2004). Sports Biomech, 3(1), 145-158.
Stojanović, E. et al. (2017). Sports Med, 47(5), 975-986.
Contact: s_wirt04@uni-muenster.de

KINEMATICS OF MAXIMUM SPEED RUNNING ON TRACKS OF DIFFERENT STIFFNESS

NEMTSEV, O., NEMTSEVA, N.
ADYGHE STATE UNIVERSITY

INTRODUCTION: One of the crucial conditions for successful performance in pole vaulting is training with a large amount of jumping done at maximal effort. At the same time, this is not always possible in the periods of intensive strength training (Verkhoshansky, 1991). A solution to this problem may be to use more elastic tracks during such periods to enhance run-up economy (Kerdok et al., 2002). However, the features of high speed running on such tracks are still poorly understood. So, the aim of this study was to compare the kinematics of maximal speed running on Mondo and on a less stiff track.
METHODS: Eleven pole volte jumpers took part in the study (eight males: age 20.8±5.8, height 1.86±0.08 m, weight 74.8±8.4 kg, personal best 5.00±0,74 m; and three females: age 17.0±3.6, height 1.69±0.07 m, weight 54.7±10.6 kg, personal best 3.36±1.51 m). Each athlete performed 30-meter maximum speed running on Mondo track and, after 15 minutes of rest, on a fiberglass track. The fiberglass track was made up of several blocks each of which was a rectangular parallelepiped with three arcs of fiberglass rods coming from above and fastened together, covered with plywood and a Regupol roll. Casio EX-ZR700 camera (240 Hz) was located 23 meters away in a perpendicular direction from the sprinting lane at the 25 meter mark from the start. SkillSpector software was used for 2D analysis. Paired sample t-test was used to estimate differences in the kinematic data.
RESULTS: Horizontal center of gravity (CG) velocity at touchdown (8.08±0.74 and 8.05±0.71 m/s) and takeoff (8.52±0.76 and 8.48±0.70 m/s), step length (2.03±0.12 and 2.05±0.10 m), flight (0.129±0.011 and 0.128±0.006 s) and support times (0.121±0.014 and 0.122±0.015 s), CG takeoff angle, CG support displacement, leg angle at touchdown, knee angle at touchdown and midstance, mean angular velocity of support leg knee flexion differed non-significantly (p>0.05) during maximum speed running on Mondo and fiberglass tracks. Horizontal CG velocity at midstance was significantly smaller (7.80±0.78 and 8.01±0.71 m/s, p=0.016) while mean angular velocity of support leg knee extension (380±113 and 333±117 deg/s, p=0.020) and support leg knee angle at takeoff (169±6 and 167±7 deg, p=0,022) were significantly larger when running on Mondo track.
CONCLUSION: The external spring element when running on fiberglass track allows pole volte jumpers to run as quickly as on Mondo track, to lose less horizontal velocity of CG at landing phase and leads to a slower and smaller extension of the support leg knee in takeoff phase. It is necessary to study the impact of training on Fiberglass track on the jumpers condition within different periods.
REFERENCES:
Kerdok AE, Biewener AA, McMahon TA, Weyand PG, Herr HM. (2002). J Appl Physiol, 92, 469-478.
Verkhoshansky YV. (1991). Teor Prak Fiz Kult, 2, 24-31.
CONTACT:
oleg.nemtsev@mail.ru

A COMPARISON OF FORCE PRODUCTION AND NEURAL DRIVE BETWEEN EXPLOSIVE ISOMETRIC AND ISOINERTIAL CONTRACTIONS AT DIFFERENT LOADS.

LANZA, M.B., BALSHAW, T.G., FOLLAND, J.P.
LOUGHBOROUGH UNIVERSITY

INTRODUCTION: Whilst explosive strength and its determinants (primarily agonist neural drive) have been investigated extensively little is known about the neuromechanics of ballistic isoinertial contractions (BC) performed across the load range. A comparison of force production and neural drive between contraction modes [i.e. explosive isometric (ECi) vs. BC] and across isoinertial loads may inform both strength assessment selection and exercise prescription. Therefore, the aim of the study was to compare knee extension force production and neural drive across the first 200 ms of contraction between ECi and BC at different loads.
METHODS: 11 healthy males (28±3 years; 1.78±0.08 m; 85±12 kg) who were participating in systematic strength training for ≥12 months participated in the study. Participants attended 5 laboratory sessions (familiarisation and 4 measurement sessions). In the first and second measurement sessions, following a warm-up, ECi, maximum isometric voluntary contractions (MVCs) and evoked twitch contractions were performed. During sessions three and four, MVC, evoked twitch contractions; BC at percentages of 1 repetition maximum (1RM) (80%, 60%, 40% and 20%) and at 1RM were performed. All tasks were executed unilaterally and superficial quadriceps EMG (QEMG) were recorded. Force was measured at 25-50 ms intervals from contraction onset, until 200 ms (F25, 50, 75, 100, 150 and 200) and QEMG was measured during consecutive 25-50 ms time periods after EMG onset (QEMG0-25, 25-50, 50-75, 75-100, 100-150 and 150-200) and normalized by maximal m-wave.
RESULTS: From F25 to F100 and also at F200 ECi present higher force than all isoinertial contractions (P<0.001) except for F25 where ECd60 did not differ from ECi and at F150 where ECi was higher than ECd60, ECd40 and ECd20 (P<0.001). 1RM was lower than the other isoinertial loads (P≤0.037) except ECd20 (P=0.444) at F50 and F75. ECd20 was also lower than ECd80 and ECd40 at F75 and lower than ECd40

(P≤0.023) at T100. During F150 and F200, ECd20 was lower than the other contractions (P≤0.003) and ECd40 also was lower than ECd80 and ECd60 (P<0.001). EMG0-25 was lower at 1RM than ECd20 (P=0.032). For EMG25-50 1RM and ECd60 were lower than ECd80 and ECd20 (P≤0.021). During EMG50-75, 1RM was lower than ECd80 and ECi but higher than ECd20 (P≤0.006). ECi also was higher than ECd60 (P=0.007) which was lower than ECd20 (P=0.009) at EMG50-75. EMG75-100 and EMG100-150 showed that 1RM was lower than ECd80 (P≤0.004). Finally, 1RM at EMG150-200 was lower than the other contractions (P≤0.046) except for ECi which was only lower than ECd80 (P=0.002).
CONCLUSION: Explosive force was generally higher during ECi vs. BC but showed no clear progression with increasing load. Neural activation varied across different loads showing 1RM generally lower than the other contractions specially at the latter phases of the explosive force.

RELATIONSHIP BETWEEN MAXIMAL VOLUNTARY CONTRACTION AND THE IMPULSE ABOVE END-TEST TORQUE IN INDIVIDUALS WITH DIFFERENT MUSCLE STRENGTH LEVELS

BASSAN, N.M.1, ABDALLA, L.H.P.1, CARITÁ, R.A.C.1,2, DE LIMA, L.C.R.1,3,4, DENADAI, B.S.1, GRECO, C.C.1

1: SÃO PAULO STATE UNIVERSITY, RIO CLARO, BRAZIL, 2: FACULDADE DE AMERICANA, 3: CENTRO UNIVERSITÁRIO HERMÍNIO OMETTO, ARARAS, BRAZIL, 4: CENTRO UNIVERSITÁRIO SALESIANO DE SÃO PAULO, CAMPINAS,

INTRODUCTION: The critical power model is utilized in both whole-body and small muscle mass exercises to estimate the critical power/critical torque asymptote (CP/CT, respectively) and the curvature constant of this hyperbola (W'). Specifically, the 5-min all-out intermittent isometric test has been used during resistive exercises to estimate end-test torque (ET) and impulse above the ET (IET) (Burnley, 2009). Cross-sectional and longitudinal studies suggest that neuromuscular characteristics influence W' (Miura et al., 2002; Sawyer et al., 2014). Thus, the aim of this study was to analyze the relationship between maximal voluntary contraction (MVC) and IET in individuals with different muscle strength levels.
METHODS: Thirty active males (25 ± 4.1 years, 175 ± 6.8 cm, 74.2 ± 16.1 kg) performed a maximal isometric test to determine MVC and a 5-min all-out intermittent isometric test to determine ET and IET. The tests were performed for knee extensors muscles. Participants were ranked according to their MVC values. The median third was excluded to form a high MVC group (HIGH) and a low MVC group (LOW). The comparison of the variables between groups was performed using the Student t test. The association between the variables was assessed using Pearsons product moment correlation coefficient.
RESULTS: The MVC (357.0 ± 52.0 N.m and 225.0 ± 26.6 N.m) and IET (8346.7 ± 1666.6 N.m.s and 4334.2 ± 2376.0 N.m.s) were significantly different between HIGH group and LOW group, respectively. There was significant correlation between MVC and IET in both groups (r = 0.76 and 0.72 for HIGH and LOW, respectively).
CONCLUSION: Thus, it can be concluded that MVC and IET are moderately associated in individuals with different muscle strength levels.
References: Burnley M. (2009). Estimation of critical torque using intermittent isometric maximal voluntary contractions of the quadriceps in humans. J. Appl. Physiol. 106(3), 975-983.
Miura A, Endo M, Sato H, Sato H, Barstow TJ, Fukuba Y. (2002). Relationship between the curvature constant parameter of the power-duration curve and muscle cross-sectional area of the thigh for cycle ergometry in humans. Eur. J. Appl. Physiol. 87(3), 238-244.
Sawyer BJ, Stokes DG, Womack CJ, Morton RH, Weltman A, Gaesser GA.(2014). Strength training increases endurance time to exhaustion during high-intensity exercise despite no change in critical power. J Strength Cond Res. 28(3), 601-609.
Contact: nambassan@gmail.com

THE RELATIONSHIP BETWEEN STRENGTH AND MUSCLE THICKNESS IN UNTRAINED PARTICIPANTS

RYAN-STEWART, H., FAULKNER, J., JOBSON, S.

UNIVERSITY OF WINCHESTER

INTRODUCTION: Larger muscles are often able to produce larger strength outputs (Lauchbach and McConville, 1969, Medicine and Science in Sports and Exercise, 1, 189-94). The relationship between muscle thickness has been established in elderly (Strasser et al., Age, 35, 2377-88) and trained (Abe et al., 2000, European Journal of Applied Physiology, 81, 174-80) populations, but it is unclear how prior activity may have contributed to this. The aim of this study was to establish the relationship of muscle thickness with strength at select locations in both the upper and lower body.
METHODS: Thirty-nine untrained male participants (mean ± standard deviation age 23 ± 5 years; height 1.81 ± 0.07 m; body mass 76.5 ± 18.7 kg) volunteered to take part in this study, which was approved by the local University ethics committee. The ultrasound measurement location was determined using anatomical landmarks to identify the middle of the muscle bulk (Takai et al., 2014, The Journal of Nutrition, Health and Aging, 18, 579-585). Three separate transverse ultrasound images were recorded using B-wave ultrasound (Terason) at the biceps brachii (BB), triceps brachii (TB), quadriceps (rectus femoris; RF), hamstring (biceps femoris; BF) and calf (gastrocnemius; G and soleus; S). Muscle thickness (MT) was determined using the inbuilt calipers on the Terason software, and an average calculated for the three images. Predicted one repetition maximum (1RM) was determined with free weights for bench press (BP), unilateral bicep curl (BC) and back squat (BS) following the ACSM (2001) protocol for RM determination, but allowing participants to reach a RM between 3-10 repetitions. Predicted 1RM was then calculated using the conversion table from Sheppard and Triplett (2016). Pearson correlation analysis was performed to compare the upper body muscle thickness values to the predicted RM for bench press and bicep curl, and the lower body muscle thickness values to predicted RM for back squat.
RESULTS: There was a significant weak positive correlation between BB MT and BP ($r = 0.388$ $p < 0.05$), and BB MT and BC ($r = 0.390$, $p < 0.05$). There was a significant moderate positive correlation between TB MT and BP ($r = 0.452$, $p < 0.05$), and TB MT and BC ($r = 0.567$, $p < 0.01$). There was a non-significant weak positive correlation between G MT and BS ($r = 0.249$, $p > 0.05$). There was a significant weak positive correlation between RF MT and BS ($r = 0.386$, $p < 0.05$), and between S MT and BS ($r = 0.388$, $p < 0.05$). There was a significant moderate correlation between BF MT and BS ($r = 0.584$, $p < 0.01$).
CONCLUSION: In untrained participants there was some relation between the thickness of the major contributing muscles and strength performance. This relationship appears to be strongest with those muscles that act as antagonists (TB and BF). Whilst the size of the muscle does appear to influence strength performance, other factors such as muscle fibre type and neurological activity also likely contribute to a person's strength

Conventional Print Poster

CP-BN02 Biomechanics of running and walking

COMPARISONS BETWEEN SYSTEMS TO MEASURE CONTACT AND FLIGHT TIMES IN ELITE RACE WALKING

HANLEY, B., TUCKER, C.B.

LEEDS BECKETT UNIVERSITY

INTRODUCTION: Race walking is an Olympic event dictated by a rule that states that no visible loss of contact with the ground should occur and that the leg must be straightened from first contact with the ground until the 'vertical upright position' . The measurement of flight times during race walking is therefore of great interest to coaches, athletes and judges. The aim of the study was to compare different methodologies used to measure contact and flight time in race walking.
METHODS: Ten male race walkers , mass: 64.4 kg <± 4.9>> and seven female race walkers , mass: 56.7 kg <± 11.0>> participated. Fourteen of the athletes had competed at the 2016 Olympic Games or 2017 World Championships. The men race walked down an indoor track at 11, 12, 13, 14 and 15 km/h , whereas the women's trials were at 10, 11, 12, 13 and 14 km/h. Contact and flight times were measured for the midsection of each trial using three adjacent 900 x 600 mm Kistler force plates <1000 Hz>, 5 x 1 m strips of an OptoJump Next system <1000 Hz> and a Fastec high-speed camera <500 Hz>. Results from the OptoJump Next system were extracted using five settings based on the number of LEDs that needed activating , and were annotated as 0_0, 1_1, 2_2, 3_3 and 4_4. The force plate values were considered the criterion values and measurements were assessed for reliability using Intraclass Correlation Coefficients and 95% limits of agreement .
RESULTS: For flight time, the ICCs between the force plate and OptoJump Next were 0.846 for the 0_0 condition , 0.901 <1_1> , 0.983 <2_2> , 0.844 <3_3> , and 0.563 <4_4> . The ICC between the force plate and the high-speed video for flight time was 0.975 . For contact time, the ICCs between the force plate and OptoJump Next were 0.967 for the 0_0 condition , 0.982 <1_1> , 0.995 <2_2> , 0.960 <3_3> , and 0.874 <4_4> . The ICC between the force plate and the high-speed video condition for contact time was 0.991 .
CONCLUSION: The OptoJump Next system provided results similar to those of the gold standard force plates, with the 2_2 setting the most reliable. Users of the OptoJump Next system should therefore note that adjusting the settings of the device might be necessary to achieve the most accurate results. The high-speed video recordings also provided very good reliability although the time-consuming nature of video analysis means the OptoJump Next system is better suited to providing immediate results.

EFFECTS OF PROSTHETIC ARM ON SPRINT PERFORMANCE AND KINEMATICS IN UNILATERAL BELOW-ELBOW AMPUTEES

HIRANO, T.1, KASHIWAGI, Y.1, SOMA, M.1,2, MIZUNO, Y.1, MIZUNO, M.1, FUNATO, K.1

1: NIPPON SPORT SCIENCE UNIVERSITY

INTRODUCTION: The relative advantages and disadvantages of using a prosthetic arm for the T47 class Paralympic Sprinter (PS) form an important question for athletes and coaches. In 2016 in the Rio Paralympics men's and women's T47 class 100m finals, three of the nine below-elbow amputees were using a prosthetic arm [1, 2]. This trend may be related to the fact that the role of the prosthetic arm in running sprints is not clear. Therefore, the goal of this study is to clarify the influences of wearing a prosthetic arm on PS sprint performance and other kinematic variables when sprinting.
METHODS: In this study, two Japanese female PSs (PS.A: missing right forearm; 100m personal record (PR): 12.86 sec; PS.B: missing right forearm; 100m PR: 13.11 sec) performed 40m sprints each with and without their prosthetic arms. Three-dimensional coordinate data of a reflective marker attached to the participants' bodies were captured by 20 infrared cameras (VICON MX, Oxford Metrics Ltd, UK) sampled at 250 Hz. Sprint velocity, spatio-temporal variables, and angular kinematics of segments and joints were calculated.
RESULTS: From these trials, it appears that PS running speed did not change significantly as a result of wearing a prosthetic arm (with vs. without; PS.A: 7.82 m/s vs. 7.71 m/s; PS.B: 7.80 m/s vs. 7.80 m/s), although there was a difference in thorax and pelvic rotation. According to previous studies, the ratio of the forearm and hand segment masses of the Japanese female athletes to their body mass is 1.5% for the forearm and 0.6% for the hand segments [3]. Therefore, together, the forearm and hand are a relatively small amount of the overall body mass compared with the trunk, thigh, and leg segments. Based on this data, the conclusion is that the prosthetic arm had no influence on sprint performance. On the other hand, it was thought that the factors of increased thorax and trunk rotation angles and angular velocities when wearing the prosthetic during sprints are augmented with the change of the arm swing motion caused by the additional mass of the prosthesis.
CONCLUSION: These results suggest that wearing a prosthetic arm does not improve a PSs running performance but may be effective to improve balance in trunk rotation.
REFERENCE:
[1] Athletics | Mens 100m - T47 Final | Rio 2016 Paralympic Games. (2016). https://www.youtube.com/watch?v=oqcupFRHFIs. September 7.
[2] Athletics | Womens 100m - T47 Final | Rio 2016 Paralympic Games. (2016). https://www.youtube.com/watch?v=c0p3-pRl-Lg. September 11.
[3] Ae M, Tang H, and Yokoi T. (1992). Biomechanisms (in Japanese), 2-23.

RELATIONSHIP AMONG RUNNING VELOCITY, CADENCE, AND STEP LENGTH IN RUNNERS AND NON-RUNNERS

GOTO, Y.1, OGAWA, T.2,3, ISO, S.3, KANOSUE, K.3

1GRADUATE SCHOOL OF SPORT SCIENCES, WASEDA UNIVERSITY, SAITAMA, JAPAN. 2FACULTY OF SPORT SCIENCES, WASEDA UNIVERSITY, SAITAMA, JAPAN. 3DEPARTMENT OF LIFE SCIENCE, GRADUATE SCHOOL OF ARTS AND SCIENCES,

INTRODUCTION: As the determinant of the velocity of human running, the relationship between temporal and spatial components have been studied extensively. The relative contribution of each component in accordance with changing running velocity differs to a great extent and is highly dependent on the velocity ranges. While in the lower velocity range there is a greater change in the step length (thus more contribution of the spatial component), the cadence (temporal component) showed the greater changes in the higher velocity range (Hay,2002; Yanai & Hay, 2004). However, it is still unclear whether the optimization of the spatiotemporal characteristics is innate or reflect functional modification due to training. The present study, therefore, focused on a wide variety of populations with different back-

ground of engagement in running training, and compared the relationship among running velocity, the step length, and cadence over a wide range of running velocity.
METHODS: The subjects were eighteen sprinters, twenty long distance runners, twenty well trained athletes with no expertise in running, and seventeen non-athletes without history of any regular participation in sports events. The participants were asked to run along the 30 m or 20 m straight path at a variety of velocities, which varied from the slowest to the fastest. Then, the velocity (m/s), step length (m) and cadence (steps sec-1) were calculated using a video camera. The running velocity lower than 5 m s-1 was defined as the "low velocity" range. From the step length and cadence data, the slope of the linear regression line was obtained using a least squares method. To test the influence of body height, the slope was normalized with the height of each subject.
RESULTS: Mean values of the slope were significantly larger in the sprinters, long distance runners, and well-trained athletes than the non-athletes. After normalization with height to eliminate its influence on the spatial aspect (step length), the slope in the three groups were still significantly larger than the non-athletes.
CONCLUSION: It was indicated that in the low velocity range the non-athletes have greater contribution of cadence increase to increase in the running velocity as compared to the sprinters, long distance runners, and well-trained athletes. In other words, the profiles among running velocity, step length, and cadence reported in previous studies would not be innate but be acquired with some training that the individuals had underwent. However, it is difficult to clarify only from the present data what type of training caused the profiles specific to each group.

LONG-TERM EFFECTS OF MEDIALLY POSTED INSOLES ON RUNNING KINEMATICS, KINETICS AND ECONOMY

AVELA, J., HÄMÄLÄINEN, H., KULMALA, J.P.

UNIVERSITY OF JYVÄSKYLÄ

INTRODUCTION: Foot orthotics represents a popular technique to alter lower extremity movement. Many orthotics, like medially posted insoles (MPI), are designed to reduce excessive foot pronation (e.g. Kosonen et al. 2017). Excessive foot pronation is potentially harmful and is associated with development of running related lower limb injuries. Biomechanical mechanisms of clinical relevance of the foot orthoses are not well known, even though a number of studies have reported their acute effects on lower extremity kinematics, kinetics and muscle activities during running. Primary aim of this study was to examine long-term effects of MPI (Footbalance Systems LTd.) on running kinematics and kinetics in subjects with over-pronation. Secondary aim was to investigate whether this has an effect on running economy.
METHODS: Recreational female runners (n=13; 27 ± 6.2 years) with excessive over-pronation were recruited for the study. Dynamic running (4.0 ± 0.3 m/s) analysis was conducted before and after a 4-week MPI intervention with MPI and normal insoles. Data was collected using an eight-camera system (Vicon T40) and five force platforms (AMTI). For motion analysis a Plug-in gait and Oxford foot models were utilized (28 markers). Running economy analysis was conducted after the 4-week MPI intervention using a portable telemetric O2 analyser (Oxycon Mobile) at a 200 m indoor running track with MPI and normal insoles in a randomized order.
RESULTS: A reduction in peak rearfoot eversion for MPI (4.7°, $p<0.05$) as well as for normal insole (4.4°, $p<0.05$) was found after the 4-week MPI intervention. A significant reduction in tibial rotation in respect to rearfoot was also found for both MPI (-4.8°, $p<0.05$) and normal insole (-5.6°, $p<0.05$). MPI decreased peak forefoot pronation in relation to rearfoot (-1.9°, $p<0.05$) and increased forefoot-rearfoot dorsiflexion throughout the stance phase. No significant effects were found for any frontal or transversal plane kinetics between sessions or between insole conditions, however, there was a tendency for decreased internal knee abductor moment for MPI (0.20 Nm/kg, $p=0.10$) and for normal insole (0.20 Nm/kg, $p=0.10$) after the intervention. There were no differences in the oxygen cost of submaximal running between the insoles after the intervention.
CONCLUSION: Current results suggest that there is an accommodation period, which is needed for full effects of MPI on foot kinematics. There also seems to be a "carry-over" effect, in which similar kinematic changes can be seen even with normal insoles after the intervention. This was most likely the reason that no differences were found in the running economy between MPI and normal insoles after the intervention. Thus, MPI's used in this study can be utilized in clinical settings to manage various lower extremity injuries without negatively affecting running economy.
REFERENCES:
Kosonen J, Kulmala JP, Muller E, Avela J. (2017) J Biomech 21; 54:58-63.
janne.avela@jyu.fi

RELATIONSHIP BETWEEN FOOT STRIKE PATTERNS AND BODY ACCELERATION IN MODERATE SPEED RUNNING.

KOJI, T.1, GAKU, K.1, YUTA, G.1, TERUKAZU, K.2, KAZUYUKI, K.1

[1]WASEDA UNIVERSITY, [2]FUJITSU SSL

INTRODUCTION: A good running form is essential to run fast and to run without injury. Recently, the foot strike pattern (FSP) attracts widespread interest and it is considered to be related to running forms. FSPs are roughly divided into two types: rear-foot strike (RFS), in which the heel first lands the ground, and non-rear-foot strike (NRFS), in which any sole part other than heel first lands the ground (Willson et al., 2014). The motion analysis of video images is widely used for the evaluation of running form. But it is time consuming. So it would be useful if wearable devices could be utilized to get real-time feedbacks concerning running form during running. To this end, we tried to clarify the relationships between FSP and acceleration of body parts.
METHODS: Subjects were 20 male students who had no orthopedic disease in the lower limb. Accelerometers were attached to the lateral gastrocnemius (LG), tibialis anterior (TA), and the waist on the Jacoby line. Nine reflective markers were also attached to the right half of the body in order to determine joint angles. After warming up, subjects were told to run on an electric treadmill at several speeds of 2.3m/s-4.2m/s. All subjects wore their own shoes. The FSP was determined from 240Hz high-speed video images. Acceleration magnitudes were calculated from the maximum and minimum values of acceleration during the stance phase.
RESULTS: Out of 20 subjects, 11 and 9 showed the RFS and the NRFS, respectively. And the subjects with the RFS had larger vertical LG acceleration magnitude compared to those with the NRFS ($p<0.001$). Similarly, the subjects with the RFS had larger acceleration of the waist in the negative direction compared to those with the NRFS ($p<0.05$).
CONCLUSION: In a previous study, RFS runners have greater collision forces compared to fore-foot strike (FFS) runners (Liberman et al., 2010). The RFS generates impacts 3-times as great as the body mass, which is much greater than the FFS. This suggests that the RFS requires much energy in landing to absorb the shock against the ground. This could be the reason why the RFS subjects of the present study had larger vertical acceleration magnitude of LG and negative direction acceleration of the waist compared to the NRFS subjects. Thus, it could be possible to distinguish FSP from the acceleration.

EFFECT OF BODY WEIGHT UNLOADING ON MUSCLE ACTIVITY AND KINEMATICS DURING WALKING

KAMIBAYASHI, K., NISHIYAMA, S., ARAKI, K., TSUJIUCHI, N., OHIRA, Y.

DOSHISHA UNIVERSITY

INTRODUCTION: Somatosensory inputs from load receptors and hip joints are considered to play an important role in muscle activities during walking (Dietz and Duysens 2000, Kamibayashi et al. 2009). To clarify the effect of decreased sensory input from load receptors during walking, changes in lower limb kinematics, kinetics and muscle activity while walking on a treadmill with different levels of body weight support were investigated.
METHODS: Eight adult subjects walked at a speed of 3.5 km/h on a lower body positive pressure treadmill under five conditions of body weight unloading (100%, 80%, 60%, 40%, and 20% of their body weights). The level of body weight unloading was computer-regulated by changing the air pressure in the chamber of the treadmill. The body weight unloading conditions were randomly changed. To investigate the muscle activity of the lower limb during walking, a wireless surface electromyographic (EMG) measurement system was used. A wearable three-dimensional motion measurement system that consisted of mobile force plates with shoes and five motion sensors (the lower back and both sides of the upper and lower legs) was used to record foot pressure and joint movements of the lower limbs. The measurements were also performed in a standing posture with five different body unloading levels.
RESULTS: The EMG activities in the vastus medialis and soleus muscles during walking were decreased by increased body weight unloading, whereas those in the biceps femoris and tibialis anterior muscles were unchanged with all five different levels of body weight unloading. The percentages of the stance phase in gait cycle at 20% and 40% body weight conditions were less than those at the other body weight conditions. The extents of hip joint extension at the late stance phase in 20% and 40% body weight conditions were less than those under the other body weight conditions. The knee flexion during the stance phase was initiated earlier under the 20% and 40% body weight conditions.
CONCLUSION: Dramatic changes in the joint kinematics of the hip and knee during walking were seen in 20% and 40% body weight conditions. With increased body weight unloading, earlier transition from the stance to the swing phase in gait cycle was observed. Therefore, the sensory inputs from load receptors might be a key factor for the transition from the stance to the swing phase of walking.

AN ANALYSIS OF LOWER BODY KINEMATICS IN RESPONSE TO CHANGES IN SPEED IN WORLD-CLASS RACE WALKERS

GRAVESTOCK, H., TUCKER, C.B., HANLEY, B., BISSAS, A.

LEEDS BECKETT UNIVERSITY

INTRODUCTION: Race walking is a competitive athletic discipline that requires competitors to comply with rules that influence the gait used. Specifically, no visible (to the human eye) loss of contact with the ground should occur, and the knee must be fully extended from first contact with the ground until the vertical upright position (IAAF rule 230.2). This rule applies to all competitive distances of race walking and is a key part of a race walker's training. Biomechanical analysis of race walking technique, and changes in this technique with speed, is of interest to coaches, athletes and the scientific community. Therefore, the aim of this study was to evaluate lower limb kinematic changes in race walking gait with speeds that are adopted in competition and training for Olympic athletes.
METHODS: Two male and two female Olympic race walkers (age: 29 ± 3 yrs; height: 1.75 ± 0.07 m; mass: 65.1 ± 8.2 kg) volunteered to participate in the study. Participants race walked at three speeds down the 40 m walkway. Speeds were relative to individual 10 km, 20 km and training paces and measured using timing gates. Twelve optoelectronic cameras (Oqus 7, Qualisys) were used to collect kinematic data from 62 retroreflective markers on body landmarks. Kinematic data were processed in Qualisys Track Manager and exported to Visual 3D for analysis. Repeated measures ANOVA and post-hoc paired samples t-tests were conducted in SPSS to compare spatio-temporal variables. Statistical parametric mapping (SPM) was used to compare lower body joint kinematics. All SPM analyses were implemented using the open-source spm1d code in Matlab (The Mathworks Inc).
RESULTS: Mean ± SD paces for 10 km, 20 km, and training were 4.03 ± 0.28, 3.78 ± 0.26, and 3.40 ± 0.15 m/s, respectively. There was an overall effect for step length ($p = 0.007$). Post-hoc tests revealed step length was greater at 10 km speeds compared with training pace ($p = 0.011$). Despite this, no differences were observed for flexion or extension at the knee and ankle for any point of the gait cycle. Additionally, no differences were observed in the hip angle in any plane of movement at any point of the gait cycle.
CONCLUSION: Despite changes in speed and step length, there were no differences in the lower body joint angles investigated. This shows that similar ranges of motion were utilised between speeds that are representative of 10 km, 20 km and training paces. The rule that constrains race walking gait, and the training requirement to develop and maintain such a technique throughout competition, potentially explain the similarities observed in lower body kinematics of Olympic race walkers.

INFLUENCE OF DIFFERENT CONCURRENT COGNITIVE TASKS ON GAIT VARIABILITY BEFORE AND AFTER SUSTAINED COGNITIVE ACTIVITY IN YOUNG ADULTS

GUBE, M., WEIPPERT, M., KNAACK, F., BRUHN, S., BEHRENS, M.

UNIVERSITY OF ROSTOCK

INTRODUCTION: Several findings of changes in gait patterns due to simultaneously performed cognitive tasks and their association with an increased risk of falling among older adults have been reported [1]. Nevertheless little systematic evidence exists for the effect of the type of concurrent attention demanding cognitive interference task on gait variability (GV) in young adults. In addition, associations between poor cognitive abilities, especially executive functions, and increased GV [2] imply an important contribution of cognitive functioning to dual-task (DT) gait performance. Thus, the aim of the study is/was to investigate the effect of single- vs. different DT walking trials with and without previous sustained cognitive activity (SCA) on GV in young adults.
METHODS: Twenty-eight healthy young adults (11 females, 17 males; 27.0 ± 4.1 years) completed single- and DT walking trials on a treadmill before and after a control and SCA intervention in a randomized order. Spatio-temporal gait parameters, i. a. step length (SL) and step width (SW) were measured at fixed, self-selected walking-speed using the Gait Realtime Analysis Interactive Lab (GRAIL). The SCA consisted of a digital version of the Stroop-Test (color-word-interference test) for 30 min. Reading in a magazine for 30 min served as control condition. To investigate the effect of the type of the DT on the gait performance, three different cognitive tasks (mental tracking, verbal fluency, inhibitory control and selective attention task) had to be completed during the DT walking trials. Coefficient of variation (CV) of SL and SW were calculated for 50 consecutive steps to quantify GV.
RESULTS: Preliminary analyses indicated significant differences between single- and DT walking, for GV (CV SL: +7.29 % ($p < 0.01$); CV SW: +6.49 % ($p < 0.01$)). Individual response patterns after SCA as well as the effects of task type will be presented.

CONCLUSION: In accordance with previous findings for shorter distances, we observed increases in GV (CV of SL and SW) during dual- compared to single-task walking in young adults. It was further demonstrated that all types of the simultaneously performed cognitive tasks disturb gait performance during DT walking in terms of increased GV. We assume that concurrently performed attention demanding tasks compete with cognitive resources contributing to stable gait pattern. This competitive interaction could explain the significant differences in single and DT gait performance. The impact of transient impairments of cognitive functioning, i. a. mental fatigue after SCA, on DT walking will be discussed in detail.
References: [1]. Beauchet et al. (2005). Gerontology, 51(1), 48-52.
[2]. Herman et al. (2010). J Gerontol A Biol Sci Med Sci, 10:1086–1092.

THE EFFECT OF 200 AND 400M TREADMILL GEOMETRY ON MUSCLE FATIGUE

MASTALERZ, A., URBANIK, C., IWANSKA, D., TABOR, P., KARCZEWSKA, M., GRABOWSKA, O.
UNIVERSITY OF PHYSICAL EDUCATION IN WARSAW

INTRODUCTION: Previous studies of different muscles fatigue were focused on muscles co-activation and dependence on the speed. (Thelen et al., 2005; Yu et al., 2008, Mastalerz et al. 2012). The influence of geometry of the treadmill (radius of curved path) on muscle fatigue has not been studied enough.
METHODS: Four professional male athletes that have an international master class in mens 400m took part in that research. The athletes aged 24±1 were 177±3 cm high and 66±3 kg weight. Subjects gave their informed consent before participating in this study. Surface Electromyographic readings were recorded using a sixteen channel Delsys TrignoTM Mobile system (Delsys, Boston, MA) at a sampling rate of 2000Hz. EMG signals were obtained by attaching eight Trigno sensors, with fixed centre to centre spacing of 1cm over various lower limb muscles bilaterally: the belly of Rectus Femoris (RF), Bicesps Femoris (BF), Tibialis Anterior (TA), and Gastrocnemius (GA) muscles, aligned parallel to the direction of the muscle fibres, all made in accordance with the SENIAM recommendations (Hermens et al., 1999). The RAW signals were first demeaned, full wave rectified and then filtered using an eighth-order Butterworth digital filter with a bandpass filter of 40-400Hz. The mean power frequency (MPF) was then calculated as fatigue indicator.
RESULTS: Muscle fatigue was evaluated by the slope of regression line. It characterizes the rate of changes in mean power of EMG signal spectrum (MPF) during the test exercise. The fatigue was different in the inside leg and outside leg and was related to the radius of the treadmill. Results indicate that the muscle fatigue was greater for the outside (right) leg (BF – 12%, TA –3%, GA -10%), excluding RF and during running on indoor treadmill (RF – 8%, BF -12%,TA – 6%, GA – 10%).
CONCLUSION: The results proved asymmetrical biomechanics of sprinting on curved path. The higher slope coefficients of the regression line shows that the right (outside) leg is exposed to greater fatigue. It is consistent with the research of Chang and Kram (2007) in which the inside leg, during sprinting on curved path, consistently generated smaller peak forces compared to the outside leg. Higher fatigue was observed during running on an indoor treadmill for all muscles. Shorter curved radius of indoor treadmill, can involve higher joint stabilization forces and it can increase the fatigue of muscle groups. Additionally, shorter radius of curved path can influenced on more muscle fatigue because the sprinter must generate centripetal forces by applying higher lateral force on the ground with each step.
Acknowledgments
This work was supported by grant no N RSA4 05354 from the Polish Ministry of Science and Higher Education in the years 2016-2019.

Conventional Print Poster

CP-BN03 Brain-muscle-tendon function

CONTROLLING NEUROMUSCULAR PERFORMANCE: DOES CENTRAL MOTOR BEHAVIOUR DIFFER IN PRECEDING CONSECUTIVE CONTRACTIONS VS. RELAXATIONS OF ONE MOTOR SEQUENCE AT DISTINCT TORQUES?

VOGT, T.1, KATO, K.2, FLÜTHMANN, N.1, BLOCH, O.3, NAKATA, H.4, KANOSUE, K.2
1GERMAN SPORT UNIVERSITY, 2WASEDA UNIVERSITY, 3OLYMPIC TRAINING CENTRE RHINELAND, 4NARA WOMENS UNIVERSITY

INTRODUCTION: Muscle contractions and relaxations involve different activation strategies that result, at least in part, from central sensorimotor modulations. However, motor-related cortical potentials (MRCP) remain to be elucidated preceding combined contraction onsets and relaxation offsets in one consecutive motor task.
METHODS: Voluntarily, 12 healthy male participants (28±4 years, 182±7 cm, 85±7 kg) performed submaximal isometric 4 sets of 10 motor sequences (i.e. right-limb wrist flexions with 20 seconds of rest between sets), embedded in 2 initial (pre) and 2 closing (post) maximum voluntary contractions (MVC). Targeting distinct torque levels, each motor sequence comprised consecutive contractions to 20% and 40% MVC followed by relaxations from 40% and 20% MVC aiming to remain at each torque level for 3 seconds. According to the 10/20-system, 32 Ag/AgCl-channels were mounted over electrode sites representing motor-relevant cortical areas. Continuous EEG synchronized with EMG recordings (i.e. flexor carpi radialis, FCR) served to detect torque level on- and offsets for MRCP analyses, in particular the readiness potential.
RESULTS: Participants accurately maintained the motor sequences with mean values of FCR muscle activity revealing no signs of fatigue ($p>0.05$). MRCP main findings were larger amplitudes over centro-parietal electrode sites ($p<0.05$) preceding 40% compared to 20% MVC, whereas amplitudes were larger over frontal electrode sites ($p<0.05$) preceding contractions compared to relaxations.
CONCLUSION: Irrespective of the muscle activation type (i.e. contraction or relaxation), producing as well as releasing lower forces (i.e. 20% or 40%) may require similar proprioceptive and visuo-motor processing preceding consecutive motor sequences.

INFLUENCE OF NEUROMUSCULAR CAPACITY AND VO2PEAK ON RIGHT HEART STRUCTURE AND FUNCTION IN BODYBUILDERS AND ENDURANCE ATHLETES

MIRANDA, D.P.1, SANTOS, M.J.2, ALVES, W.E.F.M.2, ROCHA, E.T.2, LOPES, H.H.M.C.2, SALEMI, V.M.C.1

1: PHD PROGRAM IN CARDIOLOGY, HEART INTITUTE, FACULDADE DE MEDICINA, UNIVERSIDADE DE SAO PAULO, , 2: FUNDACAO PIO XII, HOSPITAL DE CANCER DE BARRETOS

INTRODUCTION: Both endurance training and strength training promote morphological and functional adaptations in the heart, however, these adaptations have not been fully elucidated, especially when dealing with the right atrium and right ventricle. The objective of this study was to evaluate the influence of neuromuscular capacity and VO2peak on the structure and function of the right heart of endurance athletes and bodybuilders.
METHODS: We evaluated 19 athletes aged 20 to 51 years (33.1 ± 9.2 years) being 6 endurance athletes (1 woman) and 13 bodybuilders (2 women). Right atrium (RA) and right ventricle (RV) morphology and systolic and diastolic functions were evaluated using color Doppler two-dimensional echocardiography. Radioisotopic ventriculography was used to evaluate RV ejection fraction (RVEF), time to peak filling rate of the RV (RVTPFR) and the time to emptying rate of the RV (RVTER). The VO2peak was evaluated by means of cardiopulmonary test and muscle strength by means of one repetition maximum test (1RM) in the bench press and leg press exercises. The correlation between the cardiological variables and the physical performance was verified by Spearman's correlation coefficient.
RESULTS: The largest diameter of the RA was 4.6 ± 0.7 mm, the longitudinal diameter of the RV was 8.0 ± 1.1 mm, the RVEF was 45.1 ± 6.3%, the RVTPFR was 124.3 ± 57.4 ms and the RVTER was 146.2 ± 20.5 ms. The load of 1RM in the bench press was 94.5 ± 38.4 kg and in the leg press was 321.7 ± 99.1 kg, the VO2peak was 53.4 ± 9.6 ml.kg.min. There was a high correlation between greater diameter of RA and VO2peak (r = 0.890 p = 0.001) and moderate negative correlation between RVTER and 1RM in the bench press (r = -0.639 p = 0.025) and 1RM in the leg press (r = -0.703 p = 0.011).
CONCLUSION: These data show that cardiac adaptations to training, especially of the right heart are related with neuromuscular capacity and VO2peak, and it is also related to the type of exercise predominantly performed by the athlete.
Contact: douglasmiranda@usp.br

CAN AN ACUTE BOUT OF BAREFOOT RUNNING ALTER LOWER LIMB MUSCLE CONTRACTILE PROPERTIRES?

ODDY, C., KOLODZIEJCZYK, K., DUXBURY, K., FRANCIS, P.

LEEDS BECKETT UNIVERSITY

INTRODUCTION: Kinematic changes following an acute bout of barefoot running have previously been reported. Concurrent EMG readings indicate a higher pre-activation of ankle plantar flexors prior to ground contact suggesting an acute change in muscle activity when running barefoot. At present, it is not known whether changes in muscle activity are transient (occur only during measurement) or are maintained after an acute bout of barefoot running. Understanding alterations in muscle contractile properties post-activity may be the first step toward understanding the longer term adaptive responses of skeletal muscle to barefoot running. The aim of this study was to measure lower limb muscle contractile properties (Tensiomyography; TMG) prior to and after an acute bout of barefoot running.
METHODS: Following ethical approval by the Leeds Beckett University research ethics committee, 29 recreational runners, (age=28±6 years, height=173.15±10.04cm, weight=69.83±13.27 kg), free from injury and without prior exposure to prolonged periods of barefoot running provided written informed consent to participate in this study. Each participant had a measure of lower limb (Gastrocnemius Lateralis and Medialis, GL, GM; Gluteus Maximus; GT) maximal muscle displacement (Dm) and contraction speed (Tc) assessed at baseline using TMG. Following baseline assessments, all participants carried out 5-minutes of running in their normal running shoes at a pace akin to their normal warm-up intensity. Subsequently, participants were randomised to perform 10-15 minutes of running shod (n=15) or barefoot (n=14). Muscle contractile properties (Dm, Tc) were immediately re-assessed post-running. The dependent variable, change in muscle contractile properties, was calculated for both groups and a one-way ANOVA was used to compare the mean difference between groups.
RESULTS: The change in lower limb (GM, GL, GT) Dm was not different between groups (P>0.05). Those in the barefoot group had a faster speed of contraction (Tc) in the GM muscle relative to their shod counterparts post running (P=0.05). The change in Tc was not different between groups for any other muscle (P>0.05).
CONCLUSION: The results of this study demonstrate a shorter contraction time for the medial portion of the gastrocnemius after an acute bout of barefoot running. The increased speed of contraction, after barefoot running, may suggest a post-activation potentiation of the muscle. These findings are inline with the increased pre-activation of the plantar flexor muscles observed during barefoot running when measured by EMG activity.

THE EFFECT OF MUSCLE RELAXATION ON SUSTAINED CONTRACTION FORCE OF OTHER MUSCLES IN THE LIMB.

KOJI, T., KOUKI, K., KAZUYUKI, K.

WASEDA UNIVERSITY

INTRODUCTION: Many sports movements consist of contracting and relaxing multiple muscles at different strengths at the same time. Previous study suggest that novice badminton player showed excessive muscle activity compared to that of experts (Sakurai and Ohtsuki, 2000). Furthermore, many studies investigated that both of muscle contraction and relaxation of one limb affect muscles activity of the other limb (Tazoe et al.,2007; Kato et al., 2015). However, the effect of muscle contraction and relaxation on the other muscles within the same limb has not well understood. We previously demonstrated that relaxation from 50% MVC affected muscle activity in other muscle within the same limb. The purpose of the present study is to clarify the effect of muscle relaxation from relatively weak intensity (5% MVC).
METHODS: Subjects were asked to volitionally relax or contract the other muscle while simultaneous contraction of one muscle in response to an auditory stimulus. It was combined by flexor of the finger and flexor of elbow(Exp.1) or flexor of the finger and abduction of the shoulder (Exp.2). Force magnitude of finger flexor was targeted 5% MVC, force magnitude of elbow flexior and shoulder abductor were targeted to 50% MVC. Electromyography (EMG) were recorded from the right first dorsal interosseous (FDI), extensor digital muscle (ED), deltoid muscle(DM) and pectoralis major muscle(PMM).
RESULTS: In Exp.1, force magnitude of sustained contraction for elbow flexor was decreased temporally by relaxing finger flexor muscle of contraction. Force magnitude of sustained contraction for finger flexor was decreased by relaxing elbow flexor muscle of contraction.
In Exp.2, force magnitude of sustained contraction for shoulder abductor was decreased temporally by relaxing finger flexor muscle of contraction. Force magnitude of sustained contraction for finger flexor was increased by contracting shoulder abductor muscle.

CONCLUSION: In this study, it was clarified that relatively small muscle activity (5% MVC) affects the sustained force of other muscles in the same limb. Therefore, the muscle activity of 50% MVC affects within the limb, as well as 5% MVC. In sports movements, experts control multiple muscles at an appropriate timing and strength than novice. In this study it became clear that small force contraction and relaxation affect other muscle activity. From this, it is considered important to appropriate control not only large muscle activity like agonist muscle, but also small activity like accessory muscles related to the movement in order to do efficient sports movements.

EFFECTS OF HIGH- AND LOW-FORCE ISOMETRIC EXERCISE ON CERVICOMEDULLARY MOTOR EVOKED POTENTIALS

NUZZO, J.L., BARRY, B.K., GANDEVIA, S.C., TAYLOR, J.L.

NEUROSCIENCE RESEARCH AUSTRALIA

INTRODUCTION: Acute isometric resistance exercise of the elbow flexors can facilitate cervicomedullary motor evoked potentials (CMEPs) in resting biceps brachii (Nuzzo et al. 2016; Nuzzo et al. in press). The purposes of this study were to determine if (a) this facilitation is due to increased motoneuron excitability or enhanced corticospinal transmission and (b) the intensity of exercise influences any effect.
METHODS: Ten participants completed 12 sets of 8 high-force (75% maximal voluntary contraction, MVC) isometric contractions of the elbow flexors in one session. In another session, they completed 12 sets of low-force isometric contractions (15% MVC). Electrical stimulation at the cervicomedullary junction was used to evoke CMEPs in resting biceps before and then at 5, 15, and 25 minutes after exercise. To "clamp" motoneuron excitability and examine the role of corticospinal transmission, CMEPs were also acquired during weak contractions of the elbow flexors (~10% biceps maximal EMG). All CMEPs were normalised to the maximal compound muscle action potential (Mmax). During the exercise and measurement procedures, the shoulder was flexed at 90 degrees, the elbow was flexed at 90 degrees, and the forearm was supinated. A two-way ANOVA was used to test for main effects of Time and Exercise Intensity and an interaction.
RESULTS: There were no main effects for Time or Exercise Intensity for biceps CMEPs at rest or during weak contraction (all $p > 0.05$). There was also no Time x Exercise Intensity interaction. On the day that involved high-force exercise, CMEPs in resting biceps were (mean ± SD): 10.2 ± 4% of Mmax at baseline; 10.9 ± 5.8% of Mmax at 5 min post-exercise; 11.2 ± 7.6% of Mmax at 15 min post-exercise; and 9.9 ± 6.6% of Mmax at 25 min post-exercise. On the day that involved low-force exercise, CMEPs in resting biceps were: 13.1 ± 4.7% of Mmax at baseline; 11.7 ± 5.8% of Mmax at 5 min post-exercise; 12.1 ± 4.4% of Mmax at 15 min post-exercise; and 10.9 ± 3.8% of Mmax at 25 min post-exercise.
CONCLUSION: When low- or high-force isometric exercise of the elbow flexors is performed with the elbow flexed and forearm supinated, the exercise does not alter motoneuron excitability or corticospinal transmission (i.e., CMEPs). Previous studies have observed facilitation of CMEPs after acute isometric exercise of the elbow flexors (Nuzzo et al. 2016; Nuzzo et al. in press). Thus, the cause of the inconsistent results requires clarification. At present, the upper-limb posture used in the current study does not appear to be useful for studying changes in the spinal cord with acute resistance exercise.

CROSS-SECTIONAL AREA OF QUADRICEPS FEMORIS NEGATIVELY RELATES TO 100-M SPRINT TIME IN LONG DISTANCE RUNNERS

ANDO, R.1, TANJI, F.1, OHNUMA, H.1, CHINO, K.1, IKEDA, T.1, YAMANAKA, R.2, SUZUKI, Y.1

1: JAPAN INSTITUTE OF SPORTS SCIENCES , 2: TEIKYO HEISEI UNIVERSITY

INTRODUCTION: It is generally known that sprint ability would be very important to win the long distance race (e.g., 5000-m or 10000-m). One of determinant factors of sprint ability is lower limbs muscularity because it was recently indicated a possibility that muscle volume of quadriceps femoris negatively related to sprint performance in sprinters (Sugisaki et al. 2017). However, it is never demonstrated if this relationship exists in long distance runners as well. The purpose of this study therefore was to examine the relationship between muscle volume in the thigh and sprint performance in long distance runners.
METHODS: Twenty Japanese male long distance runners (Age: 25.8 ± 3.3 yr, height: 171.6 ± 5.2 cm, Body weight: 57.4 ± 3.7 kg, VO2max: 70.9 ± 3.3 ml/kg/min) participated in the study. T1-weighted spin-echo transaxial images of the right thigh were collected from the greater trochanter to the lateral epicondyle using a 3.0-T magnetic resonance (MR> imaging. The cross-sectional areas (CSAs> of quadriceps femoris, hamstrings and adductor were calculated from MR image which corresponded to 50% of femur length. We then measured 100-m sprint time and requested an official personal record of 10000-m race time. Relationships between 100-m sprint time and 10000-m race time, and each muscle group CSA and 100-m sprint time were examined using a Pearson product moment correlation.
RESULTS: 100-m sprint and 10000-m race times were 13.44 ± 0.61 (12.42–14.34> and 28:26.98 ± 00:31.92 (27:29.69–29:06.64>, respectively. CSAs of quadriceps femoris, hamstrings and adductor were respectively 69.2 ± 5.4 cm2, 32.1 ± 2.8 cm2 and 28.0 ± 4.5 cm2. There was a significant correlation between 100-m sprint time and 10000-m race time ($r = 0.491$, $P < 0.05$). CSA of quadriceps femoris significantly correlated to 100-m sprint time ($r = 0.613$, $P < 0.05$), whilst those of hamstrings and adductor were not significantly correlated ($P > 0.05$).
CONCLUSION: First of all, we confirmed that sprint ability was also important to win in the long distance race in the present study. Furthermore, association between CSA of quadriceps femoris and 100-m sprint time was demonstrated in long distance runners as previously shown in sprinters (Sugisaki et al. 2017). These results may suggest that greater volume of quadriceps femoris would be negative factor for the sprint ability, which also affects to long distance running performance.

DISTRIBUTION OF DISPLACEMENT IN THE QUADRICEPS MUSCLES DURING ISOMETRIC CONTRACTIONS REVEALED BY VELOCITY ENCODING PHASE CONTRAST MR

ODA, T., MALIS, V., FINNI, T., SINHA, S.

HYOGO UNIVERSITY OF TEACHER EDUCATION, UNIVERSITY OF CALIFORNIA SAN DIEGO, UNIVERSITY OF JYVÄSKYLÄ

INTRODUCTION: The quadriceps muscles contribute to functional ability and have important roles in many human movements such as jumping. Relative contribution of different muscles have been studied using surface electromyography but MR provides means for investigation of displacement of synergistic muscles. This may provide essential information on mechanical work which is determined as the product of force and displacement. The purpose of the present study was to investigate distribution of displacement between vastus medialis (VM), vastus lateralis (VL), vastus intermedius (VI), and rectus femoris (RF).
METHODS: Seven healthy male subjects were asked to isometrically contract and relax knee extensor muscles at 40% of maximal voluntary contraction in an MR setting. Muscle tissue velocities across entire cross-sectional area of thigh was assessed during the contractions using gated, velocity-encoded phase contrast MR images with specially designed MR compatible torque measurement system.

Subsequently, tracking algorithms applied at three different cross sectional slices along the longitudinal axis (proximal, middle and distal thigh) yielded the spatial distribution of displacement.
RESULTS: The distribution of displacements showed remarkably large variation even within each muscle in each plane. The highest proximal-distal displacement tended to concentrate around the aponeurosis (central aponeurosis) separating VI from other muscles surrounding it. The amplitudes of displacements of muscle tissues on one side of the central aponeurosis demonstrated almost similar values to those from the opposite direction. These results give rise to the possibility of synchronized length changes at these junctions. In the middle thigh, total displacement of VM was significantly larger than that of VL (p=0.005). In the distal thigh, the total displacement of VI was significantly larger than VL (p=0.004) and RF (p=0.002). In comparison of proximal-distal displacement corresponding approximately to the line of action, VI tended to show larger displacement than all the other muscles in all the sections. This large displacement of VI might imply high contribution of work generation along the length of the muscle. VM and VL demonstrated large in-plane movement in proximal section.
CONCLUSION: The results of the present work suggests that different quadriceps muscles act synchronously to produce force and displacement along the direction of line of action through the central aponeurosis, with different contribution of each muscle, which would result from architectural, morphological and physiological variations in four muscles.

ASSOCIATION OF MUSCLE SIZE AND FUNCTION WITH FORCE-VELOCITY PROFILE IN BALLISTIC ELBOW FLEXION.

NAKATANI, M., OYAMADA, K., MURATA, K., KANEHISA, H., TAKAI, Y.

NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA

INTRODUCTION: Inverse force-velocity (F-v) relationship during ballistic movements have been investigated to understand muscle mechanical properties of limbs (e.g. Samozino et al., 2012). The steeper slope obtained from F-v relationships means the higher the force capabilities compared with velocity ones. Muscle size is the main determinant of muscle function. On the other hand, the well-trained men have the lower muscle quality during isometric contraction (e.g. muscle force per cross-sectional area) (Sale et al., 1987), resulting from fiber type distribution, large pennation angle, and neuromuscular activities. However, it is unclear concerning association of F-v profile with each of muscle size and function. The purpose of this study aimed to clarify the relationships between F-v profile and muscle size and function.
METHODS: Forty men (bodybuilder, gymnasts, judo athletes and active men) performed ballistic elbow flexion at an intensity of 0, 15, 30, 45, 60 and 75% of maximal voluntary contraction (MVC) load. MVC was measured at 40 deg flexed elbow joint. The subjects were asked to flex the elbow as strongly and quickly as possible against 6 different loads. The upper arm was securely fastened to a plate of a custom-made dynamometer and the forearm was secured to a lever arm which rotated around the axis of the dynamometer. Force was measured with a load cell attached to the wrist. Velocity of elbow flexion was calculated from the angle of the lever arm measured with a potentiometer. F-v profile was defined as the slope obtained from the relationship between force and velocity. The muscle thickness (MT) of biceps brachii at 60% of upper arm length was measured with a brightness-mode ultrasound. Muscle cross-sectional area index (CSAindex) was calculated from the equation (MT/2)2 x pi.
RESULTS: F-v profile was 143.8 ± 47.8 N/m/s. MVC and CSAindex were not significantly related to the F-v profile in ballistic elbow flexion. MVC per CSAindex was negatively associated with the F-v profile ($r = -0.431$, $P < 0.05$), indicating that a man with lower MVC per CSAindex have the higher force capabilities.
CONCLUSION: In ballistic elbow flexion movement, F-v profile may depend on muscle function per muscle size.
REFFERENCE:
Samozino et al., Optimal force-velocity profile in ballistic movementsaltius: citius or fortius? Med Sci Sports Exerc. 2012.
Sale et al., Voluntary strength and muscle characteristics in untrained men and women and male bodybuilders. J Appl Physiol. 1987.

CONTRIBUTION OF EACH HEAD OF QUADRICEPS FEMORIS MUSCLE DURING SINUSOIDAL FORCE EXERTION

TOMITA, A.1, AKIMA, H.1, MASANI, K.2

1: NAGOYA UNIVERSITY , 2: UNIVERSITY OF TORONTO

INTRODUCTION: The quadriceps femoris muscle (QF) plays a critical role in various lower limb movements, such as standing and walking. The quadriceps femoris muscle consists of four muscles heads, i.e., vastus lateralis (VL), vastus intermedius (VI), vastus medialis (VM), and rectus femoris (RF). While their anatomical structures are different among these four muscle heads, it is unknown how each muscle head contributes to controlling the knee joint torque. Here we investigated the contribution of each muscle head during sinusoidal force matching tasks, by focusing on the force fluctuation using a muscle model under isometric condition and an optimization technique.
METHODS: Thirteen healthy men and women (23 ± 4 years) performed force controlled, isometric knee extension tasks at knee joint angle of 90°. The force controlled task consisted of 30-sec sinusoidal force exertion with a frequency of 0.25 Hz, and at 30-50% (Hi) and 4-8% (Lo) of the maximal voluntary contraction. The participants matched the exerted force to the target sinusoidal wave on a computer monitor. Surface electromyograms (EMGs) were recorded from the four muscle heads in the QF muscle. We used a critically-damped 2nd order system as he muscle model whose input was a rectified EMG signal from each muscle head and whose output was the estimated muscle torque was fit with the measured knee joint torque, by optimizing the parameters of the four 2nd order systems using Direct optimization method. To prioritize fitting force fluctuations along the target sinusoidal wave, the cost function was set to the root square error in the derivative of joint torque. The contribution of each muscle was calculated as the percentage of the standard deviation of each muscle output divided by the standard deviation of estimated total torque output.
RESULTS: The contribution of each muscle head was as follows; Hi: VI 12.1 ± 11.1 %, VL 25.0 ± 15.3 %, VM 39.4 ± 24.4 %, RF 23.9 ± 13.9 %, and Lo: VI 21.3 ± 13.7 %, VL 38.5 ± 18.2 %, VM 20.0 ± 6.7 %, RF 20.5 ± 16.3 %. Bonferroni multiple comparison test revealed that VM was significantly higher than VI ($p = 0.038$) and VL ($p = 0.007$) in Hi contraction, and that VL was significantly higher than VM ($p = 0.038$) in Lo contraction.
CONCLUSION: During the sinusoidal force-matching task, VM has the highest contribution in Hi contraction, whereas VL has the highest contribution in Lo contraction. The result suggests that the contribution of each muscle head depends on the amount of joint torque. The proposed method relies on assumptions that the measured EMG represents the entire muscle activity and the critically-damped 2nd order system accurately represents the muscle torque exertion, whereas this method can be a useful tool in investigating the force contribution of synergistic muscles.

INFLUENCE OF KNEE JOINT ANGLE ON MECHANICAL ACTIVITY OF KNEE EXTENSOR MUSCLES AND PATELLAR TENDON UNDER ISOMETRIC CONTRACTION

TANAKA, S.1, IMAWAKA, T.1, YOKOZAWA, S.1, SRDJAN, D.2, TSUNODA, N.1

1: KOKUSHIKAN UNIVERSITY , 2: TMG-BMC CO.

INTRODUCTION: It is well known that the generation of muscle force depend on muscle length. Tension generated by muscle contraction causes articulation through the tendon. The mechanical activity of the muscle-tendon complex is an important factor for producing muscle force during exercises. The muscle contraction (MC) sensor is possible to evaluate the mechanical activity during muscle contraction (Srdjan et al., 2011, 2014). However, there are not many report on the mechanical activity of muscle-tendon complex during force output using the MC sensor. Therefore, the purpose of this study was to investigate the mechanical activities on knee extensor muscles and patellar tendon under the isometric contraction with different knee joint angle by MC sensor.
METHODS: The subjects were 11 healthy males. Morphological parameters of vastus medialis (VM), rectus femoris (RF), vastus lateralis (VL) and patellar tendon (PT) were measured by ultrasound method. Knee extensor torque under the isometric contraction with knee joint angle of 30 (K30), 60 (K60) and 90 (K90) degrees were measured using a dynamometer. At the same time, deformation amount as an index of mechanical activity on VM (MC_VM), RF, VL and PT (MC_PT) were measured by method of MC sensor (TMG-BMC co.). The MC signal indicate deformation amount of muscle and tendon by contraction.
RESULTS: The deflection of PT in K30 was greater than that of K90 and K60. The peak torque of K90 and K60 were significantly higher than that of K30. Significant correlation was observed between torque and deformation amount of knee extensor muscles in all condition. At the extended position, MC_VM with increase torque was higher than that of flexion position. On the other hand, MC_PT indicated a peak value at 20% torque, and K30 showed a significantly lower than that of K90 and K60.
CONCLUSION: A High linearity and good dynamic properties were showed between torque and deformation amount of knee extensor muscles under isometric contraction with any joint angle. MC_VM changed by knee joint angle. VM has role of stabilizing the patella in knee extension (Belli G et al., 2015). In more extended position, it was considered that VM was influenced by the remarkable activity. Also, MC_PT depended on knee joint angle. From these results, it was suggested that the flexion position increases the mechanical activity of muscle-tendon complex, whereas in the extended position it reduction the mechanical activity of PT.
References: Srdjan D, Sara S, Andrej M, Veljko M, Saso T. (2011). Sensors, 11, 9411-9425.
Srdjan D, Saso T, Marco N, Rado P, Andrej M. (2014). Sensors, 14, 1-16.
Belli G, Vitali L, Botteghi M, Vittori LN, Petracci E, Maietta LP. (2015). J Mech Med Biol, 15(2), 1540037.
Contact: st4986@hotmail.com

FATIGUE-INDUCED CHANGES IN KNEE EXTENSOR TORQUE COMPLEXITY AND MUSCLE METABOLIC RATE ARE JOINT ANGLE DEPENDENT

BURNLEY, M.

UNIVERSITY OF KENT

INTRODUCTION: The temporal structure, or complexity, of muscle torque output is an important index of neuromuscular function, reflecting the ability to control and adapt motor output in response to task demands. It has been demonstrated that neuromuscular fatigue reduces the complexity of muscle torque output during contractions performed above the critical torque (Pethick et al., 2016). At these contractile intensities, a metabolic steady state is not attainable. It is therefore of interest that it has been proposed that system metabolic rate and complexity are inversely related: as system metabolic rate increases, physiological complexity should decrease (Seely and Macklem, 2012). During isometric contractions at short muscle lengths, muscle oxygen consumption is reduced and endurance increased (de Ruiter et al., 2005). This study tested the hypothesis that there would be an inverse relationship between knee extensor torque output complexity and vastus lateralis metabolic rate (mt Ό2) that would be conserved at different muscle lengths.
METHODS: Ten healthy participants performed intermittent isometric contractions of the knee extensors at 50% MVC for 30 minutes or until task failure (whichever occurred sooner) at 30, 60 and 90° of knee flexion (with 0° being full extension). The duty factor for the contractions was 60%, i.e. 6 seconds contraction, 4 seconds rest. Torque and surface EMG were sampled continuously. The mt Ό2 was determined using near-infrared spectroscopy and arterial occlusion. Complexity and fractal scaling of torque were quantified using approximate entropy (ApEn) and the detrended fluctuation analysis (DFA) α scaling exponent. Results are presented as means ± SEM.
RESULTS: Complexity significantly decreased during contractions at 90° and 60° (decreased ApEn, increased DFA α, both $P < 0.001$), but not at 30°. The mnΌ2 significantly increased at 90°, 60° and 30° (all $P < 0.001$), but the magnitude of this change was significantly lower at 30° compared to 60° ($P = 0.001$) and 90° ($P = 0.007$). There were significant correlations between complexity and m(Ό2 at 90° (ApEn, $r = –0.588$, $P = 0.037$), 60° (ApEn, $r = –0.657$, $P = 0.019$; DFA α, $r = 0.774$, $P = 0.004$) and 30 ° (ApEn, $r = –0.666$, $P = 0.018$; DFA α, $r = 0.940$, $P < 0.001$).
CONCLUSION: These results suggest that muscle metabolic rate and torque output complexity are correlated, and that these correlations are conserved with changes in muscle length. These results support the hypothesis of Seely and Macklem (2012) that physiological complexity and system metabolic rate are inversely related.
References: de Ruiter, C.J., De Boer, M.D., Spanjaard, M. and De Haan, A. (2005). J Appl Physiol, 99, 579-586.
Pethick, J., Winter, S.L. & Burnley, M. (2016). Am J Physiol Regul Integr Comp Physiol 310, R1144-R1153.
Seely, A.J.E. and Macklem, P. (2012). Chaos, 22, 03108.

Conventional Print Poster

CP-BN04 Skill acquisition and motor learning

TALENT IDENTIFICATION BASED ON THE SOCCER-SIMULATOR SKILLS.LAB

QUEDER, T., KONRAD, A.

KARL-FRANZENS UNIVERSITÄT GRAZ

INTRODUCTION: Additional to physical requirements, technical and tactical skills are of great importance in soccer. Therefore, the process of scouting youth soccer players could be very complex (Larkin & O'Connor ,2017). Hence, the purpose of this study was to investigate if

the soccer-simulator skills.lab could distinguish between youth professional players (YPP) and youth recreational players (YRP) in the same age.
METHODS: 21 male YPP from SK Sturm Graz Academy (mean±SD, 13.2±0.31 years, 157.8±8.3cm, 44.3±7.6kg) and 16 male YRP from recreational clubs (mean±SD, 13.4±0.33 years, 161.4±8.0cm, 46±6.4kg) volunteered in this study. In total the subjects went through three selected exercises in skills.lab, namely "trapping and passing", "dribbling and passing", and "trapping and shooting" with the dominant leg, with the non-dominant leg, respectively. Every exercise consisted of two parameters, "handling time" and "distance to target". Skills.lab is able to automatically measure those parameters. To calculate an overall score of an exercise (including handling time and distance to target) all parameters were standardized and summarized. A t–test was performed to verify if the mean values of the groups in the overall score, in the parameters were different, respectively.
RESULTS: We found a significant better performance (i.e. overall score) in the YPP in all exercises ("trapping and passing", "dribbling and passing", "trapping and shooting") compared to the YRP in the dominant and non-dominant leg. Concerning the parameter "handling time" YPP showed a significantly quicker performance compared to YRP in all three exercises and both legs. Regarding the parameter "distance to target" YPP showed higher passing accuracy compared to YRP in the exercise "trapping and passing" only.
CONCLUSION: The outcomes of this study are in accordance with Huijgen et. al (2014), who showed that YPP had better physical, technical, and tactical skills compared to YRP. In our study YPP showed quicker ball processing and treatment compared to YRP in all exercises. Moreover, in the exercise "trapping and passing" YPP reached a higher passing accuracy in the soccer-simulator skills.lab. Therefore, we can conclude that skills.lab is able to distinguish between YPP and YRP and might be a useful tool in the process of scouting.
References:
Larkin P., O'Connor D. (2017). Talent identification and recruitment in youth soccer: Recruiter`s perceptions of the key attributes for playe recruitment. PLoS ONE12 (4):e0175716
Huijgen BCH., Elferink-Gemser MT., Lemmink KAPM., Visscher C.(2014).Multidimensional performance characteristics in selected and deselected talented soccer players. Eur J. Sport Sci, 14: S. 2 - 10
Contact: thomas.queder32@gmx.at

THE ASSOCIATION BETWEEN SELF-PERCEIVED MOTOR COMPETENCE AND ACTUAL MOTOR COMPETENCE IN BRITISH CHILDREN FROM EARLY AND MIDDLE CHILDHOOD.

LAWSON, C., DOBELL, A., EYRE, E.L.J., NOON, M.R., DUNCAN, M.J.
COVENTRY UNIVERSITY

INTRODUCTION: The role of motor competence (MC) in providing children with the skills to be physically active is well known (Barnett et al., 2015). Recently perceived motor competence (PMC) has been shown to be a strong correlate of actual MC in adolescents (Babic et al. 2014). Few studies have examined the association between MC and PMC in younger children and some authors suggest that PMC in younger children does not match actual MC (Harter and Pike, 1984). Others have suggested that middle childhood marks the point in which children become accurate in self-perception (Barnett et al. 2015). This study addresses this issue by examining if actual MC differed in children who were high and low for PMC or from different developmental stages in childhood.
METHODS: Following ethics approval and parental consent, 118 children (64 Boys, 52 Girls, 6-11 years old) from two primary schools in England participated in this study. Children were categorised as early childhood (ages 6-7, n=64) and middle childhood (ages 10-11, n=52). MC (run, jump, throw, catch) was assessed using the Test of Gross Motor Development-2 (Ulrich, 2000) from which measures of total MC (0-30) object control (OC, 0-14) and locomotor skill (LM, 0-16). PMC was assessed using the Pictorial Scale for Perceived Movement Skill Competence (Barnett et al., 2015). A median split was then used to classify children as high or low for PMC. A series of ANOVAs were used to examine any differences in actual MC, OC and LM between boys and girls, early and middle childhood and high and low PMC.
RESULTS: Results indication no significant higher order interactions for actual MC, OC or LM (all P>0.05). Children high for PMC had significantly higher actual MC than children who were low for PMC (P = 0.05). For actual MC, boys had significantly higher scores than girls (P = 0.20), actual MC was significantly higher for children in middle compared to early childhood (P = 0.00) and children high for PMC had significantly higher actual MC than children who were low for PMC (P = 0.26). When LM was examined, there were no significant main effects for gender or PMC, however, LM scores were higher for children in middle compared to early childhood (P = 0.00). Conversely, for OC boys had significantly higher scores than girls (P =0.02), actual MC was significantly higher for children in middle compared to early childhood (P = 0.00).
CONCLUSION: The results of this study identify two important aspects that have not been documented in the literature previously. Firstly, the perception of MC in children in both early and middle childhood matches their actual MC. Secondly, OC skills may be more important for children in formulating their self-perception of their own competence compared to locomotor skills. Such findings underline the importance of PMC for children actual MC and are contrary to prior suggestions that young children's perceptions of their own competence may not be aligned to their actual MC.

THE ASSOCIATION BETWEEN PERCEIVED COMPETENCE AND ACTUAL MOTOR COMPETENCE IN 4-7 YEAR OLD BRITISH CHILDREN

NOON, M.R., EYRE, E.J., LAWSON, C.A., DOBELL, A.P., DUNCAN, M.J.
COVENTRY UNIVERSITY

INTRODUCTION: Regular physical activity in children is associated with short and long-term psychological and physiological health benefits. Motor skill development has an important role in promoting lifelong physical activity (PA). While research has identified a relationship between perceived motor competence, physical activity and actual motor competence (Babic et al. 2014), this has focused on older children or has been assessed linearly. Subgrouping younger children using tertiles may provide a better understanding of how perceived competence relates to actual motor competence since younger children are presupposed to form less accurate perceptions of their competence compared to actual competence (Harter and Pike, 1984). This study sought to address this issue by examining whether actual motor competence differs between children who perceive themselves to have differing level of perceived motor competence.
METHODS: Following ethics approval and parental informed consent, 290 children (158 boys; 132 girls aged 6 ± 1 years) from 4 primary schools, participated in this observational study. Weight status was assessed using BMI. Product measures of motor skills were assessed using 10m sprint speed using smart speed pro light gates (Fusion Sport Coopers Plains, Australia), 1kg seated medicine ball throw and standing broad jump measured using a tape measure. Product scores were combined to create a Z score. Perception of motor skills was

assessed using the Pictorial Scale of Motor Competence (Barnett et al., 2016) for run, jump, throw and catch (0-16). For analysis, perceptions of motor competence were subgrouped using tertiles. A 2 (Sex) by 3 (high, medium or low perception score) factor ANCOVA, controlling for BMI assessed differences in perceived motor competence and product assessed motor skills.
RESULTS: Results identified no significant sex X perception interaction for motor competence (P = 0.33). However, a main effect for perception was found (P= 0.001), where children in the high perception group (mean ± SD: 0.46 ± 2.59 AU) had better motor skills and those with low perception (mean ± SD: -0.84 ± 2.10 AU) observing lower motor skill performance. BMI was a significant covariate (P=0.04; ß= -0.15).
CONCLUSION: The results of this study suggest further support for the link between perception of motor skill development and actual motor skills. Although establishing cause and effect is challenging, the findings suggest that developing a high perceived motor skill competence in children may be determinant of actual motor development and vice versa. The work highlights the role of motor skill interventions to improve perception of motor competence in children, which may impact on lifelong physical activity although further research is needed to confirm this.

ASSOCIATIONS OF MOTOR ABILITY AND NEUROELECTRIC AND BEHAVIORAL INDICES ON TASK SWITCHING IN CHILDREN WITH ATTENTION-DEfiCIT/HYPERACTIVITY DISORDER

HUNG, C.L., HUANG, C.J., TSAI, Y.J., HUNG, T.M.

DEPARTMENT OF ATHLETIC

INTRODUCTION: The purpose of the current study was to examine the relationship between motor ability and task switching using behavioral and electrophysiological indices in children with ADHD.
METHODS: A total of 30 participants were recruited and underwent a motor ability assessment by administering the Movement ABC as well as the task switching and event-related potential (ERP) measurements at the same time.
RESULTS: Methods: A total of 30 participants were recruited and underwent a motor ability assessment by administering the Movement ABC as well as the task switching and event-related potential (ERP) measurements at the same time.
The results indicated that the MABC scores were positively associated with the response accuracy and ERP P3 amplitude. Specifically, the MABC average score was associated with higher accuracy and lager P3 amplitude. Furthermore, higher MABC scores predicted a larger P3 amplitude in the mixed, non-switching and switching trials.
CONCLUSION: Our findings suggest that motor abilities may play roles that benefit the cognitive performance of switching in children with ADHD.

THE EFFECTS OF TWO DIFFERENT FREQUENCIES OF FEEDBACK DURING THE PROCESS OF LEARNING A COMPLEX GYMNASTIC SKILL

NIZNIKOWSKI, T., MASTALERZ, A., BUSZTA, M., BIEGAJLO, M., NOGAL, M.

JOZEF PILSUDSKI UNIVERSITY OF PHYSICAL EDUCATION IN WARSAW, FACULTY OF PHYSICAL EDUCATION AND SPORT IN BIALA PODLASKA, POLAND

INTRODUCTION: Gymnasts demonstrate stability in the performance of complex and difficult elements, routines and individual styles of sports techniques. The most characteristic peculiarities are the precise postures and body positions which change dynamically during the phases and key elements of a gymnastic exercise. However, the analysis of the phase structure of an executed gymnastic exercise and routine (both basic and competitive of various complexity) shows rather significant andeven gross technical errors in exercises of many athletes (Niznikowski et al. 2007). This is especially peculiar to the key elements of preparatory and final actions of a gymnastic exercise and routines (Sadowski et al. 2013). The aim of this study was to gain knowledge about the effects of two different frequencies of feedback during the process of learning a complex gymnastic skill, the salto backward stretched, performed after the round-off flick-flack on the balance beam.
METHODS: Twenty-eight top-level female gymnasts participated in the study. Mean values of body height, mass and age were as follows: 162 cm ± 3.2 cm, 52.4 kg ± 2.3 kg, 20 ± 3.3 years, respectively. The gymnasts were randomly assigned to one of the two groups: group A - with feedback about key elements (n=14) or group B - with 100% feedback (n=14). Group A was provided with error information regarding the key elements of movement techniques only. Group B received feedback on all errors that occurred. Technical performance (performance of particular routines) was evaluated by experts (3 judges).
RESULTS: At the beginning of the experiment (pre-test), the differences between the key elements and the mean values obtained by groups A and B for performing the the salto backward stretched, performed after the round-off flick-flack on the balance beam, were not significant ($p>0.05$). The experiment effect was analysed using ANOVA with repeated measures (Group x Test Time). The post hoc comparison indicated significant differences between the feedback applied in both groups during the retention test ($p<0.05$) and the delayed retention test ($p<0.05$) in favour of group A.
CONCLUSION: Providing too much verbal feedback during the learning of a complex gymnastic skill, the salto backward stretched, performed after the round-off flick-flack on the balance beam proved to be less effective than limited verbal feedback about the key elements of movement techniques.
Verbal feedback on errors about the key elements of movement techniques was more effective than 100% feedback of the movement performance.
Acknowledgements
The research was financed from grant number N RSA4 03254 within the project "Development of Sports at University"
Niznikowski, et al. (2007). Technology of teaching of sports technique for exercises with complex movement structure. Research Year Book, 13, 38-42.
Sadowski, et al. (2013). Benefits of bandwidth feedback in learning a complex gymnastic skill. Journal of Human Kinetics, 37, 183-193.

STRATEGIES OF SELF-CONTROLLED TASK DIFFICULTY DETERMINE MOTOR LEARNING EFFECT

WANG, C.Y., JWO, H.

NATIONAL TAIWAN NORMAL UNIVERSITY

STRATEGIES OF SELF-CONTROLLED TASK DIFFICULTY MOTOR LEARNING EFFECT
Chung-Yin, WANG & Hank Junling, JWO (National Taiwan Normal University, Taipei, Taiwan)

Introduction: Self-controlled practice refers to the learner has autonomy of choice and can use strategies to acquire the best motor learning benefit during practice phase. Few previous studies of self-controlled practice investigated what the strategies were used by learners. Thus in this study, we focus on learners' strategy of self-controlled task difficulty to explore how the strategy to affect motor learning effect. Four questions were asked as follows: (1) Whether self-controlled learners' motor performance is better than the yorked and was self-efficacy higher than the yorked in acquisition phase? (2) Does motor performance correlate with self-efficacy during acquisition phase? (3) Does self-controlled practice benefit learners' motor learning? and (4) Whether self-controlled practice learners chose relatively medium task difficulty level and cause motor learning better than the chose outlier task difficulty levels?
Method
Fifty participants (mean age=23±4.1 yr.) were recruited, who were randomly assigned to either self-controlled group or yorked group. Puck-shuffling was used as experimental task. All participants completed 60 trails during acquisition. The self-controlled group was allowed to choose task difficulty level before each trial, then, self-efficacy was assessed after these choices. In contrast, yoeked groups' task difficulty level was transferred accord with the self-controlled group. After 24 hours, twelve trials were completed to examine motor learning effect through retention test.
Results: The results showed that a significant negative correlation was found between two groups' self-efficacy and absolute error. Self-controlled group's absolute error was significantly lower than that of yorked group, and self-efficacy was higher than yorked group during acquisition phase. In retention test, self-controlled group's absolute error was significantly lower than yorked group. In comparison with the learners chose outlier task difficulty level, learners chose medium task difficulty level were found a significantly lower absolute error.
Conclusion
Thus, it is suggested that (1) self-controlled practice leads to higher self-efficacy and better motor performance, (2) self-efficacy correlates with motor performance, (3) self-controlled practice promotes motor learning effect, and (4) in self-controlled task difficulty, the learners choose relatively medium level of difficulty facilitates motor learning effect.

DETERMINANTS OF SELF-CONTROLLED FEEDBACK BEHAVIOR: EXAMINATION OF DECISION TIMING AND PREVIOUS MOVEMENT PERFORMANCE

JWO, H., TSAI, M.J., WU, S.W., WANG, C.Y.
NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: Previous researches suggested self-control is a motor learning variable based on the fundamental concept of self-determination. Besides psychological factors, as for learning strategies, it is feasible for learners to initiate self-regulation on the decision of practice or feedback to shape individualized practice schedules while being in the condition with autonomy. The findings of self-controlled feedback researches indicated that learners' feedback request pattern was affected by perceived and actual motor performance, and involved with perceived competence and outcome expectation. Thus, the present study was designed to examine the determinants of feedback requesting in the course of motor learning acquisition. The effect of performance of previous trial on motor performance and learning were examined by manipulating feedback decision timing and opportunity of self-controlled feedback.
METHODS: Thirty-six adults were recruited 36 as participants who were randomly assigned to Pre-self-controlled feedback, Pre-self-controlled feedback yoked, or Self-controlled yoked groups. Golf- putting precision was adopted as experimental task. The experiment consisted of 60 practice trials and 24hr delay retention test of 12 trials.
RESULTS: Results revealed that the accuracy of the previous trials that learners requested feedback were significantly higher than the trials that they did not request feedback in Pre-self-controlled group during acquisition phase. Pre-self-controlled group exhibited significant higher accuracy than that of Pre-self-controlled yoked group and Self-controlled group in retention test.
CONCLUSION: Present study indicated that making decision of feedback provision prior to motor performance benefits motor performance and learning under a self-controlled circumstance. Also, feedback requesting prior to motor performance depends on the experience of the previous motor performance. Thus, self-controlled feedback prior motor execution is a variable of motor performance and motor learning

APPROACHING CENTRAL MOTOR BEHAVIOUR DURING BADMINTON-SPECIFIC MOVEMENT PERFORMANCES IN DIFFERENT MATCH SITUATIONS

SKRZEBA, C., VOGT, T.
PROFESSIONAL SPORT EDUCATION AND SPORT QUALIFICATIONS

INTRODUCTION: Cortical activation indicative for motor behavioural processes involves central neuronal modulations that have been detected by analysing EEG frequencies. Dominant frequencies (e.g. alpha, beta) over relevant cortical lobes (i.e. frontal, central, parietal, occipital) are suggested to reflect e.g. a requested attentional focus of e.g. a sport-specific movement performance or match situation. However, previous investigations were mainly examined in laboratory setups. Therefore, the present study aimed to examine cortical activation during sport-specific movement performances in realistic match situations, i.e. comparing the short backhand badminton serve to the smash defence.
METHODS: Voluntarily 26 healthy right-handed male players (20.3±7.7 years; 175.5±8.2 cm; 67.1±10.5 kg; 12.5±7.4 years' experience in playing Badminton) participated in this study. After familiarization, each participant performed 60 badminton-specific movement performances, randomly assigned into 30 badminton serve match situations (serve) and 30 badminton smash defence match situations (smash) with approximately 30 seconds rest between each serve and smash. 32 Ag/AgCl EEG channels recorded continuous and real-time triggered cortical activation covering frontal, central, parietal and occipital electrode sites in accordance to the standard 10:20 system. Mean cortical activation (i.e. alpha: 7-13 Hz, beta: 13-30 Hz) for baseline as well as averaged serve and smash match situations were exported for statistical analysis.
RESULTS: Results revealed interactions between match situations and relevant cortical lobes in both alpha ($p<0.001$) and beta ($p<0.001$) activation. Main findings were an increase of cortical activation during the serve (alpha: $p=0.05$, beta: $p<0.01$) that was even more distinguished during the smash match situation (alpha: $p<0.001$, beta: 0.001) compared to baseline, most pronounced over frontal and occipital electrode sites.
CONCLUSION: The present preliminary findings are in line with previous reports from laboratory-based motor task performances. However, the present findings on cortical activation indicative for motor behavioural processes (e.g. planning of a movement performance,

visuo-motor perception of a match situation) with respect to sport-specific movement performances in realistic match situations may serve applied and practical approaches as well as knowledge transfer.

RELATIONSHIP BETWEEN UNILATERAL JUMPING IN THE VERTICAL, LATERAL AND HORIZONTAL DIRECTION AND CHANGE OF DIRECTION PERFORMANCE IN YOUNG ELITE FEMALE BASKETBALL PLAYERS

ARBOIX-ALIÓ, J., AGUILERA-CASTELLS, J., BUSCÀ, B., BENET, A., MONTALVO, A., FORT-VANMEERHAEGHE, A.

1FPCEE BLANQUERNA RAMON LLULL UNIVERSITY-BARCELONA, SPAIN,2FCS BLANQUERNA RAMON LLULL UNIVERSITY-BARCELONA, SPAIN3:FLORIDA INTERNATIONAL UNIVERSITY, COLLEGE OF NURSING AND HEALTH SCIENCES (MIAMI-USA)

INTRODUCTION: Recently, some authors suggested that many unilateral actions a team sport player is required to perform in practice or match occur not only in the vertical direction but also in horizontal and lateral direction . Therefore, when assessing unilateral tasks it's important to consider different directions to create an accurate profile player. The aim of this study was to explore the relationship between tests pertaining to unilateral jumps in the vertical, lateral and horizontal direction and change of direction performance.
METHODS: Twenty-nine young elite female basketball players were included in this study: age <15.66 ± 1.34 y>, body mass <69.69 ± 10.18 kg>, height <1.82 ± 0.07 m>, sport experience <6.31 ± 1.73 y>. Single Leg Countermovement Jump in vertical , horizontal and lateral direction were tested in both legs, as well as a sprint test with a 180 º change of direction . The relationship between jumps and COD was analyzed using Pearson coefficient correlation with respect the more skillful or the less skillful leg. The more skillful leg was determined to be the leg with higher performance averages on each respective task.
RESULTS: Comparing the skillful leg, and also the less skillful leg, COD and jumping values correlated significantly between all their subvariables.
CONCLUSION: The main finding of this study was the significant relationships between unilateral jumping in the anterior, lateral and vertical direction and COD performance. However, Meylan et al <2009> obtained a limited correlation between jumping and COD with the dominant leg in women physical education students. The diferent level of training of the samples could explain this fact. The results of our study suggest that elastic and reactive strength components, assessed by jumping in all three axes correlated to a 180º COD. Many of the findings in this study have interesting assessment and training implications for the strength and conditioning coaches of young female basketball players.
REFERENCES: Hewit, J., Cronin, J., & Hume, P. <2012>. Phys Ther Sport, 13<4>, 238–42.
Meylan, C., McMaster, T., Cronin, J., Mohammad, N. I., Rogers, C., & DeKlerk, M. <2009>. J. Strength Cond. Res. 23<4>, 1140–1147.
Meylan, C., Nosaka, K., Green, J., & Cronin, J. B. <2010>. J. Sports Sci. 28<5>, 545–54.
Contact: jordiaa1@blanquerna.url.edu

Conventional Print Poster

CP-BN05 Motor coordination

LOWER EXTREMITY KINEMATICS FOR DIVISION II FEMALE SOCCER ATHLETES EXECUTING A -LANDING TASK: A COMPARISON BETWEEN LANDING ON STABLE AND UNSTABLE SURFACES

TERRELL, S., ALLEN, C., NORRSTROM, H., GRIESSLER, A., SVOPA, K., BUTLER, B., LYNCH, J.

FLORIDA SOUTHERN COLLEGE

INTRODUCTION: Female athletes in high-risk sports like soccer suffer anterior cruciate ligament (ACL) injuries 4-6 times more than male athletes. Controlling loads in lower extremity sports is best accomplished by attenuating forces and resisting perturbations through appropriate joint flexion range of motion. Our aim was to compare ankle, hip and knee kinematics during single-leg drop-landing tasks onto stable and unstable surfaces, with particular attention at the knee, to identify strategies to reduce ACL injury risk.
METHODS: Sixteen (n=16) Division II female soccer players (19.00±1.3 years; 62.32±6.6 kg; 163.81±6.4cm; 23.26±1.44 BMI) performed three single leg drop landings from 30.48 cm onto the floor, an Airex pad, and a Shuttle Balance™ device. Kinematic measures at the left and right ankle, knee and hip were assessed with Dartfish™ video analysis for the initial and the lowest landing positions. Data was analyzed using repeated measures ANOVA and paired t-tests (IBM SPSS software, 25.0) with α <0.05 a priori.
RESULTS: Total joint angle changes (Δ) at the left and right ankle, knee, and hip from initial contact to lowest landing point, indicate athletes demonstrated greater joint flexion when landing on the floor (Δ-201.85°), compared to the Airex (Δ-196.43°) and to the Shuttle Balance™ (Δ-178.93°).
At initial contact, joint angles at the knee were most reduced on the Shuttle Balance™ (Δ-72.02°) compared to the floor (Δ-83.46°), and Airex pad (Δ-85.60°). There was significantly larger total knee flexion on the floor compared to the Shuttle Balance™ (p<.001).
CONCLUSION: Proper landing strategies require an ability to absorb forces through ankle, knee and hip flexion. Landing on unstable surfaces mimics perturbations in sports like soccer. The knee flexion angle at initial contact was reduced as the instability of the landing surfaces increased, indicating landing kinematics associated with injury risk. The total knee flexion range of motion also decreased as the instability rose which paralleled similar research using a BOSU™ ball (Schultz et al., 2015). Results suggest that proper preventative training progressions which master landing on stable surfaces are needed before instability challenges are presented. Future research should compare other high ACL risk sports such as basketball or volleyball to soccer athletes to determine if similar landing strategies are utilized in the presence of stable and unstable challenges.
References: Shultz, R., Silder, A., Malone, M, Braun, H., Dragoo, J.. (2015). Sports Health, 7(2)166-171.
Contact: sterrell@flsouthern.edu

THE COMPENSATORY RELATIONSHIP BETWEEN THE MUSCLE TENSION OF THE ILIACUS MUSCLE AND OTHER HIP FLEXORS IN HEALTHY SUBJECTS.

YAGI, M., TATEUCHI, H., SAEKI, J., UMEHARA, J., HIRONO, T., MOTOMURA, Y., ICHIHASHI, N.
KYOTO UNIVERSITY

INTRODUCTION: Excessive joint force leads to joint deformity and pain (Felson, 2013). The muscle tension of the hip joint muscles generated most of the hip joint forces during movement (Correa et al., 2010), and the change in muscle tension balance of the hip muscle increased the hip joint force (Lewis et al., 2007). In particular at hip extension position, the hip joint force increased with a change in muscle tension balance, which meant decreased muscle tension of the iliacus muscle and increased compensatory muscle tension of other hip flexors such as the adductor longus muscle and the tensor fasciae latae in a simulation study (Lewis et al., 2007). However, it has not been clarified which of the hip flexors compensated for the muscle tension of the iliacus muscle in vivo. Therefore, this study aimed to show the compensatory relationship between the muscle tension of the iliacus muscle and other hip flexors at hip extension position in healthy subjects.
METHODS: Eighteen healthy subjects participated in this study. Subjects stayed in a supine position, and the muscle thickness was measured by B-mode ultrasound at the iliacus muscle, the adductor longus muscle, the tensor fasie latea, and the rectus femoris muscle. After then, their pelvis was fixed on a bed with a non-elastic belt, and subjects held their right lower limb at 0° knee flexion and 15° hip extension. During the task, we measured the shear modulus of the iliacus muscle, the adductor longus muscle, the tensor fasie latea, and the rectus femoris muscle by shear wave elastography. The shear modulus represents the magnitude of tension per unit area. In order to estimate the actual tension of each muscle, the muscle tension index was calculated by multiplying the muscle thickness and the shear modulus of each muscle. For the muscle tension index, Spearman rank correlation coefficient between the iliacus muscle and each flexor was calculated. Statistical significance was set at 0.05.
RESULTS: In the muscle tension index, a significant negative correlation was found between the iliacus muscle and the adductor longus muscle ($r = -0.624$), but no between the iliacus muscle and the tensor fasie latea or the rectus femoris muscle ($r = 0.195$, 0.420, respectively).
CONCLUSION: By using the muscle tension index, which was calculated by multiplying the muscle thickness and the shear modulus, a negative relationship was found between the iliacus muscle and the adductor longus muscle. This result suggested that the muscle tension of the adductor longus muscle compensated for the muscle tension of the iliacus muscle.
REFERENCE:
Felson, D.T., 2013. Osteoarthr. Cartil. 21, 10-15.
Correa, T.A., Crossley, K.M., Kim, H.J., Pandy, M.G., 2010. J. Biomech. 43, 1618-1622.
Lewis, C.L., Sahrmann, S.A., Moran, D.W., 2007. J. Biomech. 40, 3725-3731.
CONTACT:
yagi.masahide.54a@st.kyoto-u.ac.jp

ARM COORDINATION SYMMETRY OF OPEN-WATER SWIMMING STROKES IN EXPERT SWIMMER AND UNSKILLED SWIMMER: A PILOT STUDY ON SENSOR AVAILABILITY

BABA, Y.1, ICHIKAWA, H.1, SHIMOJO, H.1, SATO, D.1, NARA, R.1, IKEDA, Y.1, HARA, R.2, SHIMOYAMA, Y.1
1: NIIGATA UNIVERSITY OF HEALTH AND WELFARE, 2: UNIVERSITY OF NIHON

INTRODUCTION: An inertial motion sensor device is a highly transportable instrument for measuring swimming motion validated by numerous researchers. Open-water swimming motion includes sighting the next buoy or other targets, and breathing while maintaining a front-crawl. Breathing to the preferential side leads to asymmetrical coordination of the upper limb (Seifert et al., 2008), indicating these tasks can affect arm coordination symmetry. This study examined arm coordination symmetry using three inertial sensors to compare the expert swimmer and unskilled swimmer.
METHODS: Three inertial sensors were attached to both wrists and the lower back of two male swimmers. The expert swimmer had participated in the FINA/HOSA 10-km Marathon Swimming World Cup. The unskilled swimmer was inexperienced in open water swimming. Trials were performed that involved three tests in a 25-m indoor pool; a normal front crawl in apnea (Apnea), a front crawl with breathing (CrB), and ocean swimming with breathing (OSB). Every lateral breathing motion took place on the preferential side. The sampling frequency of the waterproof sensors was 1 kHz. The swimmer's stroke rate (SR) was controlled with swimming beepers (Tempo Trainer Pro, Finis®). We used inertial sensors to detect the beginning and end of each pull phase, based upon the transverse (radioulnar) axis angular velocity of double wrists, and then estimated the Index of Coordination (IdC; Chollet et al., 2000), and the Symmetry Index (SI; Seifert et al., 2008). Seifert et al. (2008) described how the coordination on the preferential breathing side (IdCP) comprises the time between the end of propulsion on the preferential side and the beginning of propulsion on the non-preferential side. The opposite side of coordination is named the non-preferential breathing side (IdCNP). Coordination symmetry was assessed by calculating the SI. SI = IdCP - IdCNP.
RESULTS: The results of the expert swimmer vs the unskilled swimmer are shown below. The time of 25-m was Apnea; 14.8 vs 15.6 s, CrB;14.9 vs 16.6 s, OSB; 15.2 vs 16.7 s. SR was Apnea; 0.61 vs 0.61 cycles/min, CrB; 0.60 vs 0.61 cycles/min, OSB; 0.60 vs 0.63 cycles/min. IdC was Apnea; 5.8 vs 1.1%, CrB; 4.3 vs 1.5%, OSB; 8.5 vs 3.4%. IdCP was Apnea; 5.1 vs -1.0%, CrB; 5.2 vs -1.5%, OSB; 6.1 vs 11.6%. IdCNP was Apnea; 7.2 vs 3.2%, CrB; 4.3 vs 4.9%, OSB; 10.8 vs -4.2%. SI was Apnea; -2.2 vs -4.1%, CrB; 0.9 vs -6.4%, OSB; -4.7 vs 15.8%. In Seifert et al. (2008) expressed, $-10\ \% < SI < 10\ \%$ revealed symmetrical coordination, $SI < -10\%$ and $SI > 10\%$ indicated asymmetrical coordination. The unskilled swimmer used asymmetrical arm coordination in OSB, whereas the expert swimmer demonstrated symmetrical coordination.
CONCLUSION: The unskilled swimmer used asymmetrical coordination in OSB. This indicates that needing to use sight to track targets during open water swimming may change arm coordination techniques, and unskilled swimmer lead to asymmetrical coordination as breathing action.

RELATION BETWEEN UPRIGHT POSTURAL STABILITY AFTER RAPID FORWARD STEPPING AND RATE OF FORCE DEVELOPMENT OF THE ANKLE PLANTAR FLEXORS AND DORSIFLEXORS

KATO, T.

KYOTO UNIVERSITY

INTRODUCTION: The ability to take a rapid forward step is important for fall prevention in the elderly population. It has been reported that the time to reacquire a stable upright posture after taking a forward rapid step (time to stabilization, TTS) is longer in elderly people in comparison to young adults (Johnson, 2003). Explosive muscle power of ankle plantar flexors and dorsiflexors is one of the contributors to a successful recovery from a rapid step. However, few studies have examined the relation between postural stability after rapid stepping and the rate of force development (RFD) of the ankle plantar flexors and dorsiflexors. The purpose of this study was to investigate the influence of plantar flexion (PF) and dorsiflexion (DF) RFD on TTS in young women.
METHODS: Nineteen healthy young women (21.7±1.7 years) took part in the study. After measurements of static upright posture on a force plate, the forward rapid stepping task was performed. Subjects were instructed to step their right foot onto the force plate as quickly as possible after being cued by light, and keeping an upright position for 15 seconds. Reaction time (RT), defined as the time from the cue to right foot-off, and the center of foot pressure (COP) velocity after landing on the force plate were measured. TTS was calculated using the following equation: (time at decreasing COP velocity to less than 2 SDs for reference COP velocity during static standing) − (time at landing of right foot). Maximum isometric strength (MVIC) and RFD of ankle PF and DF at 0° of ankle motion were measured using a dynamometer. RFD was defined as the slope of the force-time curve from the onset of contraction, defined at 2.5% of peak torque. Subjects were asked to exert force as fast as they could. 50 ms and 200 ms RFDs were calculated as the time intervals from the onset to 50 ms and 200 ms, respectively.
Stepwise regression analysis was performed with TTS as the dependent variable, and RT, MVIC, 50msRFD and 200msRFD of PF and DF as independent variables.
RESULTS: The TTS was 2.96±1.86 s. The MVICs were 1.06±0.48 Nm/kg (PF) and 0.52±0.87 Nm/kg (DF). The RFDs were as follows: 50msRFD 3.15±1.86 Nm/s・kg(PF), 2.35±1.04 Nm/s・kg (DF); 200msRFD 3.22±1.54 Nm/s・kg(PF), 2.03±0.46 Nm/s・kg(DF). The RT was 0.57±0.62 s.
Stepwise regression analysis revealed that 50msRFD of PF (β= −0.478) was a significant and independent determinant of TTS. MVIC and 200msRFD of PF, MVIC and RFD of DF, and RT were not identified as significant determinants of TTS.
CONCLUSION: This study showed that only 50msRFD of PF was associated with TTS. Our results suggest that rapid force production capacity during the early phase of plantar flexion may be more important for upright postural stability after taking a rapid forward step than MVIC.
REFERENCE:
Johnson CB. Aging and the time needed to reacquire postural stability. J Aging Physical Activity. 2003;11:459-469.

A STUDY OF THE VARIABILITY IN ADDRESS POSITION FOR AMATEUR GOLFERS

JONES, K.

ULSTER UNIVERSITY

INTRODUCTION: Highly skilled golfers have consistently demonstrated higher outcome consistency compared to lower skilled golfers (Bradshaw et al. 2009; Betzler et al. 2012). It has been postulated that a golfer's ability to achieve a consistent outcome is guided by their consistency at address, yet the evidence is inconclusive (Bradshaw et al. 2009; Glazier, 2011; Langdown, Bridge and Li, 2013). The aim of this study was to examine the variability of amateur golfers at address and shot outcome.
METHODS: Ninety-four mixed ability amateur golfers completed 10 driver and 10 5-iron shots toward a 250 yd target. Feet kinematics and ball position were captured using an 11-camera motion capture system (Qualisys Oqus 300+). Clubhead presentation and ball launch variables were captured using previously reported methods (Betzler et al. 2014). Ball position in stance, stance width and stance depth, left foot-right foot angle and feet-target line angle characterised the golfer's position at address. These variables were calculated at takeaway for each shot. Intra-individual variability was calculated using median absolute deviation.
RESULTS: Multiple linear regressions, with variability in address variables as predictors and variability in estimated total carry distance, variability in final shot angle and variability in clubhead speed as outcome variables were not significantly better predictors than a constant model for either the driver ($p = 0.73$, $p = 0.67$ and $p = 0.14$ respectively) or the 5 iron ($p = 0.07$, $p = 0.29$ and $p = 0.28$ respectively).
CONCLUSION: Bradshaw et al. (2009) reported a relationship between address variability and shot outcome variability with two groups of differently skilled golfers with a 5-iron, but these results were not replicated by subsequent research (Langdown, Bridge and Li, 2013). The present study found no clear relationship between consistency in the address variables studied and consistency in shot outcome. Rather some golfers who were consistent in shot outcome were also consistent in address whilst others were not. This suggests multiple strategies exist by which outcome consistency can be achieved and that whilst consistency in address might be one possible technique for achieving consistency in outcome, it is not necessary.

ANTICIPATORY POSTURAL ADJUSTMENTS UTILIZED BY THE DYSVASCULAR TRANSTIBIAL AMPUTEE

ROBERTS, M.1,2, PRINCE, F.1

1: UDEM , 2: SKIDMORE COLLEGE .

INTRODUCTION: Anticipatory postural adjustments (APA) allow for total center of mass to be transferred from bipedal stance in quiet standing to single limb stance, enabling gait initiation. The APA strategy employed by the healthy adult take place in both antero-posterior (A/P) and medio-lateral (M/L) directions in sequential phases (Jian et al., 1993). Few studies have investigated the APA pattern in the unilateral transtibial amputee (TTA) and no studies have yet investigated the APA strategy employed by the specific dysvascular TTA (DTTA) population. The purpose of the current study is therefore to compare the APA strategy in gait initiation employed by DTTA with that of age-matched healthy adults.
METHODS: On a walkway embedded with three force plates, standing with both feet on either side-by-side force plates, 10 DTTA and 10 control participants were asked to self-initiate gait, stepping onto the third force plate, completing five trials with each limb leading. Parameters for phases 1-3 and total APA net center of pressure displacement (dCoPnet) were calculated in A/P and M/L directions. Analyses were carried out using a Matlab program (The Mathworks Inc., MA) and SPSS 24 (IBM Corp., NY) ($p < 0.05$).

RESULTS: A significant reduction in phase 3 M/L dCoPnet was observed in the intact limb (3.59<2.9) cm) when compared to control (7.03<2.0) cm) and prosthetic (7.11<4.0) cm) limbs. An anterior total dCoPnet was observed in the prosthetic limb (3.2<3.0) cm) when compared to a posterior total dCoPnet observed in controls (-3.57<1.9) cm).
CONCLUSION: The reduction in intact limb M/L dCoPnet observed in phase 3 can be explained by limb load asymmetry observed during quiet standing in the DTTA (Hermodsson et al., 1994). The anterior total dCoPnet observed beneath the prosthetic limb is an important result in the DTTA. Previous studies have found both anterior and reduced posterior total dCoPnet, prior studies investigating APA in both traumatic and dysvascular TTA (Vrieling et al., 2008). When compared, the DTTA are deconditioned and inactive (Hermodsson et al., 1994). The total anterior dCoPnet observed would appear to be related to further reductions in stability caused by reduced fitness levels, sensory loss, peripheral dysvascularity in the intact limb, etc. associated with dysvascular amputation.
REFERENCES:
Jian Y, Winter DA, Ishac MG, Gilchrist L. (1993). Gait Posture, 1(1), 9-22
Hermodsson Y, Akdahl C, Persson BM, Roxendal G. (1994). Prosthet Orthot?Int, 18(3), 150-158.
Vrieling AH, Van Keeken HG, Schoppen T, Otten E, Halbertsma JPK, Hof AL, Postema K. (2008). Gait Posture, 27(3), 423-430.
CONTACT:
mroberts@skidmore.edu

THE EFFECTS OF A PROLONGED HIGH INTENSITY INTERMITTENT RUNNING PROTOCOL ON BALANCE PERFORMANCE AS MEASURED BY THE MODIFIED BALANCE ERROR SCORING SYSTEM

O MEARA, D., LODGE, C., CAREY, M., HUNT, B.
INSTITUTE OF TECHNOLOGY, CARLOW

INTRODUCTION: The Modified Balance Error Scoring System (MBESS) is an objective tool for assessing deficits in static postural stability in adults (Guskiewicz, 2003). This measure is included as part of the Sports Concussion Assessment Tool 5 (SCAT5) (McCrory, et al., 2017). Various types of exercise have been shown to have a short term negative effect on static postural stability in adults (Hill, et al., 2016; Petry, et al., 2016). A Prolonged High Intensity Intermittent Running (PHIIR) protocol has been shown to closely replicate field sports in many physiological and performance based parameters (Sirotic & Coutts, 2007). Despite being designed to be used in a pitch-side setting, the short-term effects of sports related fatigue on MBESS scores remains unknown. Therefore, the aim of this study was to analyse the effect of a PHIIR protocol on MBESS performance.
METHODS: 20 participants were divided into two groups, experimental (n=11) and (n=9). The experimental group was administered the MBESS prior to (pre-test), and twice after (5 minutes post-test and 10-minutes post-test) completion of the PHIIR protocol in a controlled laboratory setting. The control group was administered the MBESS prior to, and twice following, a period of rest. The timeline of administration of the measures exactly replicated that of the experimental group. Data was analyses using IBM SPSS statistics package version 23.
RESULTS: A 3 by 2 mixed within-between analysis of variance revealed there was a significant group by time interaction present. Post-hoc analysis using Wilcoxon Signed-Rank tests revealed a statistically significant increase in total errors from pre-test (1.64 +/- 1.362) to 5 minutes post-test (4.73 +/- 3.636) (z=-2.527, P=0.012) and a statistically significant decrease in total errors from 5 minutes post-test (4.73 +/- 3.636) to 10 minutes post-test (2.55 +/- 2.544) (z=-2.196, P=0.028) in the experimental group. Analysis of group differences using Mann Whitney U tests revealed a statistically significant difference between groups at 5 minutes post-test (U=15.5, z=-2.650, P=0.007)
CONCLUSION: The results show that performance on the MBESS was significantly negatively affected following a PHIIR protocol. This indicates that performances on the MBESS may be affected by sports related fatigue. this may impair the validity of the MBESS as a pitch-side tool for assessing concussion as any deficits detected cannot be conclusively attributed to a mild traumatic brain injury in the presence of fatigue.
REFERENCES: Guskiewicz K. (2003). Current Sports Medicine Reports, 2(1), 24-30.
Hill M, Higgins M, Price M. (2016). European Journal of Applied Physiology, 116(10), 1965-1974.
McCrory P, Meeuwisse W, Dvorak J, Aubry M, Bailes J, Broglio S, Cantu R, Cassidy D, et al. (2017). British Journal of Sports Medicine, 51(11), 838-847.
Petry V, Paletta J, El Zayat B, Turgay E, Michel N, Skwara A. (2016). Orthopedic reviews, 8(1), 38-42.
Sirotic A, Coutts A. (2007). Journal of Science and Medicine in Sport, 11(5), 500-50

OPERATING FACTORS THAT DETERMINE THE ACCURACY OF THROWING TO SECOND BASE IN THE BASEBALL CATCHER

SUZUKI, C., FUJII, M., MURAKAMI, K., NAKAMOTO, H., MAEDA, A.
NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA

INTRODUCTION: In baseball game, the catcher plays an important role for checking the steal base. In order to achieve successful checking, there are three important conditions: Ⅰ. quick throwing action, Ⅱ. high ball speed, Ⅲ. accurate throwing. Previous studies have been identified key kinematic factors to satisfy the condition Ⅰ. Also, other researcher has been investigated the strategies that to achieve conditions Ⅱ. No research, however, about catchers "Accurate throwing" has been found. That is, it is unclear what kind of factor is affecting for successful performance and, how to improve the performance. Therefore, the purpose of this study was to clarify the determinant factors that enhance the accuracy of the catchers throwing to second base.
METHODS: The subjects were 15 mens baseball players who specialized for catchers (age: 21.0 ± 2.5 years old, height: 172.4 ± 5.5 cm, body weight: 75.7 ± 5.8 kg, competition history: 11.6 ± 3.0 years, catchers experience: 8.0 ± 3.3 years). The subjects caught a ball that is thrown from midway between the mound and home plate, and they required to throw 15 to 20 balls to a fielder in second base. We measured throwing kinematics and kinetics by using optical 3 dimensional motion analysis system Mac3D (500 fps) and by using multi analytical force plate (2 kHz). In addition, we measured ball velocity by using "TRACKMAN". To evaluate the accuracy of the thrown ball, distance from the position where the fielder on the second base catches the ball to the origin (an arbitrary point in the vicinity of the second base) was calculated using image analysis software. The throwing motion was divided into four phases; 1) catching ball (Catch), 2) pivot foot's contact to the ground (PFC), 3) stride foot's contact to the ground (SFC), 4) ball releasing (Release). We carried out multiple regression analysis by stepwise method with the accuracy of throwing (throwing position) as dependent variable and each analysis item as independent variable.

RESULTS: Different independent variables were chosen for each phase. In the entire operation phase, the moving distance of the pivot foot in the x direction from the Catch to the PFC, the forward trunk angle at the time of Release, and the inner and external rotation angular velocities of the axial leg knee joint at the time of Catch were selected The contribution rate was 83.5%.
CONCLUSION: It was suggested that the accuracy of the catchers throw can be explained from the operating factors of the lower extremity and trunk.

COMPARISON OF FINGER DWELL AND OVERLAP TIMES IN PIANISTS

LIPKE-PERRY, T.1, DUTTO, D.J.2, LEVY, M.1

1: UNIVERSITY OF MINNESOTA DULUTH, 2: EASTERN OREGON UNIVERSITY

INTRODUCTION: Musicians and scientists study pianism to better understand the mechanics of underlying technique. Movement control both within and across pianos is essential for optimal performance. Pianists often refer to the "feel" of a particular instrument: its responsiveness and sensitivity; key resistance; and the evenness and predictability of the instrument.
The purpose of this study was to compare duration of vertical key depression (dwell time) and overlap time of subsequent keystrokes on three piano keyboards during a common scale exercise. Dwell time was defined as the length of time the key was completely depressed, while overlap time was length of time that 2 subsequent fingers are down at the same time on a given hand.
METHODS: Seven (7) pianists with a minimum of 6 yrs of experience performed C-Major scales on three keyboards. Three keyboards were used: Kawai MP11, Kurzweil PC2, and a Yamaha upright piano. Both the Kawaii and the Yamaha had fully weighted keys. Participants were fitted with 22 retro-reflective markers to create a hand/finger model. Markers were tracked with a 240-Hz Optitrack motion capture system (Corvallis, Oregon, USA). Subjects performed 10 subsequent two-octave ascending/descending C-Major scales using both hands (right hand beginning on Middle C, left hand one octave below). Scales were performed at 60 bpm with 4 notes/beat. Fingers were identified by side (left/right) and given a number 1-5 (thumb = 1; fifth digit = 5). Position-time fingertip data were tracked and processed using a 12-Hz low-pass filter from which dwell and overlap times were extracted for all fingers. Comparisons of dwell and overlap time for each finger and keyboard were done using repeated measures ANOVA.
RESULTS: During the performance of the scale, transitions occur when fingers crossover. It is during these events that obvious time differences emerged when playing scale, but these differences were similar across keyboards. In particular, the R3-L3 to R1-L2 transition (occurring twice during the ascending scale), dwell time substantially increases for the right (**Δ**:0.07 ± 0.03s) and decreases for the left (**Δ**:-0.03 ± 0.03s), while during the descending scale (R3-L3 to R2-L1) it does the opposite (R:-0.06 ± 0.03s vs L:0.08 ± 0.02s). Differences in dwell time coincide with significant decreases observed in the overlap time in fingering transitions. The overlap times in transition were significantly smaller (0.05 ± 0.01s in transition, vs 0.10 ± 0.02s between transitions).
CONCLUSION: The scale performance was produced at 60 bpm with 4 notes/beat. Theoretically, a dwell time would be expected to be 0.25s and observed dwell times were around 0.35s. Similarity of respective overlap times across keyboards suggest that pianists adapt to different instruments. In addition, dwell times greater than 0.25s and variability of dwell times suggest that performance of a scale is not quantified simply and that a relationship among keystrokes is essential though not intuitive.

CORE MUSCLE EMG CHARACTERISTICS OF STAND UP PADDLE BOARDING YOGA

CHEN, C.Y., LIANG, J.M., LIAW, L.J., HSU, H.T., TSAI, F.H., WU, W.L.

KAOHSIUNG MEDICAL UNIVERSITY

INTRODUCTION: Stand Up Paddle Board Yoga (SUP Yoga) is the exercise combine core muscle training and stand up paddle surfing (SUP) on calm water. Because of SUP provide the instability, therefore, it is an exercise for core muscle training, muscle endurance, and balance control to enhance core muscle strength and endurance and improve exercise performance. The muscle activation patterns adopted during specific yoga poses on SUP have not yet been confirmed, for this reason, our research hypothesis is that the effect of training could improve by unstable surface. The aim of this study is to assess the core muscle activation in specific Yoga pose when using SUP, and compared with stable surface (land).
METHODS: 20 people with SUP YOGA experience were recruited into this study that completed on calm water training at swimming pool, and the individual must have practiced yoga at least over a year. In this study, subjects were use Stand Up Paddle and Delsys Trigno (Trigno TM Wireless system, Delsys Inc., USA). The dominant side of the core muscle as the main measurement, include: m. rectus abdominis (RA), m. obliquus externus (OE), m. multifidus (MF), m. erector spinae (ES) and m. rectus femoris (RF). Each subject was instructed to perform the same Yoga pose (High Lunge with hands on SUP/land, Plank, Upward Facing dog) on land and on SUP. Paired t-test was used to compare iEMG value among these two conditions.
RESULTS: SUP Yoga yielded the higher iEMG value for RA, ES and RF, when compared with land condition in High Lunge with hands on SUP/land. In the Plank pose, the ES, MF, EO and RF produced higher activities level on SUP Yoga than on land. Finally, during the Upward Facing dog pose, the RA, ES and MF show higher muscle activity than on land.
CONCLUSION: The higher level of activity in core muscles were achieve during specific Yoga pose on the SUP. Previous literature, when performing movements on unstable surface, muscle could produce higher activities to maintain the balance and stability (Imai et al., 2010; Feldwieser et al., 2012). In this study, we found Yoga combined unstable-base, such as SUP, could be a more effective strategy for core stability training.

Conventional Print Poster

CP-BN06 Technologies and methods for qualifying perfomance

HOW DOES THE METHOD AND PITCH LOCATION OF GAINING POSSESSION INFLUENCE POSSESSION OUTCOME IN CLUB LEVEL GAELIC FOOTBALL?

MCGUIGAN, K.

SPORT NORTHERN IRELAND SPORTS INSTITUTE

This study aimed to investigate the influence both pitch location and method of gaining possession have on the outcome of any given possession in club level Gaelic football (GF). Possessions (n=2203) from 25 games across all three tiers (senior = 10, intermediate = 8,

junior = 7) of the Ulster club football championship of 2015 and 2016 were analysed using validated operational definitions for Gaelic football. Pitch location was defined as defensive third, middle third or attacking third and was based on where a team gained first gained full control of the ball. Methods of gaining possession were defined as opposition kick out, own kick out, turnover, throw up, regained and 45m kick. Possessions were measured retrospectively, using Dartfish TeamPro version 7 video analysis software (Dartfish Limited, Switzerland), for both teams participating in each of the analysed games.
Of the 2203 possessions analysed, 962 were gained in the defensive zone, 1019 in the middle third and 222 in the attacking zone. A total of 398 shots were generated from 962 (41.4%) possessions gained in the defensive zone. Possessions gained in the middle zone (1019) resulted in 543 (53.3%) shots, while attacking zone possessions proved most prolific with 178 shots generated from 222 possessions (80.2%).
The most prominent of the six methods of gaining possession were 'own kickout', 'opposition kickout' and 'turnover'. Winning an 'opposition kickout' resulted in a shot 192 times from 314 possessions analysed (61.4%), while possession from 'own kickout' was less effective at generating shots, with 259 shots from 577 possessions analysed (44.9%). The most common method of gaining possession was through 'turnovers' (1113), but only 533 (47.9%) of 'turnover' possessions resulted in a shot. When area of the pitch is factored in, possessions beginning from a turnover in the attacking zone are most likely to result in a shot (80.5%), when compared to those in the middle third (56.9%) and the defensive third (40.4%).
While basic, the data presented provides, for the first time, evidence upon which to base tactical approach of teams participating in GF. There are important factors to consider relating to kickout strategy, both defensively (opposition kickout) and offensively (own kickout), and the potential influence winning each may have on the eventual outcome of a possession. Another key strand of the data relates to the potential impact pitch location has on possessions won via a turnover, with valuable evidence provided for consideration when determining team defensive strategy. In summary, this is the first study that has examined tactical factors relating to Gaelic football at club level, and as such provides useful information for coaches throughout the GAA world upon which to consider and apply various tactical approaches.

DOES A DECADE OF THE RALLY-POINT-SYSTEM IMPACT MATCH CHARACTERISTICS IN ELITE BADMINTON?

HOFFMANN, D., VOGT, T.

GERMAN SPORT UNIVERSITY COLOGNE

INTRODUCTION: Numerous studies have investigated match characteristics (e.g. 'rally time') in elite Badminton, addressing an impact of different scoring systems (e.g. the the 'old' scoring system before 2006 and the Rally-Point-System since 2006) and the Rally-Point-System (e.g. from Olympic Games 2008 and 2012). Previous research mainly focused on the men's finals at Olympic Games between 1992 until 2012; however, a comprehensive approach covering the entire period in which the Rally-Point-System has been practiced is lacking.
Therefore, the purpose of this study was to investigate match characteristics in elite Badminton over the entire period of the Rally-Point-System with a particular focus on changes in match duration.
METHODS: Based on video recordings of the Badminton World Federation's (BWF) World Championship tournaments from 2006 to 2017, the focus has been on men´s singles quarter-finals, semi-finals and finals (i.e. 7 matches per tournament) to cover elite Badminton matches. Videos were accessed via the BWF BadmintonWorld.TV archives and, wherever applicable, via open-to-public YouTube® channels to collect a total data set of 56 matches. Herein, the following temporal and notational parameters have been subject to a preliminary analysis: official match duration (stated on BWFs result sites); rally time (the time from the service until the shuttlecock touched the ground on each point); rest time (the time that elapsed from when the shuttlecock touched the ground until the next service was performed).
RESULTS: While an increase in 'official match duration' by 20.36% failed significance (p=0.101) from 47.00 minutes (± 9.90) in 2006 compared to 56.57 minutes (± 11.22) in 2017, 'rally time' increased (p=0.002) by 64.43% with 7.45 (± 1.60) seconds in 2006 compared to 12.25 (± 2.85) seconds in 2017. In addition, 'rest time' increased (p=0.001) by 45.64% with 20.40 (± 0.91) seconds in 2006 compared to 29.71 (± 3.27) seconds in 2017.
CONCLUSION: The present preliminary findings reveal an impact of a decade of the Rally-Point-System on the rally time and the rest time. It seems reasonable that further (planned) analyses support this impact on e.g. the 'real time played', 'total points played', 'work density', 'shots per rally' and 'shot frequency'. Annual developments are further hypothesized also have an impact. The present preliminary findings in support of the hypothesized impact may serve the on-going discussion to change the scoring system (again) to a Best-of-Five (until 11 points).
This study is funded by the Badminton World Federation (BWF).

MEASURING JUMPING PERFORMANCE IN A CONTROLLED SETTING ON SAND AND RIGID SURFACES WITH TWO DIFFERENT DEVICES

HENDKER, A., SZWAJCA, S., EILS, E.

HUMAN PERFORMANCE & TRAINING IN SPORTS

INTRODUCTION: In the last decade, beach sports such as -volleyball, -handball, and -soccer have become increasingly popular which demand specific attributes for the athletes. Sport-specific diagnostic, e.g. jumping performance on sand surfaces need valid measurements to evaluate training interventions. Jump performance diagnostics mainly takes place under controlled conditions e.g. in a lab on rigid surfaces questioning ecologic validity in sand sports. It is necessary to facilitate the "in field" diagnostic to make results feasible for athletes and the trainer. Therefore, the aim of the present investigation was to measure jumping performance in a controlled setting on sand and rigid surfaces with two different devices. One reliably method was set to as the gold standard (3D motion analysis with markers) and compared with a system that is easy to use in the field.
METHODS: A sandbox (1.25x1.25mx30cm) was constructed to measure counter-movement (CMJ) and drop- jumps (DJ) on a sand surface in the lab. Seventeen healthy novices (28.4±4.7 years, 181±8.4cm, and 76±11.2kg) perform CMJ and DJ on sand and rigid surface in a balanced order. Jumping height was measured using a 3D motion capture system (Q) (Qualisys, Göteborg, Sweden) and compared with an accelerometer-based system (H) (Humotion SmarTracks Diagnostics, Muenster, Germany). Validity of the in-field system was calculated using differences of the measured jumping performance compared to Q. Furthermore, 95% confidence intervals (CI) and Bland-Altman-Plots were used to assess validity.
RESULTS: Mean vertical jump results were 37.8±6.7cm (95%CI: 34.6-40.9) (Q) and 35.8±6.9cm (32.5-39.1) (H) for CMJ on sand, 39.4±6.9cm (36.1-42.7) (Q) and 38±8.2cm (34.1-41.9) (H) for CMJ on rigid surface, 28.4±8.2cm (24.5-32.3) (Q) and 27.5±7.6cm (23.9-31.1)

(H) for DJ on sand, 31.3±7.1cm (28.0-34.7) (Q) and 30.4±7.6cm (26.8-34.1) (H) for DJ on rigid surface. Mean differences between Q and H were 1.9±2.4cm for CMJ on sand, 1.4±2.8cm for CMJ on floor, 0.9±2.5cm for DJ on sand, 0.9±1.8cm for DJ on floor, respectively.
CONCLUSION: Although mean values and differences appear to be comparable with a systematic error between systems, high standard deviations and large confidence intervals suggest that individual results deviate greatly from the mean (Humotion does not constantly underestimate the gold standard). Bland-Altman-plot evaluation strongly suggests that results spread in an unsystematic manner out of the range of confidence intervals on either side. Single deviations up to 9.3cm were found between systems, and 15% of all jumps had to be repeated due to wrong automatic or non-detection of jumps via H especially on sand surfaces. Therefore, the validity of the accelerometer based system for the assessment of vertical jump performance is questionable on rigid as well as on sand surfaces. This is of particular importance when focusing on elite athletes´ performance.

COMPARISONS BETWEEN SYSTEMS TO MEASURE CONTACT AND FLIGHT TIMES IN DURING TREADMILL RACE WALKING

TUCKER, C.B., HANLEY, B.

LEEDS BECKETT UNIVERSITY

INTRODUCTION: Race walking is an event dictated by a rule that states that no visible loss of contact with the ground should occur and that the leg must be straightened from first contact with the ground until the 'vertical upright position' (IAAF Rule 230.2). The measurement of flight times during race walking is therefore of great interest to coaches, athletes and judges. The aim of the study was to compare different methodologies used to measure contact and flight time in race walking on a treadmill.
METHODS: Seven male race walkers (stature: 1.79 m (± 0.05), mass: 66.6 kg (± 3.3)) and six female race walkers (stature: 1.68 m (± 0.11), mass: 58.0 kg (± 11.5)) participated. The men race walked on an instrumented treadmill (Gaitway) at 11, 12, 13, 14 and 15 km/h (in a randomised order), whereas the women's trials were at 10, 11, 12, 13 and 14 km/h. Contact and flight times were measured for each trial using two in-dwelling Kistler force plates on the treadmill that recorded vertical ground reaction forces (1000 Hz) from both feet and temporal data, a 1 m strip of an OptoJump Next system (1000 Hz) placed on the treadmill and a Fastec high-speed camera (500 Hz). Results from the OptoJump Next system were extracted using five settings based on the number of LEDs that needed activating (contact begins after_contact ends when), and were thus annotated as 0_0, 1_1, 2_2, 3_3 and 4_4. The force plate values were considered the criterion values and measurements were assessed for reliability using Intraclass Correlation Coefficient (ICC) and 95% limits of agreement (LOA: bias ± random error).
RESULTS: For flight time, the ICCs between the force plate and OptoJump Next were 0.946 for the 0_0 condition (LOA: .003 ± .016 s), 0.889 (1_1) (LOA: −.009 ± .017 s), .648 (2_2) (LOA: −.021 ± .021 s), 0.446 (3_3) (LOA: −.032 ± .025 s), and 0.304 (4_4) (LOA: −.043 ± .021 s). The ICC between the force plate and the high-speed video for flight time was 0.912 (LOA: .002 ± .022 s). For contact time, the ICCs between the force plate and OptoJump Next were 0.983 for the 0_0 condition (LOA: −.003 ± .019 s), 0.982 (1_1) (LOA: .008 ± .009 s), 0.898 (2_2) (LOA: .020 ± .025 s), 0.799 (3_3) (LOA: .031 ± .030 s), and 0.688 (4_4) (LOA: .041 ± .034 s). The ICC between the force plate and the high-speed video condition for contact time was 0.978 (LOA: −.003 ± .022 s).
CONCLUSION: The OptoJump Next system provided results similar to those of the gold standard force plates, with the 0_0 setting the most reliable. Users of the OptoJump Next system should therefore consider this setting (which is the default setting) along others such as minimum flight time and contact time (typically the default is 10 ms) to achieve the most accurate results when using a treadmill. The high-speed video recordings also provided very good reliability but it was occasionally difficult to subjectively identify contacts with this method. Therefore, the Optojump Next system is better suited to provide more immediate results when collecting treadmill data.

HOW CHANGES IN BLOCK DESIGN AFFECT RELAY START PERFORMANCE IN SWIMMING

TOWNSEND, N., HALL, S., MCLEAN, S.P., SMITH, J.

SOUTHWESTERN UNIVERSITY

INTRODUCTION: Starting blocks used in competitive swimming often incorporate a wedge for the rear foot to push against when performing flat starts. In most competitions, this wedge cannot be removed so relay starts must be performed with the wedge in place despite the common addition of an approach step during a relay starts. The presence of the wedge constrains the length of the approach step but does provide an inclined surface from which to push which may improve propulsive force development. The purpose of this study was to evaluate the effect of using a wedge in relay start performance.
METHODS: Eight collegiate swimmers (177.69 + 8.73 cm, 74.7 + 9.11 kg, 19.59 + 0.59 years) provided informed consent and completed eight maximal effort relay starts, four with the wedge in place and four without. For all starts, participants were instructed to maintain a streamline position upon entering the water and to glide as far as possible. A relay judging platform was installed on the block and used with an in-water touch pad to measure the exchange time for the relay start. Two synchronized cameras captured movements at 60 Hz above and below water. A 16-point model of the body was used to compute center of mass position for above water movements. Takeoff velocity and angle were defined using the horizontal and vertical velocity of the whole body center of mass. Time to 7m was measured as the time needed for the wrist to reach a point 7m from the pool wall. Paired t-tests were used to compare dependent measures between start conditions.
RESULTS: Exchange time ($t(7) = 0.11$, $p = 0.99$), takeoff angle ($t(7) = 0.60$, $p = 0.57$), time to 7 m ($t(7) = 0.69$, $p = 0.51$), and max depth ($t(7) = 1.10$, $p = 0.31$) were not different when using the wedge as compared to not using the wedge (Table 1). However, takeoff velocity without the wedge was 2.4% faster ($t(7) = 2.48$, $p = 0.04$) than with the wedge on the block ($p<0.05$). This difference was characterized by a moderate effect size (Cohen $d = 0.46$).
CONCLUSION: Presence of the wedge on the block had a minimal effect on relay start performance. It adversely affected start performance by decreasing takeoff velocity however no other kinematic variables were affected. Having the wedge on the block may constrain the step length of the swimmer during the relay start, which might explain the decrease in velocity.

THE RELIABILITY OF LOWER-LIMB STIFFNESS MEASURES DURING HOPPING WITHIN A SLED-BASED SYSTEM

DIGGIN, D., ANDERSON, R., HARRISON, A.J.

ITHACA COLLEGE

INTRODUCTION: Stretch-shorten cycle (SSC) tasks are those where eccentric muscle actions are immediately followed by concentric shortening (Komi and Nicol 2011). Sled-based systems (SBS) are often used to study aspects of SSC operation (Flanagan and Harrison 2007).

Stiffness (k) is a characteristic that influences SSC function. Studies show that measures of leg (kleg) and ankle joint (kankle) stiffness exhibit strong reliability during overground hopping (Diggin et al. 2016). In contrast, knee (kknee) and hip joint (khip) stiffness measures exhibit weak-to-moderate reliability (Diggin et al. 2016). The reliability of kknee and khip may be confounded by variation in upper body movement and by participants' ability to control centre-of-mass position. Reliability during hopping may be improved by employing a SBS. The aim of this study was to examine the reliability of k measures during hopping within a SBS.
METHODS: Kinematic and kinetic data were collected at the same time of day on three separate days spaced five-to-seven days apart. Participants completed two trials of single-legged hopping at three different frequencies (1.5, 2.2 and 3.0 Hz) while attached to a SBS (Flanagan and Harrison 2007). Stiffness was calculated using models previously outlined (Diggin et al. 2016). Statistical analysis identified absolute and relative measures of reliability. Participants were familiarized with testing procedures seven days prior to initial data collection.
RESULTS: Data illustrated that kleg measures exhibited weak-to-moderate consistency (ICC = 0.71 → 0.89) between testing bouts at all hopping frequencies. kankle exhibited strong reliability at 1.5 Hz (ICC = 0.94) with weak and moderate consistency evident at 2.2 and 3.0 Hz respectively (ICC = 0.88 → 0.91). kknee and khip measures exhibited weak consistency throughout (ICC = 0.62 → 0.84).
CONCLUSION: Results showed that reducing task complexity by restricting upper body movement within a SBS did not alter the consistency of kknee and khip measures. In previous works, kleg and kankle exhibited strong reliability during hopping (Diggin et al. 2016). The use of a SBS in the present work caused deterioration in hopping consistency. Thus despite having been familiarized with procedures prior to testing, hopping within a SBS represented a novel task for the current participants. This point is supported by higher levels of variability than associated with overground hopping. Researchers should consider these findings prior to associating data collected within SBS to natural SSC actions.
References: Diggin D, Anderson R, Harrison A.J. (2016) J Appl. Biom, 32(3), 278-286.
Flanagan E. Harrison A.J. (2007) J Str Cond Res, 21(1), 67-72.
Komi P.V. Nicol C. (2011) Neuromuscular Aspects of Sport Performance. John Wiley and Sons, Ltd. Chichester, UK
Contact: ddiggin@ithaca.edu

DEVELOPMENT OF A COMBINED BENDING STIFFNESS INDEX FOR CYCLING AND OUTDOOR FOOTWEAR

MICHEL, F.I.1, RAUNER, K.2, KORDEN, O.1, SENNER, V.2

1: VAUDE , 2: TECHNICAL UNIVERSITY OF MUNICH TUM

INTRODUCTION: Footwear bending stiffness represents one of the most important functional properties in athletic footwear . During walking the shoe should provide an appropriate dorsiextension around the MTP-joints to ensure a smooth ride. Contrary, cycling shoes should be stiff to allow a direct power transmission. However, there are specialty shoes, such as for cycle touring, which should offer both a smooth ride during walking and adequate power transmission during cycling. Thus, the aim of this study was to develop a combined bending stiffness index to evaluated cycling and outdoor footwear according to activity and its functional requirements.
METHODS: To investigate the longitudinal bending stiffness a mechanical testing device was used . The device measures forefoot and midfoot flexibility regarding both DF and plantarflexion movement. Different loading condition were applied and the resultant bending angle was measured. Ten outdoor shoes and 8 cycling shoes were tested differing in functional requirements based on their field of use.
RESULTS: For outdoor footwear, the stiffness bending index consists of 4 values measured during DF. For cycling shoes one additional value during PF is considered. Depending on the field of use the tested footwear exhibit different bending stiffness properties. Within outdoor footwear, shoes belonging to the category "Approach" indicate much stiffer bending characteristics compared to "Urban Life". In cycling, the tested shoes of the "Cross Country"-category exhibit clearly stiffer PF bending characteristics compared to "Cycle Touring". Besides, tested footwear for "Cycle Touring" show a similar DF forefoot flexibility like "Urban Life".
CONCLUSION: Data recorded with the TrakTester allow the development of a combined bending stiffness index for outdoor and cycling footwear. The informative value of the mechanical testing is confirmed by several subjective test reports published in consumer magazines . However, a comparison with other studies is not possible since the method to determine the bending stiffness vary strongly . Based on the index, the longitudinal bending characteristics can be evaluated and improved according to field of use and its requirements. Moreover, the index may support the athlete to find the right shoe for its preferred activity.
References: Grund T, Senner V <2010>. Procedia Engineering, 2<2>, 2783-2788.
Krumm D, Schwanitz S, Odenwald S <2013>. Sports Eng, 16, 13-19.
Stefanyshyn DJ, Wannop JW <2016>. Footwear Sci, 8<2>, 51-63.
Bayer C <2017>. http://enduro-mtb.com/lab-026-parts-und-equipment-im-dauertest/3/, 12.12.2017.
Contact: frank.michel@vaude.com

FUNCTIONAL INSPIRATORY MUSCLE TRAINING, RESPIRATORY MUSCLE FATIGUE AND LOAD CARRIAGE

HINDE, K.1, LOW, C.1, LLOYD, R.2, COOKE, C.2

1-LEEDS BECKETT UNIVERSITY, UK, 2-LEEDS TRINITY UNIVERSITY, UK

INTRODUCTION: When load carriage exceeds 20 kg, respiratory muscle fatigue is induced . Performing in hypoxic-cold conditions increases the likelihood of RMF. Inspiratory muscle training can increase inspiratory muscle strength and attenuate RMF, but when combined with LC, IMT has failed to reduce RMF . Exercise involving LC alongside IMT may activate non-respiratory roles of the diaphragm and respiratory muscles and provoke adaptations beyond that of static IMT.
METHODS: Participants performed a loaded <18.2 kg> 6 km walk at 50%VO2max, at 4300m in -10°C, pre, mid and post training . The walk comprised 4 stages of 0.5 km at 0, 5 and 10% gradient. After trial 1, participants were randomly assigned to CON or EXP to undertake 4 weeks of foundation IMT using a Powerbreathe device. CON performed 60 daily breaths at 15% maximal inspiratory pressure whereas EXP performed 2 x 30 breaths daily at 50%Pimax. An additional 4 weeks of functional IMT 3 times weekly followed, which included 5 exercises designed to develop core strength. Three of the 5 exercises required LC <18.2 kg> and all were performed at ~50%Pimax and 15%Pimax .
RESULTS: Relative to baseline <126.9 ± 15.7 cmH2O> trends were identified for greater Pimax in the EXP group post-IMT <145.5 ± 20.5 cmH2O, p = 0.066, likely increase> and post FIMT <155.3 ± 30.8 cmH2O, p = 0.104, likely increase>. Pimax in CON remained unchanged. The reduction in Pimax post-6 km was unchanged by IMT or FIMT. There was no effect of IMT or FIMT on Ve, HR, VO2, BF or SpO2. Following FIMT, there was a significant 4-way interaction for whole-body RPE suggesting a greater reduction in RPE in EXP following FIMT.

CONCLUSION: Whilst IMT and FIMT produced an increase in the absolute strength of the inspiratory muscles, this failed to translate into any meaningful benefits and did not attenuate the reduction in Pimax post exercise. This may be because training load did not progress as time elapsed. Due to the prolonged, low intensity nature of LC activity, respiratory muscle endurance may be more influential than strength. Future research should focus on the effect of LC in cold-hypoxia on RME and employ a progressive overload IMT protocol that aims to improve Pimax and RME.
References: Faghy, M. & Brown, P. <2015> Training the inspiratory muscles improves running performance when carrying a 25kg thoracic load in a backpack. European Journal of Sport Science, pp. 1-10.
Faghy, M. Blacker, S. & Brown, P.I. <2016> Effects of load mass carried in a backpack upon respiratory muscle fatigue. European Journal of Sport Science, 16 <8>, pp.1032-1038.
Contact k.hinde@leedsbeckett.ac.uk

DECELERATION DEFICIT: A NOVEL METHOD OF MEASURING DECELERATION ABILITY DURING CHANGE OF DIRECTION PERFORMANCE

CLARKE, R., HUGHES, J.D., DE STE CROIX, M.
UNIVERSITY OF GLOUCESTERSHIRE

INTRODUCTION: Recently, the use of a change of direction deficit (CDD) has been proposed in order to quantify change of direction (COD) performance while controlling for linear speed ability. However, the CDD is still a composite of different skills (deceleration, reacceleration and turning technique). Due to the effect of momentum on joint loading and injury risk during COD performance, it would be beneficial to isolate the athletes deceleration capability during testing. This study utilised a novel method of measuring deceleration ability, termed the deceleration deficit (DD), during a 180° COD task and investigated its relationship with CDD, COD task completion and sprint speed.
METHODS: Sixteen recreationally trained athletes (21.5 +/- 6.2y; 84.5 +/1 19.7kg; 176.2 +/- 7.2cm) performed a 15m sprint (with a 10m split) and a 180° COD task with time measured (Smart Speed and Smart Jump, Fusion Sport) at 0m, 10m, the turn line (15m) and after a 5m re-acceleration (return past the 10m line). The CDD was calculated as the difference between the best 10m sprint time and the 10m portion of the COD task including the 180° turn (505 time). The DD was calculated as the difference between the best 15m sprint time and the time to reach the 15m turn line during the COD task. All variables were calculated from dominant side COD attempts. Correlations and partial correlations (P 0.05) were calculated between variables to compare their relationship with and without controlling for linear speed (15m sprint time). Z-scores were calculated to compare the difference between CDD and DD.
RESULTS: The CDD was significantly correlated to 505 time ($r = 0.531$; $P = 0.03$) while the DD was not significantly correlated to any other variable. The partial correlation reported significant relationships between CDD and 15m COD approach ($r = 0.743$; $P = 0.00$), total COD ($r = 0.748$; $P = 0.00$), re-acceleration ($r = 0.821$; $P = 0.00$) and 505 ($r = 0.964$; $P = 0.00$); and between DD and 15m COD approach ($r = 0.568$; $P = 0.02$), total COD ($r = 0.822$; $P = 0.00$) and 505 ($r = 0.525$; $P = 0.04$). 94% of participants showed a difference greater than the SWC between CD and DD z-scores.
CONCLUSION: It maybe concluded that the DD provides a practical tool to isolate an athletes deceleration capability and identify athletes whose COD performance is or is not hindered by their deceleration capability. This will allow coaches and researchers to measure the effect of training interventions, helping to mitigate potential injury risk and improve performance.

Conventional Print Poster

CP-BN07 Kinematics and movement analysis

GAME PHYSICAL PERFORMANCE OF JAPANESE TOP-LEVEL FUTSAL PLAYERS IN DIFFERENT CATEGORIES

OHMURO, T.1, ISO, Y.2, TOBITA, A.1, HIROSE, S.1, SAKAUE, K.2, ISHIZAKI, S.2, YASUMATSU, M.1
1: RIKKYO UNIVERSITY , 2: SHIBAURA INSTITUTE OF TECHNOLOGY

INTRODUCTION: Several research on the game physical performance of futsal players in different competition levels have been reported (Dogramaci et al., 2011, Makaje et al., 2012). However, these studies neither comprised data of official matches, nor did they include male youth and female players. Therefore, the aim of this study was to compare the game physical performance of male, male youth and female Japanese top-level futsal players in official matches.
METHODS: The subjects were 79 top-level male players (age: 28.4 ± 4.6yrs), 59 top-level youth players (age: 17.1 ± 0.7yrs) and 87 top-level female players (age: 25.6 ± 6.9yrs). The game physical performance was assessed by active profiles of the matches using the automatic tracking system (Iseyama et al., 2016). All values are presented as means ± SD. Differences in the game physical performance between the different categories were determined by the analysis method one-way ANOVA, and in the case of significant differences, the Bonferroni˜s post hoc test was used to identify the point of difference. Statistical significance was set at $p < 0.05$.
RESULTS: The average of the total distance covered during matches of the male futsal players (141 ± 11 m/min) was significantly higher than those of youth (131 ± 10 m/min) and female players (134 ± 11 m/min; $p < 0.05$). In addition, the percentage of high intensity exercise (15.5 km/h～) during matches of youth and female futsal players was significantly lower than that of the male players ($p<0.05$).
CONCLUSION: This is the first study that has examined the game physical performance during official matches of youth and female futsal players, and these data may be useful for designing training programs of these groups. As a result of this study, the total and the high-intensity distance of the male futsal players was higher compared to Brazilian players (Murilo et al., 2014) and this game physical performance can be suggested to be the strength of the Japanese. These results also show that male futsal players have higher physiological demands than youth and female players, and it could be a help for physical coaches of youth and female futsal players in the future.
REFERENCES:
Dogramaci et al. (2011). J Strength Cond Res, 25(3):646-651.
Makaje et al. (2012). J Sports Med Phys Fitness, 52(4):366-74.
Iseyama et al. (2016). International Research in Science and Soccer II, 251-258.
Murilo et al. (2014). Sports Biomechanics, 13(3):230-240.
CONTACT:
[tatsuhiro.ohmuro@gmail.com]

3X3 BASKETBALL: INERTIAL MOVEMENT AND PHYSIOLOGICAL DEMANDS DURING ELITE GAMES

MONTGOMERY, P., MALONEY, B.

ASPETAR

INTRODUCTION: 3x3 basketball has had an exponential increase in popularity in recent years and has now been included in into the 2020 Olympic Games. Given that 3x3 basketball is a relatively new sport, little is known regarding the game demands, or the physical and physiological responses of players during these games. The aim of this study was to determine changes in game demands and physical performance during international tournament match-play of elite 3x3 basketball.
METHODS: 361 males and 208 females competing in the under 18 World Championships, Senior European and World Championships, and Professional World Tour Final had game demands assessed by wearable technology (GPS, inertial measurement, heart rate) along with post game blood lactate and perceived responses. The total number of GPS and accelerometer game files collected for data analysis were 820 over 252 games, and 635 over 85 games for males and females respectively. Differences in the means were compared using magnitude based inferences and reported with Effect Size and associated 90% confidence limits, along with the percentage difference (ES; ±90%CL, % difference) of log-transformed data.
RESULTS: PlayerLoad™ and PlayerLoad™·min-1 during play was 127.5 ± 31.1 and 6.7 ± 1.5, and 128.5 ± 32.0 and 6.5 ± 1.4 for males and females respectively. For males, clear trivial differences were shown in PlayerLoad™ responses between under 18 (0.05; ±0.23, 1.2%), and World (0.17; ±0.21, 4.4%) championship levels compared to the professional level only. For females, a small difference was seen between European (0.28; ±0.22, 9.4%) and under 18 level. For PlayerLoad™·min-1, a trivial, and small clear difference was seen between the European and under 18 level for males (0.14; ±0.19, 3.3%), and females (0.20; ±0.22, 6.2%) respectively. There were small differences in accelerations >3.5m·s between competition levels up to 0.31; ±0.20, 22.2% for males, and 0.29; ±0.19, 20.3% for females, and for decelerations >3.5m·s; 0.29; ±0.19, 19.3% for males and 0.26; ±0.19, 17.2% for females, with European championships generally greater than other tournament levels. Average game heart rate was 165 ± 18 and 164 ± 12 bpm for males and females, with no difference between levels. Average RPE was 5.7 ± 2.1 and 5.4 ± 2.0 for males and females. Average game lactate for males and females was 6.33 ± 2.43 and 6.09 ± 2.24 mmol·L -1 respectively.
CONCLUSION: 3x3 basketball games require frequent high speed inertial movements in a limited volume of distance creating a relatively high physiological response. Practitioners working with 3x3 players at this level should endeavour to focus on the attributes that will improve these player characteristics for greater success.

CAN THE TIME-SERIES ANALYSIS OF BENCH PRESS FORM BY THREE-DIMENSIONAL MOTION ANALYSIS CONTRIBUTE TO THE PROBABILITY OF AN APPROPRIATE FORM IN PARA POWERLIFTING?

ISHIDA, N.

AICHI GAKUIN UNIVERSITY

INTRODUCTION: As targeting the athletes participated in Para Powerlifting of Paralympic, the author has already confirmed the influence from tiredness due to the subtle form disturbance and the repeated motion on its form by measuring the electromyogram at the bench press lifting, the joint angle of the elbow, the palmar force of holding position of the barbell shaft, and the floor reaction force at the position where shoulder blade attaches floor. In addition, the time-series analysis of bench press form by three-dimensional motion analysis were carried out to measure in this research. The subject is an able-bodied person and the experiment was conducted by aiming to establish an appropriate measuring method. After considering its practicality, the same measurement was carried out on the Para Powerlifting athletes with the aim to verify its effectiveness.
METHODS: The subject was the former Japan Masters Champion , one athlete aimed to participate in Paralympic as specializing for Para Powerlifting competition, and one athlete already participated in Paralympic 3 times. For the measurement, the bench press maximum weight of the subject was checked. As for the measuring condition, weight of 70% and 50% of 1RM was determined and 5 times of repeated lifting were carried out. The measurement was conducted by motion analysis with 9 Vantage/Vero cameras by VICON.
RESULTS: The difference in movement of left and right shoulders and elbows and the inclination of the shaft were detected from the change of segment position in left and right direction during continuous lifting motion. In addition, the difference between left and right of shaft movement while lifting was detected. Furthermore, in addition to the difference in left and right movement of the elbow joint and the shoulder joint, the angle at which the trunk and the shoulder joint open was able to be detected with high accuracy.
CONCLUSION: The subtle difference between the left and right movements revealed by the measurement is small, not able to be found from the visual observation. However, if these movements are continued in daily training, there is a possibility that it may lead to injury to the elbow or shoulder, and that is undesirable even if it's just subtle difference between the left and right from the viewpoint of strengthening. From the measurement of motion analysis at bench pressing with the normal training form conducted, it was found that it is possible to evaluate detailed motion. This result seems to be able to effectively contribute to obtain an appropriate and effective form for Para Powerlifting athletes.

BIOMECHANICAL ANALYSIS FOR SIMULATING THE WHEELCHAIR 100M AND 400M RACINGS USING MOTOR RESISTED ERGOMETER SYSTEM.

KASHIWAGI, Y.1, HIRANO, T.2, SOMA, M.3, HAKAMADA, N.4, FUNATO, K.2

1:SENSHU UNIVERSITY, 2:NIPPON SPORT SCIENCE UNIVERSITY, 3:JUMONJI UNIVERSITY, 4:JAPAN INSTITUTE OF SPORTS SCIENCES

INTRODUCTION: Wheelchair race of the Paralympic games have become increasingly popular in the last few years. Development of a wheelchair is record improve very it being important of an athlete. However, there are little quantification of mechanical output of an athlete playing a game and kinematic information while development and study of a wheelchair advance. In addition, pattern of wheelchair racing speed indicated that is different from compared with the Olympics 100m racing speed pattern. Wheelchair athletes have a case to participate in from a short distance to a long range races, and a document choosing a physical strength element specialized in a competition is poor. The purpose of this study was to biomechanics analysis of wheelchair sprint racing the 100m and 400m race simulations using wheelchair ergometer.
METHODS: The six wheelchair athletes（age:40.5±7.2yrs. BH:165.5±7.6cm, BW:55.5±8.7kg, Class: T53,54, 100m time:16.08±1.03s, 400m time:53.79±2.61s） were participated in this study. Subjects were performed 100m and 400m race simulation each wheelchair racer attach on wheelchair ergometer system (1kHz, KEKU,Canada). Reflective marker was attached to the upper limb anatomical point: acromion, humeral lateral epicondyle, ulnar styloid, Finger the second metatarsal. Upper limb extremity kinematics data was analysed using

the motion capture system (250fps, BTS, Italy). During race simulate mechanical model was applied form primary research. One stroke wheelchair power output was calculated from push force and disk velocity. One cycle time of spatio-temporal parameters were determined by power curve, stroke frequency (SF) was calculated from the reciprocal number. Stroke length was divide average of one cycle velocity by frequency (SF). Mechanical power output and spatio-temporal parameters of race simulations were indicated mean±SD each 10m or 50m phase.
RESULTS: In 100m race simulation, maximum speed was appeared just before 100m, but the 400m race simulation was indicated between 100m and 150m phases. Stroke frequency was not difference between 100m and 400m race simulations. As for the velocity of both races, what SL influenced than SF was accepted. As for the force, decrease was present, but the power display was steady in 100m race simulation. On the other hand, in 400m race simulation was indicated that decrease both force and power output. Maximum velocity was not significant difference between 100m(8.4±0.3m/s) and 400m(8.5±0.4m/s) race simulations.
CONCLUSION: Maximum velocity was not significant difference between both race conditions. It is suggested that rate of velocity not maximum velocity important for 100m and 400m race performance. Furthermore, it was indicated that ability for maintenance of power output important for 400m race. This study is suggested that upper limb strength to overcome frictional resistance of a wheel of early period of race is important in wheelchair racers.

PREDICTORS OF WALKING EFFICIENCY IN ADOLSCENTS WITH CEREBRAL PALSY

THEIS, N., RYAN, J., LAVELLE, G., NOORKOIV, M.
UNIVERSITY OF GLOUCESTERSHIRE

INTRODUCTION: Children with cerebral palsy (CP) have increased muscle stiffness and reduced muscle strength, which may contribute to a high metabolic cost of walking. In typically developing children, efficient gait is achieved by substantial force generation of the calf muscles, coupled with an optimum stiffness ratio between muscle and tendon to allow low muscle fibre shortening velocities (Lichtwark and Wilson, 2008). In children with CP, a greater stiffness ratio between muscle and tendon (Theis et al., 2016) and reduced muscle strength and size (Wren et al., 2010) may explain the high mechanical energy cost during walking. Understanding if these variables can predict walking efficiency may support the development of effective therapeutic strategies.
METHODS: Regression analysis of cross-sectional data from 30 adolescents with CP (age 13.0 ± 2.3 y; GMFCS levels I-III) was used to investigate if medial gastrocnemius muscle volume, plantarflexor muscle strength and stiffness and Achilles tendon stiffness would predict walking efficiency, measured from net non-dimensional energy cost during a 6-minute walk test. Simultaneous recording of ultrasonography and motion analysis during a maximal plantarflexion contraction manoeuvre was used to derive strength and stiffness. Muscle volume was assessed with a 3D-freehand ultrasound method.
RESULTS: All variables were significant and independent predictors of walking efficiency. Muscle volume alone explained 46% of the variance and when plantarflexor strength was also included in the model, the explained variance increased to 52%. Higher plantarflexor muscle stiffness and lower Achilles tendon stiffness were associated with lower walking efficiencies. When muscle and tendon stiffness were added to the model, the explained variance in walking efficiency was 67%.
CONCLUSION: Walking efficiency in adolescents with CP may be influenced predominantly by muscle weakness, which can be attributed to both reduced muscle volumes and strength. High plantarflexor muscle stiffness coupled with low Achilles tendon stiffness may prevent muscle fibres from operating at an optimal length. Therapeutic efforts for adolescents with CP should be aimed at increasing muscle size and strength, and optimising stiffness of the calf muscles and Achilles tendon.
References: Lichtwark G, Wilson A. (2006). J Theor Biol, 252, 662-673.
Theis N, Mohagheghi A, Korff T. (2016). J Biomech, 49, 3004-3008.
Wren T, Cheatwood A, Rethlesfen S, et al. (2010). J Pediatr Orthop, 30, 479-484.

MOVEMENT CHARACTERISTICS AND GREATER LEVER ARMS AS BIOMECHANICAL RISK FACTORS OF KNEES VALGUS DEFORMITY IN SEPAK TAKRAW ATHLETES

CHANG, C.C., JIANG, Y.S., CHANG, S.Y., ADEEL, M., HSIEH, Z.R., AHMED, M.I., HSU, W.C.
NATIONAL TAIWAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

INTRODUCTION: Increased risk of lower limb osteoarthritis (OA) has been found to be associated with repetitive, high impact sports (Conaghan 2002). For an athlete, a major knee injury will often have severe short-term consequences such as an interrupted sports career (Lohmander et al. 2004). Nowadays, the diagnosis of OA has most often been based on radiographic appearance. However, if we can relate the cause of knee OA during dynamic motion to sports mode or training method, athletes can adjust their strategy to prevent injury. Therefore, the aim of this study is to see the feature of knee OA in dynamic trial when performing different landing types.
METHODS: Two Sepak Takraw athletes participated in this study and one of them has been diagnosed with valgus knee, especially at the left side. Subjects were instructed to do three types of jumping, which were double-leg landing from 40cm platform, single-leg jumping forward with left leg as single propulsive leg and right non-weight bearing from 40cm platform, and single-leg jumping forward. The data was collected by motion capture system (Qualisys) and force plates (AMTI). Kinetic and kinematic parameters were analyzed using MATLAB including lever arm of knee joint, joint angle and joint moment of hip, knee, and ankle. Lever arm definition (3D). Positive value of lever arm indicating the GRF is lateral to the center of rotation at the knee joint while the negative value of lever indicating the GRF is medial to the center of rotation at the knee joint.
RESULTS: During single-leg jumping forward with left leg as single propulsive leg and right non-weight bearing, the greater knee adductor moment at the left limb compared to that at the right limb was only observed in the subject with more severe valgus left knee. If the subject keep performing this asymmetric task with already asymmetrically deformed valgus alignment at the propulsive side, the deformity may aggravate fast due to the found biomechanics repeated injured mechanism, in terms of greater lever arm and its corresponding adductor moment, reported in current study.
CONCLUSION: Research have showed that asymmetry of the movement characteristics may increase risk of deformity in Sepak Takraw athletes and that this biomechanical risk factor may become more pronounced for athletes with knees valgus deformity due to greater peak knee adductor moments and lever arms in the frontal plane.

REAL-TIME RECORDING OF PROPULSIVE PARAMETERS OF PADDLE-BOARDER ELITE SWIMMERS DURING CROSSING OF THE ATLANTIC

JOFFROY, S., GARNIER, S., OUAKNINE, M., AUTET, B., MAURIÈGE, P.

UNIVERSITÉ PAUL SABATIER

INTRODUCTION: Three elite women athletes (27 ± 5.8 yr-old) specialized in coastal rescue have related the islands of Cape-Breton in Canada to Capbreton in France (5000 km) on "Paddle-Board". They have taken turns day and night to travel 100 km on average a day. Postural adaptation of the locomotion of the swimmers was measured during all the crossing: their performances and spatio-temporo-frequential parameters of swimming in athletes of very high level under extreme conditions and constraints were analyzed.
The analysis of the driving forces is based on the measurement of the traction and propulsion forces exerted by the ventral side of the hand resting on the water (Silva and al. 2005). The sensors developed in our service were attached on the palm and / or the pulp of the finger (major or index) of the hand. They consisted of membranes or blades whose deformation is retranscribed as an electrical signal by means of strain gauges.
METHODS: To evaluate the swimming technique, our objective was to create a system for acquiring paddle board propulsion forces in real time, by measuring the swimmers hand thrusts on the mass of the paddle board water. The sensors had to be waterproof, miniaturized and placed not to hinder the locomotion of the swimmers. The sensors are connected to a box attached to swimmers'arms in the emerged part of the body. The electronic interface is responsible for shaping the force signals, performing a digital conversion at a rate of 20 Hz and sending the digitized sequences over the air (2.4 GHz). All in a waterproof conditions. The data are immediately recorded and transformed on board the logistic boat in the form of graphs giving the real time evolution of the locomotive pressures. The power supply of the boxes is ensured by accumulators of 3.6 volts. Swimmers row continuously with an active period of 2:30 h and a rest period of 5 h. The software, "SWIMMEX" acquisition, records the name of the current swimmer, the type of sensor, the start and end dates of the recording as well as various notes in progress exercise.
RESULTS: Our results allowed to establish the profile of a motor cycle, from which it is possible to extricate, its period, its spectral composition, the forces, speeds, accelerations under hostile environmental condition. Indeed, the results showed that the three women have adopted the same tactical swimming by alterning elongated and kneeling positions. The elongated position is fluid and controlled while the kneeling position is impulsed.
CONCLUSION: Swimmers have adopted the same swim-start tactics, probably for energy saving, exercise management and ergonomics considerations for the posture adopted on the paddle-board (Zamparo and al. 2005). This is the first time that such measurements were performed during a major sports event.

VARIABLES RELATED TO FATIGUE DURING A 2 X 40 MIN GAME SIMULATION IN MALE YOUTH SOCCER PLAYERS.

KUNZ, P.1, ZINNER, C.2, SPERLICH, B.1

1 UNIVERSITY OF WÜRZBURG, 2 UNIVERSITY OF APPLIED SCIENCES FOR POLICE AND ADMINISTRATION OF HESSE

INTRODUCTION: Soccer performance is, although not exclusively, determined by the players' endurance, addressing both the aerobic and anaerobic system and various neuromuscular demands like jumping and sprinting. Therefore, counteracting fatigue represents one major aim in planning and training of soccer players. Besides having an adverse effect on the probability of injuries and other health risks like overtraining, fatigue directly influences variables affecting acute match performance and should therefore be prevented. Especially short activities like sprinting, jumping or change-of-direction (CoD), frequently applied in a soccer game, often decide upon success and should be investigated in detail. Therefore, the aim of this study was to examine performance in sprinting, jumping and agility of male youth soccer players during a 2 x 40min soccer game simulation to investigate the time course of variables related to fatigue.
METHODS: Eleven highly trained male youth soccer players (16 ± 1 yrs; 178 ± 7 cm; 67 ± 7 kg) completed a 2 x 40-minute soccer match simulation in the lab, with a 10-minute half-time to recover. One half consisted of walking, jogging, linear sprinting, jumping and CoD in reaction to an extern stimulus. The percentages of these diverse physiological demands where set in accordance with youth soccer match analyses. The CoD were performed on the SpeedCourt (Globalspeed GmbH, Hemsbach, Germany). To complete one 40-min simulation, the player had to finish 15 equal rounds in 2 min 40 s, including all given intensities. To determine the cardio-respiratory load during the simulation in relation to maximum values, all players underwent an incremental test to receive VO2max (MetaMax3B_R2, Cortex, Leipzig, GER) and HRmax (H10, Polar Electro OY, Kempele, FIN). Lactate was measured after every five rounds and RPE was determined using Borg's 6-20 scale (Borg 1970) every round.
RESULTS: Within both halves, RPE increased significantly over time to 17.6 in the last round ($p<0.05$). VO2max and HRmax averaged 71% and 86%, respectively. When comparing the average 20m linear sprinting time of rounds 1-5 (3.2 ± 0.17 sec) with rounds 25-30 (3.21 ± 0.14 sec), no significant difference could be detected ($p = 0.92$). Similary, no difference were detected for jumping (CMJ) between rounds 1-5 (38.7 ± 5.3 cm) and rounds 25-30 (40.0 ± 5.7 cm) ($p= 0.27$). CoD performance was greater in rounds 25-30 (16.74 ± 1.48 sec) compared to round 1-5 (17.95 ± 1.97 sec).
CONCLUSION: In our study, we found signs of increasing intensity and high physical strain during a simulated 2 x 40 min soccer match as indicated by the increase in HR and VO2 and additionally by the players' perceived high exertion. Conversely, no decrease in neuromuscular performance, expressed in linear sprinting, jumping and CoD, were detected. These findings may provide indications that fatigue in this laboratory simulation was mainly of central origin, without affecting neuromuscular performance.

THE EFFECTS OF AUDIBLE STIMULUS ON GOLF COACHING PEDAGOGY BASED ON KINEMATICS

YOO, K., WU, X., ZHUANG, W., XIA, Z., LIU, Y.

KEY LABORATORY OF EXERCISE AND HEALTH SCIENCE OF MINISTRY OF EDUCATION, SCHOOL OF KINESIOLOGY, SHANGHAI UNIVERSITY OF SPORT, YANGPU, SHANGHAI 200438

INTRODUCTION: Golf coaching methodology has taken an important position in golf categories for improving mechanical respects with enhancing performance and injury prevention. However, the traditional golf pedagogy which has been depended on empirical and individualized method with insufficient scientific based verification are required to develop for the new forms of golf coaching methodology. Therefore, the purpose of the current study is to verify the efficacy of audible stimulation as a golf coaching strategy for novice golfers through the well-established kinematical variables after 5 weeks golf lesson.
METHODS: Twenty four male right handed novice participants who had no experience in golf and musculoskeletal injury participated in the study and randomly separated into two groups TG (tagger group / n=13) and NG (non-tagger group / n=11). The golf coaching pro-

cess was conducted on three times a week for 5 weeks. Only different coaching treatment between two groups was tagger using during the lesson procedure. To measure kinematical variables, 10 infrared cameras used and the resulting data was evaluated with kinematic analysis in the study. Also, Trackman radar device used to measure ball and club variables coincidently in the experiment.
RESULTS: The significant superiority of kinematical characteristics of club head and pelvic rotation in TG has found to compare with NG. Also, the COM (Center of Mass) alteration during the acceleration phase from backswing top to follow throw found the less COM displacement on X, Y, Z axis in TG at 5 week. Moreover, the golf performance parameters (club speed, face angle, ball speed, flight time, carry distance) except smash factor in TG have presented on significant improvement.
CONCLUSION: The efficacy of audible stimulus as a golf coaching strategy has proven by all kinematical parameters in the current study. The variation of velocity and acceleration in club head and pelvis have fully support the main idea, and the COM variation have shown comparatively better motor control ability in TG to compare with NG. Most of all, the golf performance parameters have revealed credible superiority in TG. Besides, the author as a researcher and professional golf coach has found the efficacy of audible stimulus in the process of golf lesson. So, we are able to acknowledge the effect of audible stimulus in golf coaching pedagogy based on the results in the study respectively. As a new golf coaching pedagogy trial, immediate audible stimulus feedback method would be utilized to lesson golf for novice golfers. Furthermore, it could be expected to provide a better motor learning process for golfers with all skill level, age, and gender.

Conventional Print Poster

CP-BN08 Training and cognition

QUANTIFICATION OF VISUAL BEHAVIOR AND PREPARATORY ACTION IN VOLLEYBALL BLOCKING

UMEZAKI, S., YAMAMOTO, D., KIDA, N., NOMURA, T.

TENRI UNIVERSITY

INTRODUCTION: In modern volleyball, it is a critical moment for the blocker to quickly judge the direction of opponent attackers in order to block their shots. The purpose of this study was to investigate the effective preparation of blocker from the point of visual behavior, and step motion. We hypothesize that the high-level blockers can read the direction of attacks by collecting the opponent setter and other behavior.
METHODS: We set up two groups by skill: i.e. Expert professional player (female, n=4), College player (female, n=4), and made players block balls from unexpected three directions (i.e. left, middle, right) at random. Eye movements of blockers while seeing a setter and their initial response towards take-off were both recorded using a lightweight binocularly eye mark recorder (EMR-9, 60 Hz) and video-camera (60 Hz), respectively. We measured the three sequential starting time points of preparation step, main step, and take-off, and analyzed the duration between them. We extracted 10 blocks per each player from the right and left directions, not middle one.
RESULTS: The expert players paid longer attention to setter's face while college ones to setter's hands (i.e. expected toss-impact). The means percentage of the viewing duration of the expert group on the setter's face was higher than the experienced group. During the starting time of preparation step and main one (i.e. preparation-step phase), 5 different type of steps were defined (i.e. the side-thrust, jab-step, kick-back, split-step, and double-step). During the starting time of main step and take-off (i.e. main-step phase), we defined cross-step, side cross-step and running-step. The experts stayed longer until the toss-impact in the preparation-step phase while the college players started moving with their assumption.
CONCLUSION: These finding showed that the expert players waited to start the preparatory motion until just before toss impact, and quickly executed that motion after precisely reading the direction of toss. Results suggested that experts give priority to perceptions when judging the direction of a toss, whereas experienced college players might give priority to motions for starting a move.

THE RELATION OF REGULAR PHYSICAL ACTIVITY WITH LIVING BEHAVIOR AND MENTAL HEALTH IN KOREAN ADOLESCENTS

GWAK, H., KIM, S.

KOREA UNIVERSITY

INTRODUCTION: According to the Organization for Economic Cooperation and Development , Korean adolescents resulted in 82 points in 2016 their self-reported sense of happiness as measured. The scores were the lowest rank among the members of the OECD. Also, Korean adolescents ranked high in the lack of physical activity. The severe problem is that level of stress and depression are increasing in Korean adolescents. This study examines the relation of regular physical activity with living behavior and mental health factors in Korean adolescents using Korea Youth Risk Behavior Web-based Survey data.
METHODS: Complex sampling design data was obtained from the 12th KYRBWS. The subjects, total 65,212 middle and high school students, were classified into two groups based on regular physical activity, depending on gender. We included economic status, academic achievement, breakfast, time sitting down, sleep duration, sleep satisfaction, smoking, drinking, self-rated health, self-perception of body image and BMI category in living behavior factor, and stress, depression, suicidal ideation and subjective well-being in mental health factor. Data were analyzed by complex sample linear model, chi-squared analysis, and logistic regression.
RESULTS: Regular physical activity did not differ by height and BMI in boys and girls from a little physical activity. Regular physical activity was more weight than little physical activity in boys, but girls were not a significant difference. Boys and girls containing regular physical activity were a higher academic achievement, eating breakfast ratio, normal sleep , sleep satisfaction and healthiness in self-rated health than other. Also, both genders included regular physical activity had less sedentary time than little physical activity. However, all adolescents of regular physical activity were higher ratios in smoking and drinking than little physical activity. Boys and girls who had little physical activity appeared to have a significantly higher than regular physical activity in to get stress. Boys and girls had OR values of 1.274<95% CI from 1.206 to 1.346> and 1.138<95% CI from 1.077 to 1.202>. In depression, boys and girls who had little physical activity were significantly lower than regular physical activity. Boys and girls had .820<95% CI from .771 to .873> and .939<95% CI from .883 to .998>. Also, suicidal ideation showed differences between boys and girls students. Boys had little physical activity were significantly higher than regular. Girls had little physical activity were significantly lower than regular. Boys had 1.152<95% CI from 1.051 to 1.263>, but girls had .783<95% CI from .728 to .843>.

CONCLUSION: In this study, Korea adolescents who had regular physical activity show positive in living behavior. Stress and suicidal ideation were associated with a regular physical activity. Stress was an association with regular physical activity in girls. This study provides a relation of regular physical activity mental health and factors related student living behavior in Korea.

A FUNCTIONAL NIRS EVALUATING TRIAL OF MOTOR IMAGERY AND PHYSICAL EXERCISE TASKS FOR A KARATE EXPERT

FUJIEDA, Y., KOBAYASHI, Y., TAKESHITA, K.

FUKUI HEALTH SCIENCE UNIVERSITY

INTRODUCTION: It has been taught that Karate katas, traditional self-learning method of form exercise must be executed against imagined opponent(s). A legendary karate adept had told his a disciple "Curiously enough, I am now perspiring due to only performing kata in my mind despite of no actual body movement". This open-skill learning strategy of solo performance can correspond to motor imagery and/or mental rehearsal of modern sport methodology. Recent neuroimaging studies have shown that skill acquisition or improved performance induces economical changes in brain areas demanded by the practiced task. In this study, we investigated the similarity and difference of cerebral activity between motor imagery and executing physical performance of karate kata in the way of an expert case study.
METHODS: A well-trained male karate ascetic (56 year-old, 8th degree of dan) was asked to mentally rehearse a traditional kata of Pinnan-shodan from a first person-perspective in sitting posture, a standing rest for 30 seconds, and to perform the same kata with actual physical actions. Through this brock-designed task, oxy-hemoglobin changes in the prefrontal lobe and motor areas of the subject were evaluated by using a wearable functional NIRS device （SMARTNIRS, SHIMADZU）. The oxy-hemoglobin data was analyzed to identify and map brain areas by using a software (Statistical Parametric Mapping for Near Infrared Spectroscopy : NIRS-SPM). The participant was right-handed with no clinical history of cerebral or neurological diseases.
RESULTS: During motor imagery of Pinnan-shodan, brain activations at bilateral frontal lobes and motor cortex were observed. On the other hand, similar brain activations at frontal lobes and reduced activations at motor related areas were revealed while the karate expert was executing the same Kata with actual physical movements. It could be considered that this economically activated motor cortex during performing Kata exercise was derived from the automation effects of physical skill that had been acquired by the expert.
CONCLUSION: Economically reduced activation at motor related area of a karate expert during physical performing karate kata than mental rehearsal can be detected by functional NIRS.

TRANSCRANIAL DIRECT CURRENT STIMULATION SUPPRESSES THE CONTRALESIONAL HEMISPHERE: A SYSTEMATIC REVIEW AND META-ANALYSIS

KANG, N., WEINGART, A., KIM, M., CAURAUGH, J.H.

INCHEON NATIONAL UNIVERSITY; UNIVERSITY OF FLORIDA

INTRODUCTION: The conventional perspective on the contralesional primary motor cortex (cM1) has changed because of the potential supportive role of the cM1 for a subset of stroke patients. Despite increased cM1 activity patterns post stroke interfering with paretic motor function, in some cases the hyperactive cM1 may contribute to improving paretic arm function. Thus, this comprehensive meta-analysis examined the beneficial effects of cathodal transcranial direct current stimulation (ctDCS) that suppresses the cM1 activity on motor rehabilitation for stroke individuals in different recovery phases.
METHODS: Fifteen studies that applied ctDCS on the cM1 for stroke motor rehabilitation were included. We identified 20 total comparisons from the qualified studies indicating motor function changes between ctDCS and sham stimulation protocols. For moderator variable analysis, we compared effect sizes between two different recovery stages: (a) acute and subacute phases (time since stroke = 6 months): eight comparisons and (b) chronic phase (time since stroke > 6 months): 12 comparisons.
RESULTS: A random effects meta-analysis model showed significant improvement in paretic motor function after applying ctDCS on the cM1: standardized mean difference effect = 0.61; SE = 0.15; 95%CI = 0.31-0.92; $P < 0.001$. Interestingly, the moderator variable analysis revealed that effect size for acute and subacute stroke patients was not significant (effect size = 0.46; $P = 0.07$), whereas the ctDCS protocol for chronic stroke patients showed significant effect size (effect size = 0.71; $P < 0.001$).
CONCLUSION: The current meta-analysis indicates that the treatment effects of ctDCS on the cM1 for stroke motor recovery are different between acute and subacute stroke patients and chronic stroke patients.

EFFECTS OF HALO SPORT ON COGNITIVE PERFORMANCE

ZHENG, X., HUANG, L.Y., WANG, Y.N., BIAN, X.L., LIU, Y.

SHANGHAI UNIVERSITY OF SPORT

INTRODUCTION: Recently, athletes use electrical stimulation to improve exercise performance or make the training more efficient. Halo Sport is a non-invasive brain stimulation headphone, and it has been shown to improve the height of jump (Hornyak, 2017). The ergogenic effect of Halo Sport may be due to deliver a constant, mild electrical pulses to the scalp and the brain, supposedly allowing motor-cortex neurons to build neural connections more easily. However, the effect of Halo Sport on the brain remains unclear. The cognitive function, specifically executive function, has been show related to the brain activation (Huppert et al., 2017). Therefore, the purpose of the present study was to investigate effects of Halo Sport on the performance of executive function.
METHODS: A within-subjects design with a counterbalanced order was employed. Six male participants in randomized order received a placebo Halo Sport stimulation (SHAM) or real Halo Sport stimulation (Halo). Each condition lasted 20 min and current was set at 0 mA or 2 mA. The executive function generally consists of metal set shifting, information updating, and inhibition of prepotent responses. To observe the changes of executive function, the Stroop Test and the N-back task were performed before and after Halo Sport for inhibition of prepotent responses and measuring information updating. The Stroop Test consisted Stroop Color and Stroop Color-Word conditions. The N-back task applied in this study, designed using E-prime software, consisted 1-back, 2-back and 3-back conditions.
RESULTS: Participants exhibited a decrease of reaction time in Stroop Test from pre- to post-stimulation after Halo Sport, but not after sham stimulation. Halo Sport induced a trend towards significant improvement of 2-back reaction time, but did not affect 1-back and 3-back conditions.
CONCLUSION: Halo sport is designed similar as transcranial direct current stimulation (tDCS) applied to the primary motor cortex. Using the same stimulate session and current intensity, tDCS has been showed to improve exercise performance and cognition, these effects of

tDCS may be due to the improvement of cortical excitability (Angius et al., 2018). In the present study, we firstly evidenced that Halo Sport could improve cognitive function, and these results indirectly indicate that the ergogenic effect of Halo Sport may be due to enhance brain function.

REFERENCES: Angius L, Mauger AR, Hopker J, Pascual-Leone A, Santarnecchi E, Marcora SM (2018). Brain Stimul, 11(1)*108-117.
Hornyak T (2017). Nature, 549, p. S1.
Huppert TJ, Karim H, Lin CC, Alqahtani BA, Greenspan SL, Sparto PJ (2017). PLoS One, 12(10): e0184918.

A CONCEPTUAL FRAMEWORK FOR THE MECHANISTIC EFFECTS OF PHYSICAL ACTIVITY ON IMPROVING COGNITIVE FUNCTION AND REDUCING THE RISK OF NEURODEGENERATION

PARMAR, V., BAIN, P.B.

IMPERIAL COLLEGE

INTRODUCTION: There is considerable interest concerning the effects of maintaining higher levels of physical activity throughout the lifespan with regards to improving cognitive abilities and reducing the risk of developing neurodegenerative diseases. Here we provide a conceptual framework for the likely mechanisms underlying these processes.
METHODS: We assembled information about the mechanisms concerning physical activity and improved cognitive function and decreased risk of neurodegenerative diseases from a scoping review of the literature.
RESULTS: Conceptually, the effects of physical activity can be perceived as having two component processes, either building a 'cognitive reserve' or providing active 'neuroprotection', each of which is likely to have a greater or lesser degree of influence on cognitive function depending on the individual's age.
Cognitive reserve itself has two sub-processes, one involving simply increasing the quantity of available neurons and the other involving increased neuronal connectivity; improving the way that the nerves interact and connect with each other, having more parallel circuitry in place.
Neuroprotection on the other hand is a more defensive process involving the prevention of damage to neuronal cells by upregulation of mechanisms which deal with oxidative stress; a significant factor in the pathophysiology of neurodegenerative diseases.
Physical activity contributes to these two component processes by intrinsic changes to the brain and also via systemic changes. Intrinsic factors include the production of neurotrophic factors such as BDNF, directly causing neurogenesis and dendritic formation. Systemic changes involve an increased aerobic capacity which will improve cerebral perfusion, thereby facilitating both neurogenesis and neuroprotection (improved delivery of nutrients and removal of wastes including reactive oxygen species). Additionally, in adulthood, IGF-1 synthesis shifts from cerebral production predominantly to production in metabolically active tissues elsewhere in the body. This production contributes directly to neurogenesis, but also to increasing cerebral perfusion via angiogenesis and directly modulating protein clearance adding to its neuroprotective qualities. Hence IGF-1 promotes an activity feedback loop with the brain.
CONCLUSION: We provide a conceptual framework for the main evidence gathered from animal and human studies on the effects of physical activity on improving cognitive function and modifying the risks of neurodegeneration. Understanding these concepts not only provides potential avenues for therapeutic interventions, which will help to tackle the ever-burgeoning problems of cognitive decline but helps to provide an insight into how these diseases arise.

COGNITIVE TRAINING TO IMPROVE ON FIELD PERFORMANCES IN RUGBY PLAYERS: A PILOT STUDY

DAVIAUX, Y.1, LEPAGNOT, M., DUMONT, J., LALANNE, R.2, LINI, S.1

<1> AKIANI FLOWTIDE, FRANCE / <2> UNIV BORDEAUX, FRANCE

INTRODUCTION: Team sport players have to divide cognitive resources when in multi-task situations: for example, when motor (driving a ball) and perceptual (gathering visual information on opponents) tasks are performed in the same time. Interestingly, training of perceptual process using Multiple Object Tracking task (3D-MOT) benefits to sports with dribbling skill while swift decision has to me made (e.g., ice hockey, Duchêne et al. 2016). Better on field game statistics are assumed to be the consequence of a reallocation of cognitive resources, from perceptual task to highly resource demanding task of fundamental (dribbling) skills.
We were interested in verify if such improvement was also verified in rugby, where ball manipulation is not as much demanding (ball holding but not dribbling). We hypothesized cognitive training to improve on field performances in rugby players. Cognitive training should benefit to global performance also because of others global processes involves in motor command (decision making).
METHODS: Twelve rugby women (age 19.6±1.1 y/o) were randomly separated into 2 groups of 6 players: trained group (TRN) vs. control group (CTL). TRN was assigned to 2 sessions x 3 weeks of cognitive 3D-MOT training. It consisted in 3 blocks of 20 trials: for one trial, participant was asked to visually track 4 targets mixed with 4 distractors for 8 seconds. Depending on tracking success or failure, speed was increased or decreased for the next trial.
Same procedure was used one week before (PRE) and after (POST) the training period, to track changes in groups performance. Averaged speed of the last 3 trials was computed for each blocks, with highest speed (Speed) taken as marker of the cognitive performance.
A dual-task reaction time (RT) of ball pass in reaction to visual trigger was also performed while rugby women performed 3D-MOT at 50% of Speed.
Rate of ball pass failures (RATE) was computed for PRE and POST in a rugby opposition game, for 20 sequences of 2 vs. 2 + 1 players. Counting was video-based, using a dedicated evaluation grid.
RESULTS: Two rugby women has been injured: inferential statistics were not applied because of sample size. TRN group shows however promising trends for larger improvement than CTL for cognitive performance (Speed +32% vs. 18%, respectively), dual-task performance (RT -21.1% vs. +10.4%, respectively), and on-field marker of rugby performance (RATE -26.0% vs. +21.2%, respectively).
CONCLUSION: Trends need a larger sample to be confirmed. Maker of cognitive improvement in 3D-MOT task has to be correlated with on-field marker of performance, to better understand how it profits to the on-field multifactorial performance in team sport.
Meanwhile, cognitive training in rugby can be carefully considered to take players to the next step of performance alongside with physiological and technical trainings.

THE INFLUENCE OF SLEEP DEPRIVATION ON RECOVERY FROM FATIGUE FOLLOWING ECCENTRIC STRENGTH EXERCISE

SHIODA, K.1, HONMA, T.1, HAYASHI, T.1, SUGIMURA, H.2

1: KANAGAWA UNIVERSITY, 2: KOHOKU FAMILY CLINIC

INTRODUCTION: Sleep is important for restoring the physiological processes that keep the body and brain properly functioning. However, it is unclear that the relationship between sleep duration and recovery in terms of central or peripheral fatigue resulting from muscle contraction.
The interpolated twitch technique (ITT) is used to assess voluntary activation (VA) of skeletal muscles (Kooistra et al., 2007). Additionally, the decline of VA in maximal efforts and resting twitch (RT) is the sign of central fatigue and peripheral fatigue, respectively (Gandevia, 2001). The critical flicker fusion frequency (CFFF) test is useful for assessing the arousal level, and the value of CFFF decreases with fatigue (Curran et al., 1990). The purpose of this study, therefore, is to investigate the effect of sleep duration on recovery from fatigue following eccentric strength exercise using ITT and CFFF.
METHODS: Healthy young adults who did not have sleep problem were recruited. To cause fatigue, they performed 3 sets of biceps curl with 75% of 1 repetition maximum until exhaustion before sleep. The quality of sleep was evaluated by polysomnogram (electroencephalogram, electro-oculogram, electromyogram, and heart rate) and rectal temperature during the nocturnal sleep. They participated in three experimental conditions in random order: sleep (0%: SL), partial sleep deprivation (50%: SD50) and total sleep deprivation (100%: SD) conditions. They performed isometric maximum voluntary contraction (MVC) of elbow flexor muscles for assessing VA using ITT before and after condition. In addition to ITT and CFFF, subjective fatigue and sleep index were measured using visual analogue scale and Stanford Sleepiness Scale.
RESULTS: In SD condition, RT which is index of peripheral fatigue shows lower than other conditions. Furthermore, the results show that there were certain differences VA and CFFF.
CONCLUSION: In conclusion, the present study revealed that sleep duration has a difference influence on the recovery from central or peripheral fatigue following eccentric exercise.
References: Kooistra RD, de Ruiter CJ, de Haan A. (2007). Eur J Appl Physiol, 100(3), 309-320.
Gandevia SC. (2001). Spinal and supraspinal factors in human muscle fatigue. Physiol Rev, 81(4), pp. 1725-1789.
Contact: Kohe0715@kanagawa-u.ac.jp

NEUROMUSCULAR FUNCTION AND FATIGABILITY IN PEOPLE EXPERIENCING HIGH LEVELS OF MULTIPLE SCLEROSIS FATIGUE

ELLISON, P., GOODALL, S., KENNEDY, N., HOWATSON, G., SAXTON, G.M.

NORTHUMBRIA UNIVERSITY

INTRODUCTION: Multiple sclerosis (MS) fatigue is multifactorial, directly linked to the disease itself (demyelination, inflammation) and other factors (depression, sleep quality). Defining and measuring fatigue in MS is challenging and the underlying neuromuscular mechanisms of motor performance are not fully understood. The aim of this study was to compare lower-limb neuromuscular function and fatiguability between people experiencing high and low levels of MS fatigue and healthy age-matched controls.
METHODS: 30 patients with definite MS were grouped, 15 fatigued (MS-F), 15 less-fatigued (MS-LF) and 15 healthy controls (HC). Fatigue was characterised using the Fatigue Severity Scale (FSS; fatigued ≥5 and less-fatigued <5). The Hospital Anxiety and Depression Scale (HADS) was used to measure anxiety (HADS-A) and depression (HADS-D). Muscle strength and voluntary activation were determined using twitch interpolation of the right quadriceps muscle during a maximal voluntary contraction (MVC). Fatigability was assessed during intermittent submaximal contractions. Comparisons between groups were made using one-way ANOVA. Associations between outcomes were determined by Pearsons coefficient correlation.
RESULTS: Group differences were observed in MVC at baseline (p=0.025) and post intermittent task (p=0.026). No differences in potentiated twitch force at baseline (p=0.490) and post fatigue task (p=0.621) between groups. VA differed at baseline (p=0.033), with reduced voluntary drive in HF-MS (p=0.035). People with MS fatigued more quickly than healthy controls (F-MS: 21 ± 9 min; N-FMS: 24 ± 15 min; HC: 30 ± 20 min, respectively). Subjective fatigue was significantly greater in HF-MS compared to LF-MS (p=0.000) with HC (P=0.000), with similar fatigue severity between LF-MS and HC (p=0.233). Fatigue severity significantly correlated with anxiety (r=0.64, p=0.010) and depression (r=0.54 p=0.036) in F-MS, but not for LF-MS and HC.
CONCLUSION: The impairment in voluntary activation associated with fatigue severity between MS-F and MS-LF are consistent with evidence of impairment of central motor drive to the muscle. People with MS tend to exhibit higher subjective fatigue scores and anxiety/depressive emotions when compared to their less-fatigued counterparts and healthy controls. Proposing central fatigue is mostly responsible for persons with MS, especially in MS-F.

RELATIONSHIP BETWEEN FRAILTY AND DUAL-TASK PERFORMANCE IN LONG-TERM NURSING HOME RESIDENTS

REZOLA-PARDO, C.1, GIL, S.1, IRAZUSTA, J.1, ARRIETA, H.1, ITURBURU, M.2, YANGUAS, J.3, RODRIGUEZ-LARRAD, A.1

1: UNIVERSITY OF THE BASQUE COUNTRY , 2: MATIA INSTITUTO, 3: FUNDACIÓN BANCARIA

INTRODUCTION: Despite frailty has been described as a purely physical syndrome, increasing evidence advocates that physical frailty and cognitive impairment interact together (Robertson et al. 2013) and suggest that an impaired capacity to perform two tasks simultaneously or dual-task (DT) could be a novel marker of frailty. Nevertheless, little attention has been given to the associations between frailty and DT in long-term nursing home (LTNH) residents. Therefore, the aim of this study was to assess the relationship between frailty and DT performance in LTNH residents.
METHODS: 64 participants from 4 LTNHs were included (inclusion criteria: age ≥ 70 years old, ≥ 50 on the Barthel Index, ≥ 20 on MEC Test (an Spanish validated version of MMSE) and capable to walk independently for 10m. Participants performed a Timed Up and Go (TUG) as a single task, and also a TUG while performing different cognitive tasks such as calculus, semantic fluency and inhibition (TUG-DT). The duration difference between the TUG and TUG-DT was calculated (dual-task cost, DTC). Moreover, frailty according to the Fried frailty Index, Rockwood frailty score, Tilburg frailty indicator, gait speed, short physical performance test (SPPB) and the Berg balance scale (BBS); and cognition, using the Montreal Cognitive Assessment (MoCa) test.
RESULTS: A significant correlation was observed between DTC under the inhibition task and Fried (r=0.477; p<0.001), Rockwood (r=0.691; p<0.001), gait speed (r=-0.703; p<0.001), SPPB (r=-0.751; p<0.001) and BBS (r=-0.672; p<0.001). In addition, there was a significant association between DTC under the calculus task and Rockwood (r= -0.277; p<0.05), SPPB (r=0.315; p<0.05) and BBS (r=0.347; p<0.05). Finally,

the BBS also showed significant correlations with DTC under the semantic fluency task (r=0.266; p<0.05). No correlations were found between DTC and the MoCa or Tilburg frailty Index tests.
CONCLUSION: The present study confirms the relationship between frailty and DT performance (Guedes et al. 2014). Additionally, DTC under an inhibition task is more related to frailty than the calculus or semantic memory tasks. Interestingly, the MoCa test failed to show correlations with any of the DTCs. Although DT performance has been associated with cognitive impairment in community-dwelling older adults (Plummer et al. 2012), in institutionalized older adults DTC seems to be independent of the cognitive and frailty status (Cadore et al. 2015). Future studies should further explore the relationship between frailty, cognitive impairment and DT in a highly deconditioned population like LTNH residents.
REFERENCES: 1. Robertson et al. 2013. Ageing Res Rev 12(4):840-51.
2. Guedes et al. 2014. Braz J Phys Ther 18(5):445-52.
3. Plummer et al. 2012. J Aging:1-8.
4. Cadore et al. 2015. Age 37(6):124.
CONTACT: chloe.rezola@ehu.eus
ACKNOWLEDGEMENTS: Perceived grants from the Basque Government (ELKARTEK17/61; KK-2017/00085; IT922-16) and the University of the Basque Country (PIF2015; PPG17/34).

Conventional Print Poster

CP-SH04 Well being, optimal functioning\dysfunction in sport and exercise

A FIRST TEST OF THE CLOUD-BASED IMPLICIT RELATIONAL ASSESSMENT PROCEDURE AS A MEASURE OF SELF-ESTEEM IN TAIWANESE ATHLETES

CHAN, W., CHI, L.K., CHIU, C.Y., HUANG, Y.C., CHAN, C.A.
NATIONAL TAIWAN NORMAL UNIVERSITY

A FIRST TEST OF THE CLOUD-BASED IMPLICIT RELATIONAL ASSESSMENT PROCEDURE AS A MEASURE OF SELF-ESTEEM IN TAIWANESE ATHLETES
CHAN, WEN-YU1 (TAIPEI, TAIWAN), CHI, LI-KANG1 (TAIPEI, TAIWAN), CHIU, CHUANG-YUAN1 (SHEFFIELD, UK), HUANG, YAO-CHUNG2 (TAIPEI, TAIWAN), CHAN, CHIH-AN3 (TAICHUNG, TAIWAN)
Introduction: Studies reported paper-based self-esteem measures typically register non-automatic evaluations of the self (Barnes-Holmes et al., 2006, Zentner and Renaud, 2007); by contrast, implicit self-esteem measures, such as Implicit Relational Assessment Procedure (IRAP), are designed to capture more automatic evaluations of the self (De Houwer et al., 2009). It might be not easy for evaluating athletes' mental status when they are in outdoors; therefore, it is an important issue to be considered. The aim of this study is to validate the cloud-based Implicit Relational Assessment Procedure (CBIRAP) with Rosenberg Self-Esteem Scale.
Method
Forty-seven participants who are athletes (aged 21.3±1.3 years old) in the university or college in Taiwan were recruited. Participants were requested to take the paper-based self-esteem questionnaire (Rosenberg Global Self-Esteem Scale) and the cloud-based questionnaire while they were in the training session or in outdoors. Criterion Related Validity is used, and the association between paper-based questionnaire scores and D-algorithm (CBIRAP) was assessed by using linear regression as the first step of calculations and Pearson correlation coefficient as the second step. All values were presented as mean and standard deviation, and the level of significance was set at $P < 0.05$.
Results: There was a small connection between the total self-esteem score and the total IRAP score (r=0.21, P=0.151). The CBIRAP questions with positive words has a medium association with the self-esteem scores for positive words (r=0.31, P=0.037); identically, the CBIRAP questions with negative words has a medium relation to the self-esteem scores for reversed words (r=0.40, P=0.005).
Conclusion
This study is the first research to evaluate the self-esteem level by web-based Implicit Relational Assessment Procedure in Taiwanese athletes, and it can be regarded as the antetype for the CBIRAP used in outdoors.
References: Barnes-Holmes, Y., Power, P., Hayden, E., Milne, R., & Stewart, I. (2006). Do youreally know what you believe? Developing the Implicit Relational Assessment Procedure (IRAP) as a direct measure of implicit beliefs. The Irish Psychologist, 32, 169–177.
De Houwer, J., Teige-Mocigemba, S., Spruyt, A., & Moors, A. (2009). Implicit Measures: A Normative Analysis and Review. Psychological Bulletin, 135(3), 347-368.
Zentner, M., & Renaud, O. (2007). Origins of adolescents ideal self: An intergenerational perspective. Journal of Personality and Social Psychology, 92(3), 557-574.

PRELIMINARY ANALYSIS OF THE PSYCHOMETRIC PROPERTIES OF THE MEXICAN VERSION OF THE PASSION SCALE IN SPORTS

MARTINEZ-ALVARADO, J.1, MONTOYA, G.1, AGUIAR, L.1, REYNAGA-ESTRADA, P.2, MAGALLANES, A.1, ASADI, A.1
1: UNIVERSIDAD AUTONOMA DE BAJA CALIFORNIA; 2: UNIVERSIDAD DE GUADALAJARA

INTRODUCTION: Vallerand & Houlfort (2003) define passion as a strong inclination toward a self-defining activity that one likes (or even loves), finds important, and in which one invests time and energy on a regular basis. Passion is of two types, which according to Vallerand et al., (2003) are the harmonious and obsessive passion. Harmonious passion refers to an autonomous internalization in the activity within the individual identity. Internalization occurs when the individual chooses freely and for pleasure the activity he wants to perform, this means that the personality of the individual is flexible (Decy, & Ryan, 2000). The obsessive passion is related to the complete control that the activity has over the individual identity, even there is the same desire for commitment that in the harmonious passion, in the obsessive passion this desire is not under the control of the person. The objective of this research is to analyze the psychometric properties of the Mexican version of the Passion Scale in Sports (Vallerand et al., 2003)
METHOD
The sample consisted of 468 Mexican athletes of both sexes and ages between 12 and 18 years (M = 16.3, SD = 1.65). The athletes reported an average of 3.62 years practicing their sport (SD = 2.54), as well as an average of 2.35 hours of training (SD = .79) distributed in

3 days a week. The Passion Scale consists of 14 items that evaluate obsessive passion and harmonious passion, each factor represented by 7 items using a Likert scale of five points.
To analyze the construct validity we used Exploratory and Confirmatory Factor Analysis and Cronbachs alpha coefficient for reliability.
RESULTS: The results of the EFA indicate two dimensions, each represented by 7 items obtaining a factorial weight between .77 and .88 and explaining 67.8% of the variance. As for the AFC, we found acceptable adjustment indices (X2 = 334.71; X2 /gl = 4.65; p < .01; TLI = .91, IFI = .94, CFI = .94 and RMSEA = .08) sustaining the model of 2 factors.
Regarding to the reliability of the two factors of the scale, we have found acceptable scores in the Cronbach alpha coefficient to evaluate the internal consistency (Obsessive Passion = .90, Harmonious Passion = .92).
DISCUSSION: The results of the different analyzes performed in this study indicate adequate psychometric properties of the Passion for Sport Scale in terms of construct validity and internal consistency. This allows an adequate use of the scale in young Mexican athletes of both sexes.
REFERENCES: Deci, E. L., & Ryan, R. M. (2000). The what and why of goal pursuits: Human needs and the Self- Determination of behavior. Psychological Inquiry, 11, 227-268.
Vallerand, R. J., & Houlfort, N. (2003). Passion at work: Toward a new conceptualization. En S. W. Gilliland, D. D. Steiner, & D. P. Skarlicki (Eds.), Emerging perspectives on values in organizations (pp. 175-204). Greenwich, CT: Information Age Publishing.

IMPACT OF RESTORATIVE FLOW MOVEMENT PATTERNS ON MENTAL HEALTH AND RESILIENCY IN NCAA DIVISION II BASKETBALL ATHLETES

GEIJER, J., METTILLE, C., GEISLINGER, A.

WINONA STATE UNIVERSITY

INTRODUCTION: The National Collegiate Athletic Association (NCAA) has identified mental health as a primary health concern for student-athletes. In an effort to address physical and mental health concerns of student-athletes, the authors developed the Restorative Flow Movement Patterns (RoFlow). RoFlow is a combination of yoga principles, functional movements, and various other training principles. The traditional yoga movements are essentially modified to improve function, recovery, mobility, and stability. Additionally, the RoFlow program is based on an incorporation of many of the same breathing and relaxation techniques as traditional yoga movements from which much of the program is based. RoFlow sessions were designed to combine the physical and mental training aspects of functional movements and yoga in an effort to improve the athletes abilities to withstand the physical and mental stresses associated with sport participation at the collegiate level. The purpose of this investigation was to determine program efficacy in improving not only the physical aspects of competing at the collegiate level, but also the mental aspects, as measured by survey responses.
METHODS: Thirty one (17 female) NCAA Division II mens and womens basketball athletes were surveyed before and after the 2016-2017 competition season. The survey contained 35 questions, which were selected from the College Student Health Survey (Boynton Health, University of Minnesota, Minneapolis, MN). The survey addressed aspects of physical health, drug and alcohol use, screen time, relationships, sleep, stress management, and resiliency. Between survey responses, athletes participated in weekly flows (RoFlow) as part of their in-season training regimen. RoFlow combined progressive functional movement patterns with yoga principles, once per week for the duration of the competitive season.
RESULTS: Athletes reported an 8% increase in the number of days their mental health has been negatively impacted (5.12 6.5 vs. 5.23 6.8; p=0.835). Additionally a 289% increase in the number of days their usual daily activities have been interrupted by physical or mental health concerns (1.06 1.6 vs. 4.14 9.2; p=0.146). Despite evidence of increased stress over the course of the competitive season, athletes reported significantly improved resilience between pre- and post-testing sessions (2.42 1.02 vs. 1.90 0.70; p=0.036).
CONCLUSION: The implementation of the RoFlow practice to the in-season training of NCAA Division II mens and womens basketball players may have improved the athletes ability to be resilient during stressful times. While not all statistically significant, the athletes reported improved resiliency across all six survey questions which centered on their abilities to appropriately manage stressful events. The combination of RoFlow practice and sports-specific training may improve the mental strength and resiliency of NCAA Division II collegiate basketball student-athletes.

THE EFFECT OF PARENTAL PSYCHOLOGICAL CONTROL ON MORAL DEVELOPMENT OF HIGH SCHOOL STUDENT ATHLETES

TENG, H., LIAO, C.

NATIONAL TAIWAN SPORT UNIVERSITY

The effect of parental psychological control on moral development of high school student athletes
Hsiu-Chiung Teng and Chu-Min Liao
National Taiwan Sport University
Introduction: Research has showed that teenagers who perceived higher levels of parental psychological control tended to experience negative emotions more often and showed more physical violence and disruptive behaviors (May, 2012; Cui, Morris, Criss, Houltbetg, & Silk, 2014). Parental psychological control refers to the behaviors by which parents manipulate parent-child relationship and make their children feel guilt and shame to control their children. In this study, we examined the effect of parental psychological control on high school student athletes' moral development based on Kohlberg's (1969) moral development theory.
Methods: 177 high school student athletes (M=113, F=64, mean age = 16.51) from 9 sports participated and filled in the Parental Psychological Control Scale (PPCS) and the Sport Moral Development Questionnaires (SMDQ). PPCS measured participants' perceived parental psychological control. SMDQ examined participants' stage of moral development by answering questions regarding a moral dilemma scenario in sport and provided reasons of their decisions.
Results: Participants were categorized into Kohlberg's five moral development stages with n=47, 44, 8, 19, 28, and 31, respectively. ANOVA and post-hoc comparisons showed that participants at both the "Obedience and punishment orientation" stage (M =1.78, SD = 0.60) and the "Interpersonal accord and conformity" stage (M = 2.05, SD = 0.47) had a significant higher score in perceived parental psychological control (p = .008 and p = .049, respectively) than those at the "Social contract orientation" stage (M = 1.38, SD = 0.37). No other between group differences was found.
Discussion: The results provided preliminary support for our notion that parental psychological control might affect young athletes' moral development. It seems that for young athletes from a family in which parents are more psychological controlling, avoiding punishment

and being a good boy/girl rather than the general welfare for most people are their major concerns when making a moral decision in sport. This study is correctional in nature, however, and more studies are certainly warranted.
References: Cui, L., Morris, A. S., Criss, M. M., Houltberg, B. J., & Silk, J. S. (2014). Parental psychological control and adolescent adjustment: The role of adolescent emotion regulation. Parenting: Science Practice, 14:1, 47-67.
Kohlberg, L. (1969). Stage and sequence: The cognitive development approach to socialization. In: D. Goslin (Ed), Handbook of socialization theory and research. Chicago: Rand Mcnally.
May, I. (2012). Relations among parental control and adolescents self concept, emotional disturbance and disruptive behavior. Unpublished Doctoral thesis, National Chengchi University, Taipei.
Contact: chuminliao@gmail.com Dr. Liao

ON THE SYMBOLIC AND THERAPEUTIC MEANINGS OF "DISORDERED MOVEMENT AND BODY PROBLEMS" MENTIONED BY ATHLETES IN PSYCHOTHERAPY

NAKAGOMI, S., AKIBA, S.
KOKUSHIKAN UNIVERSITY

On the symbolic and therapeutic meanings of "disordered movement and body problems"
mentioned by athletes in psychotherapy
Shiro Nakagomi and Shigeki Akiba
Introduction: The authors have found that athletes often talk about their disordered movement and physical problems during psychotherapy. The symbolic implications of their narratives help deepen our understanding of their inner experiences. Some of the athletes are able to arrive at therapeutic turning points because of these clues to the roots of their problems embedded in their narratives . The purpose of this presentation is to provide some case material on athletes in psychotherapy and describe the significance of their descriptions of disordered movement and physical problems.
Method
Based on the interview records of three clients, we retrospectively analyzed the overlap of therapeutic meanings between the clients' psychological tasks for resolving their main complaint and their descriptions of movement and their own bodies during therapy sessions. One case was that of a female gymnast who complained of feeling constrained and of a decline in performance. The other two cases were a female swimmer and a male track and field athlete whose talk of disordered movement coincided with their psychological tasks.
Results and Discussion: In case 1 , her description of her daily life , as well as her Landscape Montage Technique drawings showed a clear connection to her feelings of constraint in athletic performance. And while we never pointed out these connections to the client over the course of her therapy , she often spoke of her daily life and eventually came to understand the connections on her own. In that way her performance problems were resolved. Clients' descriptions of disordered movement and physical problems are uniquely significant in psychotherapy for athletes. They are richly symbolic and therapeutically significant – windows to an athlete's inner experience.
In our poster session we will present 2 additional cases.
References: Nakagomi, S. <2013> Clinical sport psychology :psychological support for athletes. Dowasyoinn.
Nakagomi, S. and Suzuki, M. <2017> How to support psychological problems in athletes. : practice of sport counseling. Seishinsyobou.
Nakai, H.<1984> Landscape Montage Technique and I. Yamanaka, Y. H・NAKAI Landscape Montage Technique. Tokyou, Iwasakigakuzyutsusyuppann.
Contact [E-mail adreaa: nakagomi.shiro.fp@u.tsukuba.ac.jp]

EFFECTS OF FREE CLIMBING TRAINING TO PROMOTE THE INTERPERSONAL COMMUNICATION SKILLS —EXAMINATION OF AN EDUCATIONAL INTERVENTION PROGRAM TO SUPPORT PARENT-CHILDREN RELATIONSHIPS IN JAPAN—

TAKANASHI, M.
INTERNATIONAL CHRISTIAN UNIVERSITY

【Introduction】
Communication between parents and children is changing due to a rapidly declining birthrate and technological changes. In countries like Japan it is more difficult for fathers to spend recreational time with their children on weekdays due to work pressures. The number of working mothers is also growing in Japan further straining relations and communication between parents and children. This research aimed to analyze the effects of family sports participation on parent-child communication.
【Methods】
Participants included twelve children（4 males, 8 females, average age: 11.17 years old, and SD: 1.75） and eight parents （2 males, 6 females, average age: 43.25 years old, and SD: 3.45）. They participated in two, 2.5hour indoor climbing lessons that were designed to facilitate social interaction and trust. Validated questionnaires were administered to participants. Children answered the "Resilience Evaluation Scale for Children" （RESC） and the "Childrens Commitment Evaluation Scale for Parents" （CCESP）, while the parents answered "Child-Rearing Attitude Evaluation Scale for Parents" （CRAESP） and "Childrens Resilience Evaluation Scale for Parents" （CRESP）. Both parents and children were also asked to write their subjective impressions about the lessons and their relationship. Questionnaires were administered before the first lesson (Pre-test) after the final lesson (Post-test) and one month after the lesson completion (Follow-up test). Analyses included calculation of Cronbach's alpha scores for each scale, mean values and standard deviations, correlations between each scale for children and parents, and one-way repeated measures ANOVA to compare the results at pre-test, post-test and follow-up.
【Results】
The analyses of variance revealed that, with regards to "CCESP", 1） "Dependence on Parents" showed positive change immediately after and one month following the lessons. In relation to"CRAESP" 2） "Parents' Respect for Autonomy of Children," "Parents' Behavior Limits Children" and "Behavior Limitation Setting to Children" (subscales of CRAESP) showed positive changes immediately after and one month following the lessons.
【Discussion】
This research found that the climbing lessons became the opportunities to reconsider how parents' approached interactions with their children, and had positive effects on communication between participants, especially for parents. Usually, Japanese parents watch their children during sports practice, but have little direct recreational connection. By trying new sports activities together, such as climbing,

sharing experiences created an opportunity to change views about each other and influence parents' attitudes to child rearing. Sport climbing will be an official event from the Tokyo Olympic Games in 2020 and facilities will increase in Japan in the future. This preliminary research suggests that free climbing may have efficacy as a means to build relationships between parents and children.

DOES A BRISK WALKING PROGRAM IN POSTMENOPAUSAL WOMEN GENERATE SOCIAL HEALTH INEQUITIES?

GARNIER, S.1,2, JOFFROY, S.1,3, THON, B.1, AUNEAU, G.1, MAURIEGE, P.4

1 UPS, F2SMH, TOULOUSE - CRESCO FRANCE ; 2 GRAPA, MONTRÉAL, CANADA ; 3 ITO, TOULOUSE, FRANCE ; 4 UNIVERSITÉ LAVAL, DÉPARTEMENT DE KINÉSIOLOGIE, QUÉBEC, CANADA

Introduction: Reducing health inequalities is a major public health issue (WHO 2000). In France, the difference in life expectancy at age 35 is 7.5 years for men and 4 years for women between graduates of higher education and non-graduates (INSEE, 2016). Follow-up of an aerobic training program is a factor of health improvement in moderately obese postmenopausal women. Indeed, preferences for sport are part of the dispositions that constitute the habitus (Bourdieu, 1984). However, is this type of program more effective for the highest social classes women? Will it not increase social inequalities in health ?
The aim of this study is to evaluate the impact of a brisk walking program on physical cardiorespiratory fitness (CRF), body composition, perceived health, and adherence to the program of women, once social classes and educational levels are considered.
Methods: 168 sedentary and overweight-to-obese (mean body mass index, BMI = 30± 4 kg/m2) postmenopausal women (60±5 yr-old) were subjected to a 4-month endurance-training program (3 sessions of 45 min walking/week at 60 % of their heart rate reserve).
Following measurements were performed before and after the 4-month walking program:
. CRF assessed by the 2-km walking test (Roussel et al., 2009; Garnier et al., 2013),
. Body weight, height (BMI calculated) and waist circumference measured using standardized procedures (Roussel et al., 2009; Garnier et al., 2013),
. Fat mass and fat-free mass determined by bioelectrical impedance (Roussel et al., 2009; Garnier et al., 2013)
. Perceived health estimated by a visual analogue scale (six questions) (Garnier et al., 2013)
. Subjects' assiduity registered in an exercise logbook (Garnier et al., APRM 2015)
Results: Four months later, the decrease in body weight, BMI, fat mass, as well as the increase in CRF ($p<.001$) were not significantly different once social classes and educational levels were considered. However women with the highest education level showed the greatest reduction in waist circumference. Changes in perceived health ($p<.01$) and adherence to the program did not differ.
Discussion: It seems that our program does not increase health inequalities probably as brisk walking is also considered the most common feasible form of aerobic exercise for middle-aged women because of its safety (low risk of injuries), popularity (low cost) and accessibility to all publics and because the place of walking training was close to the subjects' residency.
References: Bourdieu P. (1984) In Richardson JG. 241-258.
Garnier S., et al. (2013). Menopause, 20(8): 804-812.
Garnier S., et al. (2015). Ann Phys Rehabil Med., 58(3) : 119-125.
INSEE Première, 1584, (Février 2016).
Roussel M., et al. (2009). Menopause, 16(3):566-575.
WHO (2000). Reducing inequalities in health – Proposals for health promotion policy and action.

INVESTIGATING THE RELATIONSHIP BETWEEN PHYSICAL ACTIVITIES AND MOTHERS' SUPPORT WITH RATE OF PHYSICAL ACTIVITIES IN YOUNG FEMALE STUDENTS

OSTOVAR, S., ASADOLAHI, M., NEZAMI, N., MIRAHMADI, M.

ISLAMIC AZAD UNIVERSITY CENTRAL TEHRAN BRANCH

Introduction: Physical activities positively influence on the humans' health, and it has particularly been found more essential for children. Numerous studies and researches have been conducted on supporting families to carry out such activities and they showed the impacts of parents' physical activities, particularly mothers, as an effective variable in increasing their daughters' physical activities (Hesketh et all., 2014)
Methodology:
The sample of the research included 121 female students at the age of 10 to 12 and their mothers which were selected by random cluster sampling method. The research instrument was a questionnaire on Sharki physical activities for assessment and evaluating the rate of physical activities of mothers and their daughters and a questionnaire of parents' support on physical activities. The research methodology was applicable and it was descriptive in correlation way, based on the data.
Pearson tests were performed to evaluate the correlation and linear regression models were used to describe the mathematical relation between variables and to calculate the determination coefficients. Also, ANOVA analysis helped to check for significance of regression coefficients
Research RESULTS: The results showed that the rate of daughters' physical activities is higher than their mothers and mothers; physical activities influence on their daughters physical activities(p= 0.00). Also there is a positive significant relationship between mothers' support and their daughters' physical activities(p= 0.00)
Discussion:
The rate of mothers' physical activities and amount of their support positively influence on the rate of their daughters' physical activities. The current research is eligible to be used in curriculum of schools in order to increase the rate of young female students and also in mothers' training and getting them involved in such physical activities curriculums.
References:
Hesketh K,Goodfellow L, Ulf Ekelund .(2014). Pediatrics,133,973-980.
Contact: Sarah.ostovar@gmail.com

EFFECTS OF ATTENTIONAL FOCUS AND PERSONALITY ON AFFECTIVE EXPERIENCE AND EXERTION AFTER ACUTE PHYSICAL ACTIVITY

MEIXNER, F., HERBERT, C.

INSTITUTE OF PSYCHOLOGY AND EDUCATION, ULM UNIVERSITY

INTRODUCTION: Long-term physical activity leads to a magnitude of positive health outcomes, benefitting not only physical health, but also psychological health (Petruzzello, Landers, Hatfield, Kubitz, & Salazar, 1991; Woll & Bös, 2004). In the short term, however, acute physical activity may have various consequences. While leaving some people active and energized, it can also lead to feelings of exertion, fatigue and negative mood in others. According to recent research literature, attentional focus during the activity (e.g., associative/dissociative strategies; Brick, MacIntyre, & Campbell, 2014; Lind, Welch, & Ekkekakis, 2009) and personality factors (e.g., Behavioral Inhibition / Behavioral Activation System (Hall, Ekkekakis, & Petruzzello, 2005; Schneider & Graham, 2009) according to the revised Reinforcement Sensitivity Theory (r-RST; Carver & White, 1994; Corr & Cooper, 2016; Gray, 1970) might prove to be potentially moderating variables.
METHODS: An experimental study (N = 15 female participants; repeated-measures design, 4 points of measurement for each participant) was conducted. Participants were asked to cycle on a stationary bicycle ergometer at moderate intensity (60-70% of HRmax), which was ensured by heart rate monitoring. During activity, the attentional focus of the participants (external/internal/no focus) was experimentally manipulated. A control condition without physical activity was included. Personality variables (e.g., r-RST) were assessed in an online questionnaire beforehand. At multiple times during the experiment, positive and negative affect, exercise experience and perceived exertion were recorded to measure the experience before, during, and after the activity.
RESULTS: Instructing an external focus or no specific focus resulted in an increased positive affect immediately after the physical activity, while an internal focus had no effects on positive affect, the inactive control condition displayed a decline in positive affect. Perceived exertion was generally higher after physical activity, but did not interact with attentional focus. Behavioral Inhibition (BIS) was negatively correlated with positive exercise experience during the internal focus condition. Behavioral Activation (BAS) was positively associated with favorable exercise experience during and immediately after the activity, but only when no specific or an internal focus was instructed.
CONCLUSION: The results obtained in this study suggest that instructing specific types of attentional focus might interact with personality variables to determine exercise experience and positive/negative affect during and following physical activity. This might help in understanding the link between certain personality traits and aversion towards physical activity, which consequently might lead to sedentary behavior (Schneider & Graham, 2009; Voigt et al., 2009). Manipulating attentional focus as a means to optimize exercise experience for people with certain personality traits is discussed.

Conventional Print Poster

CP-SH03 Social sciences and humanities perspectives on sport exercise

BARRIERS TO PHYSICAL ACTIVITY FOR SEXUAL MINORITY WOMEN IN THE UNITED KINGDOM

WESTON, M., MULCAHY, A.

KINGS COLLEGE LONDON

Previous research suggests that sexual minority women (SMW) face specific barriers to physical activity in addition to those reported by other populations of women (Brittain et al, 2006, Women & Health, 43, 75-92). Research in this area is limited to the experiences of homosexual women, rather than women identifying as other minority sexualities, and findings are predominantly from the United States. Therefore the purpose of this study was to identify the factors affecting participation in physical activity, and how they are of influence, for SMW aged 18-25 living in the United Kingdom. A mixed methods explanatory design was adopted, comprising a 16-item questionnaire followed by semi-structured interviews. With institutional ethics approval, self-identifying SMW completed the questionnaire (N=100) and individuals were selected from the pool of respondents to participate in semi-structured interviews (N=10). Using Likert-type scales to investigate general and SMW-specific barriers, questionnaire respondents reported their physical activity levels and perceptions of how various factors influenced it. The interviews were audio-recorded and analysed using grounded theory analysis, grouping data into themes. When considered as a whole cohort, SMWs reported the most influential factors to be time, motivation, and tiredness. However, when considering those who had experienced homophobia in isolation, 'methods of addressing homophobia and sexism in physical education and sport' was reported as the most influential barrier. 47.0% of participants (N=47) indicated that they had experienced homophobia whilst participating in physical activity and, of that number, 68.09% (N=32) stated that this had affected their future participation. The latter group reported a lower average hours of physical activity, excluding walking, in the past week (2.6 hours) compared to 3.54 hours in the rest of the cohort. This was statistically significant (P = 0.048). Some of the common barriers identified following interview data analysis include: 1) navigating the intersecting identities of being both a woman and non-heterosexual; 2) discomfort in same-sex changing rooms due to sexual minority status; 3) the isolation associated with a 'masculine' appearance and subsequent assumptions about the individual's sexuality; 3) and 4) discomfort within a physical activity setting with men. One participant commented that "The locker rooms can be a hostile place for a gay person … I've experienced the worst homophobia in football". In conclusion, these results suggest an oversight when assessing the needs of SMW in sport and physical activity settings, associated with their experiences as a minority group, and this should be a focus for future research.

CHARACTERISTICS OF TWIN ATHLETES' INTERNAL EXPERIENCES BASED ON AUTOBIOGRAPHICAL MEMORIES

OKUDA, A., NAKAGOMI, S.

BIWAKO-GAKUIN UNIVEWRSITY, KOKUSHIKAN UNIVERSITY

INTRODUCTION: The motivation of athletes to perform over the long term is influenced by various psychosocial factors. Investigating these factors may contribute to a better understanding of their motivation to continue playing and striving for performance improvement. Based on autobiographical memories of monozygotic twins athletes who had continued to play the same sports over an extended period of time, this study explored some of the characteristics of these internal experiences.
METHODS: Study participants are 12 monozygotic twins athletes (6 pairs: 3 male and 3 female) who had played on college or corporate sports teams. Participant's identical twin status was verified by medical questionnaires. Individual interviews were conducted with each

athlete, asking questions about their autobiographical memories. Questions were asked about proto-scenery from their childhood (i.e., memories of various types of scene), proto-experiences in sport (i.e., memories of play and physical activities), the twin sibling relationship at the time their life-path decision-making, their continued involvement in their sport of choice, and the significance of each other's existence.
RESULTS: Results of qualitative analysis of the interviews demonstrated that their memories of their proto-scenery appeared to be highly dynamic with many sport-related elements mentioned. Both twins in 4 out of the 6 pairs mentioned each other's existence in their proto-scenery. In addition, 10 participants described proto-experiences in sport and stories of successful sport activities from memories of their earliest developmental stage. With respect to twin sibling relationships at the time of life-path decision-making, results suggest that the joint existence of each twin as a role model for the other played a part in career path selection and continued involvement in sports. The complementary nature of these relationships was often mentioned: "We have always played together," and "I am always encouraged by being in this together."
CONCLUSION: The subjects of this study were monozygotic twins that closely resemble genetically and environmentally.Characteristics of the internal experiences of these participants may help us understand the psychosocial factors involved in the continued involvement in sports of other athletes as well. In particular, the twin sibling relationship explored in this study could be considered as a potential role model for relationships between athletes and their significant others, including the important relationship between athletes and their coaches.

THE EFFECT OF STATUS AND POWER ON DISTRIBUTIVE JUSTICE

HUANG, L.W., LIAO, C.M., SHEN, W.C.
NATIONAL TAIWAN SPORT UNIVERSITY

Introduction: In an organization, authority's hierarchy has been the significant dominant of fairness owing to its demonstrated relation to resource allocation and subordinate's justice perception (Fast, Halevy, & Galinsky, 2012). It is considered, subordinates perceive differences in outcomes as fair depending on the different level of authority's concern on hierarchy (Blader & chen, 2012). In particularly, status (i.e., the prestige, esteem, respect and admiration from others) and power (i.e., control over critical resource), the 2 major components of hierarchy, represented different concerns of authority and different way in resource allocation, consequently, might lead to different impacts on subordinate's justice perception. However, systematic research attempt to compare the effect on fairness from different components of authority's hierarchy is relative scarce. The present study aimed to exam the effect of coach's status and power on athlete's distributive justice in sport team.
Methods: In the first stage, 34 recruited physical education teachers and coaches were randomly assigned to either status or power group. They were asked to play a role of a head coach and make allocations on champion prize ($75,000) to head coach, assistant coach and six athletes (including five finalist and one preliminary), and then complete questionnaire for manipulation check. 3 categories (baseline, status and power condition) of allocation patterns were conducted after allocation decision. In the second stage, we recruited 64 athletes (Mage=18.13, SD=2.71) to play the role of the athletes of the champion team and rank the fairness of the 3 different allocation decisions with 11-point scale, 0 (very unfairly) to 10 (very fairly).
Results: A series of independent t-test confirmed the success of manipulations. Participants in the status condition ($M = 5.81$, $SD = 1.31$) indicated that they had significantly more status than those in the power condition ($M = 4.73$, $SD = 1.39$), $t = -2.43$, $p = .02$, $\eta 2 = .16$. Similarly, participants in the power condition($M = 4.58$, $SD = 1.39$) had more power than those in the status condition($M = 3.30$, $SD = 1.22$), $t = 2.72$, $p = .01$, $\eta 2 = .19$. A one-way repeated measure ANCOVA was conducted to test the difference of justice perception between status and power. The result revealed that athlete's distributive justice in status condition ($M = 5.47$, $SD = 1.67$) is greater than in power condition ($M = 4.03$, $SD = 1.82$), $F = 20.12$, $p < .001$, $\eta 2 = .14$.
Discussion: Our study showed strong support that athletes' distributive justice perceptions were influenced by different dimensions of hierarchy. Compared the decision made by a coach who highlighted dominant critical resourced, the decision made by a coach highlihighlighted esteem and reputation was perceived more distributive justice by athletes. Further researches are warranted to explore the different effect status and power on other justice dimensions.
Contact: chuminliao@gmail.com

FOREIGN PLAYERS ARE GAME-CHANGERS IN CHINA FOOTBALL SUPER LEAGUE? — AN ANALYSIS OF PLAYERS' ROLES INSIDE PASSING NETWORK

GAI, Y., CUI, Y., GONG, B., YI, Q., GÓMEZ, M.A.
FACULTAD DE LA CIENCIAS ACTIVIDAD DE FÍSICA Y DEL DEPORTE

Introduction: Computer-based approaches have been applied to collect and analyse technical, tactical and physical aspects in team sport, especially in football. Recently, the general structure of football teams and connections among players during match-play were investigated using social network analysis. This body of research helped to understand the most prominent players' positions that best contributed to the build of attack in football and investigated the number of passes per minute and the clustering coefficient of teams during the FIFA World Cup. However, given the fact that many foreign elite players were transferred into Asian clubs, the research knowledge about the influence of foreign players on passing network in Asian professional football leagues is unknown. Therefore, the study was aimed to investigate the passing network features of teams from China Football Super League (CSL).
Method
Detailed inter-player passing statistics of a total of 211 matches from the China Football Super League (first division) 2017 season were tracked and provided by Champion Sports Information Technology Co., Ltd. through a validated data collection system. The data included 64,221 passes of 374 players (286 domestic and 88 foreign) from all 16 teams in the league. The inter-player's passing count less than 5 passes was excluded. Afterwards, thirteen passing network related variables that measure player's prominence inside a team's network were calculated and were compared between domestic and foreign players via standardized (Cohen) mean differences, computed with pooled variance and respective 90% confidence intervals (CL). Uncertainty in the true differences of the comparisons was assessed using non-clinical magnitude-based inferences.
Results: Foreign players presented higher values than domestic players in closeness (difference in means: 0.06; ± 90% CL: ± 0.03; inference: possibly), stress centrality (1.96; ± 0.94; possibly), directed edges (0.68; ± 0.23; likely), in-degree (0.35; ± 0.13; likely), out-degree (0.33; ± 0.14; possibly), betweenness (0.04; ± 0.01; likely) and number of passes received per match (2.46; ± 1.07; possibly). While domes-

tic players had a higher value of neighborhood connectivity than foreign players (0.29; ± 0.12; possibly). There were trivial differences between two groups of players in the other variables.
Conclusion
Using social network related metrics is helpful to identify how players connect with each other and compare the strength of the connection between domestic and foreign players. Foreign players played a prominent role in the offensive play of CSL teams and contributed to the build of attack. However, cautions should be taken for stake-holders of the league and clubs, given that an over-relying on foreign players would probably hinder the development of domestic players. This study provided useful information for coaching staffs in training and preparing the appropriate strategies during the matches.

AN ANALYSIS OF THE KEY FACTORS IMPACTING UPON THE COMPETITIVENESS OF CHINESE SUMMER OLYMPIC SPORTS

WANG, J.
TIANJIN UNIVERSITY OF SPORT

An Analysis of the Key Factors Impacting upon the Competitiveness of Chinese Summer Olympic Sports
Jian WANG et al
Introduction: China, since it rejoined the Olympic Games in Los Angeles 1984 has, with the exception of Seoul 1988, consistently ranked in the top 4 medal positions in the summer Olympic Games. Consequently, planning a sustainable development of Olympic sports in China has become an important task . However, China's Summer Olympic medals have been confined to a limited number of events most of which are not core Olympic sports such as athletics. This suggests that any sustainable success requires a restructuring of the Chinese Olympic sports development strategy in order to broaden the base of Olympic sports thereby facilitating the achievement of medal in sports previously considered unworthy of investment whilst increasing the overall medal count.
This research project employed survey research design techniques to critically analyse the current strategy for the development of Chinese Olympic sport and subsequently to identify the key factors impacting its effectiveness at the Olympic Games.
The research objectives were to identify:
1. the key impact factors determining China's medal count at the 27th & 31st Olympic games;
2. the barriers hindering the sustainable development of Chinese Olympic sports;
3. the sports events to be prioritized which could ensure an increase in medals at the next Olympic games.
Method
1. Documentary evidence regarding the top 8 of every event in 25th -31st summer Olympic Games. Relevant data were collected.
2. A questionnaire survey was distributed to 51 randomly selected experts in the field of Olympic sports in China.
3. The questionnaire consisted of 24 opened questions.
Results: The key findings:
1. The medal count in the 25th -31st summer Olympic Games evidenced as flat &/or declining.
2. The medals were concentrated in a minor of sports e.g. Table Tennis, Badminton, Gymnastic , Shooting, women's Judo and women's Weightlifting.
3. The medal count was equally distributed between men and women athletes.
There are barriers impacting the sustainable development of summer Olympic sports in China:
1. Shortage of talent pools;
2. The coaching knowledge and techniques are dated;
3. The Athletics events are remaining disadvanced position in the competition.
Discussion and suggestions
The strategic planning of Olympic sports development in China is a big project . This research was limited, however, on Olympic sport events analysis, the results only reflect issues directly impacting sport events development. The research made the following suggestions:
1. To prioritize women's events, e.g. team events which will be more effective in achieving medal success.
2. Preparation should focus on:Diving, Gymnastics, Table Tennis, Weightlifting, Shooting and Judo,Swimming, Athletics et

Conventional Print Poster

CP-SH02 Stress process and imagery in sport

PERFORMANCE AT A COST: AN EXAMINATION OF CONTINUOUS PERFORMANCE UNDER PRESSURE PUTTING HEALTH AT RISK PARTICULARLY FOR THOSE HIGH IN NARCISSISM

BARWOOD, C.
BANGOR UNIVERSITY

In most life domains excelling under pressure is seen as an advantage. However, high performance requires chronic engagement with stressors, and it is not clear whether this sustained performance may harm one's health. Individuals with extreme reactions to stress may be more susceptible to health problems that stem from high performance(Cheng, Tracy, & Miller, 2013). We examined whether narcissism moderated the performance-health relationship. We hypothesised those with high trait narcissism would be more susceptible to health problems due to their extreme stress reactions and increased effort when performing under pressure.
We used the openly available Addhealth database, (Harris et al., 2009), a longitudinal study of Americans. We measured performance via education and earnings, trait narcissism with the Addhealth narcissism scale (Davis & Brunell, 2012) and health in two ways; Diabetes was a dichotomous variable (diabetic or not) calculated by combining serum glucose and Haemoglobin A1C%, self-report history of diabetes, and anti-diabetic medication use. High cholesterol risk (HCR) was calculated from a range of serum lipid measures which were combined and dichotomised (high or low risk).
Significant moderating effects of trait narcissism were found when using education as the performance measure for both diabetes and HCR. Overall the models were significant (Hosmer & Lemeshow X2 =9.37,2.18 p=.31,.96 respectively). The regression analysis had significant effects for trait narcissism LLCI=.30, ULCI.50 and the interaction (educ*narc) LLCI=-.50, ULCI=-.06. Simple slopes analysis of the moderation showed no significant effects however Johnson-Neyman follow-up showed two regions of significance. The first region was ≥ -

1.62SD below the mean of narcissism; a significant positive moderation increasing the relationship between education and HCR, LLCI=.00,ULCI.=.88. The second region was ≥ 1.02SD above the mean of narcissism; a significant negative moderation decreasing the relationship between education and HCR, LLCI=-.61,ULCI=.00. When substituting trait narcissism descriptive statistics back in a score of ≤29 increases the positive relationship between education and HCR and a score ≥43 negatively decreases the relationship between education and HCR. The earnings model moderating effects were consistent with those of the education model. Similar results were seen for diabetes, simple slope analysis of the interaction showed significant moderation at low and average levels of narcissism LLCI= .05 and .01 respectively and ULCI= .83 and .52 respectively.
Results suggest those who are high performers are more at risk of diabetes and high cholesterol if they are low in trait narcissism. However, individuals high in trait narcissism don't have a increase in diabetes or risk of high cholesterol as education or earnings increases. This suggests there is a performance health trade-off and that narcissism has a protective role narcissism in this relationship.

PERFECTIONISM MEDIATES THE RELATIONSHIP BETWEEN INTOLERANCE OF UNCERTAINTY AND FEAR OF FAILURE

NIETO, M., JONES, E., VOSLOO, J., HARENBERG, S.

ITHACA COLLEGE

Introduction: The outcome of sport competitions is inherently uncertain. Athletes have to manage the perceived outcome uncertainty regularly. However, athletes, who are intolerant of uncertainty, may experience heightened maladaptive emotions (e.g., fear of failure, anxiety; Robinson & Freeston, 2015). It is very likely that various personality characteristics (e.g., perfectionism) may influence this relationship, however, empirical evidence on this topic is sparse in the current literature. Hence, the purpose of the present study was to examine if perfectionism mediates the relationship between intolerance of uncertainty and fear of failure.
Methods: Two hundred and forty-two NCAA Division III athletes (female n=131; Mage = 19.37±1.13; MYear of Study = 2.13±1.04) from track and field (n=60), swimming and diving (n=46), soccer (n=43), crew (n=40), lacrosse (n=33), gymnastics (n=20) teams participated in the study. The participants completed the Sport Multidimensional Perfectionism Scale-2 (Gotwals & Dunn, 2009), the Intolerance of Uncertainty Scale (Carleton et al., 2007), and the Performance Failure Appraisal Inventory (Conroy, 2001). Structural Equation Modeling (SEM) with Test of Joint Significance (TJS) was used to analyze the data.
Results: SEM revealed that intolerance of uncertainty predicted 29% of the variance of fear of failure (=.54, p<.001). TJS showed a full mediation of this relationship by perfectionism. The mediated model showed an acceptable fit (2/df = 3.40, CFI = .91, TLI = .86, RMSEA =.10, CI90%=.08-.12) and explained 60% of the variance of fear of failure (s=.60-.69, p<.001).
Discussion: The present study provides further evidence that personality factors may influence maladaptive emotions (i.e., fear of failure) towards the uncertainty of athletic competitions. In particular, perfectionism seems to play a central role in this relationship. The evidence from this study may inform counseling methods to target intolerance of uncertainty and perfectionism in order to optimize athletes preparation for competitions. Further reserach could examine the effectiveness of such interventions. In addition, future research should explore other personality factors that may influence athletes emotions towards competition. Limitations of the present research are discussed.
References: Carleton RN, Norton M, Asmundson G (2007). J Anxiety Disord, 21, 105-117.
Conroy D (2001). Anxiety Stress Coping, 14, 431-452.
Gotwals J, Dunn J (2009). Meas Phys Educ Exerc Sci, 13, 71-92.
Robinson G, Freeston M (2015). J Clin Sport Psychol, 9, 335-344.
Contact: mnieto@ithaca.edu

THE EFFECTS OF DIVING EXPERIENCE AND PERSONAL ANXIETY STATE IN SCUBA DIVERS

CHEN, C.Y., TSAI, F.H., CHEN, T.Y., LIANG, J.M., HSU, H.T., WU, W.L.

KAOHSIUNG MEDICAL UNIVERSITY

INTRODUCTION: Scuba diving has become increasingly popular in recent years. There were some dangers and risks are presented by factors such as hydraulic pressure, water temperature, experience or personal anxiety level. Previous researches have reported that experience and anxiety would be related to underwater performance (Kneller et al., 2012; Morgan, 1995; Paulsen & Trevor, 2017; Steinberg & Doppelmayr, 2015). However, there were some inconsistent results due to different participant's age ranges, test environments, and testing tools. Therefore, this study involved using the same age group, test environment, and test methods to explore how diving experience and individual anxiety levels affect diving performance.
METHODS: 34 novice divers (23 male and 11 female, mean age = 23.5 ± 5.4 yr with 5.26 ± 3.56 logged dives) and 21 experienced divers (18 male and 3 female, mean age = 23.2 ± 4.1 yr with 418.76 ± 940.51 logged dives) were enrolled in this study and scuba diving performance was measured in a pool (2 m depth). The standardized scuba diving skills in the Scuba Schools International (SSI) dive guide involved mask clearing, buddy breathing, regulator recovery, and buoyancy control. The completion time of each skill and the total time were recorded by a diving instructor. Participants had to complete a trait-anxiety questionnaire and were subdivided into two groups on the basis of having trait anxiety scores either above or below 39. Two-way ANOVA was conducted using the two factors, diving experience and trait anxiety, and the score was used to analyze the difference in scuba performance. Statistical significance was set at p values < 0.05.
RESULTS: The two-way ANOVA analysis indicated that dive experience significantly affected the buddy breathing ($p < 0.01$) and total time ($p < 0.01$), and trait anxiety level significantly affected the completing time of mask clearing ($p = 0.02$) and regulator recovery tests ($p < 0.01$).
CONCLUSION: The results of the present study suggest that diving experience and personal anxiety level both affect recreational scuba diving performance. Emergency situations such as choking on inhaling water during mask clearing or losing a regulator may increase psychological stress and negatively affect underwater performance for individuals with higher trait anxiety scores. In addition, continuous practice is necessary to retain diving skills and is particularly valuable when divers are beginners.

THE VALIDATION OF THE CHINESE VERSION OF SPORT COURAGE SCALE

HSU, C.H., PENG, Y.C., LIAO, C.M.

1: CARDINAL TIEN JUNIOR COLLEGE OF HEALTHCARE AND MANAGEMENT 2: NATIONAL TAIWAN UNIVERSITY OF ARTS 3: NATIONAL TAIWAN SPORT UNIVERSITY

The Validation of the Chinese Version of Sport Courage Scale

Chih-Hao Hsu,1 Yi-Chen Peng,2 and Chu-Min Liao3
1: Cardinal Tien Junior College of Healthcare and Management (Taiwan)
2: National Taiwan University of Art (Taiwan)
3: National Taiwan Sport University (Taiwan)
Abstract
Introduction: Sport is a highly competitive environment and it takes great courage for athletes to overcome numerous setbacks before achieving the highest achievement. Courage refers to the voluntary willingness to act in response to a threat to achieve an important goal (Pury, & Lopez, 2011). This great virtue of a champion, however, has not been systematically and thoroughly studied in sport. So far, only Konter and Ng (2012) have attempted to explore the nature of courage of athletes and developed a Sport Courage Scale (SCS). SCS comprised five sub-scales labelled "determination", "mastery", "assertiveness", "venturesome", and "sacrifice behaviors". This study was an exploratory validation of a Chinese version of SCS with a sample of Taiwanese athletes.
Method
Items of SCS (English language) were translated into Chinese language (traditional font) with a back-translation procedure and administrated to 207 Taiwanese collegiate athletes (male=148, female=59; mean age=20.29, SD=1.73) of an average of 8.6 years of sports experiences (SD=2.92) from 10 sport teams. Exploratory factor analysis and item analysis were conducted given that this was a cross-cultural validation and changes in factor structure were possible.
Results: Results revealed a 4-factor structure with a total of 54.78% variance accounted and sub-scale internal consistency coefficient ranged from .66~.82. The four factors were "determination", "mastery", "assertiveness", and "venturesome" and were in line with four of the five sub-scales in the original SCS. All the four items from "sacrifice behaviors" of the original SCS were contained in either the "determination" or "venturesome" sub-scale.
Conclusion
The results provided preliminary support for the validity and reliability of the 4-factor, 18-item Chinese version of Sport Courage Scale (CSCS). The drop of the "sacrifice behaviors" sub-scale from the original SCS may due to the inadequate internal consistency of the original sub-scale (α = .61) and/or the possible cultural differences between the sample of Konter and Ng's work and our study. Further examination of criterion-related validity and cross-validation on more samples from various backgrounds are warranted.
References: Konter, E. & Ng, J. (2012). Development of sport courage scale. Journal of Human Kinetics, 33, p.163-172.
Pury, C. L., & Lopez, S. J. (2011) Courage. In C. R. Snyder & S. J. Lopez (Ed.), The Oxford handbook of positive psychology, P.375-382. New York, NY: Oxford University Press.
Contact: chuminliao@gmail.com Dr. Liao

THE RELATION BETWEEN ACTION ORIENTATION AND RUMINATION IN COMPETITIVE SPORTS

KRÖHLER, A., BERTI, S.

JOHANNES GUTENBERG-UNIVERSITY MAINZ

INTRODUCTION: Frequently athletes report that their thoughts revolve around the future or past and not around the here and now during competitions. Here the question arises whether there is a relation between the distraction of thoughts and other personality traits. The theory of action control (Kuhl, 1983) distinguished between action and state orientation, two action intentions that promise a further starting point. State orientation is described as ruminative cognitions about past, present and future states that inhibit the individual action readiness and implementation (Dibbelt & Kuhl, 1994). So far, there are little empirical results of this postulated relation. In the present study, we investigated the direct relationship between failure-related action orientation (HOSP: Beckmann & Wenhold, 2009) and rumination in competitive sports assessed by three rumination questionnaires, a general (PTQ, Ehring et al., 2011), a clinical (RRQ, König, 2012) and a competition-related one (modified from Krys et al., in prep.).
METHODS: Within a period of three months (October – December 2016) 157 athletes from different sports (77 males and 80 females) participated in an online-study. Mean age was 21.57 years (range 15-30 years, SD = 3.63). Overall 120 of the participants were squad athletes or did their sports on a comparable level. The athletes averaged 13.40 of competitions (SD = 8.02) per year.
RESULTS: Results of the (robust) regression analysis confirmed that action orientation is a significant predictor for rumination (PTQ: R^2adj. = .23, β = -.46, $p < .001$; RRQ: R^2adj. = .22, β = -.48, $p < .001$; competition-related rumination: R^2adj. = .24, β = -.50, $p < .001$).
CONCLUSION: Results confirm the assumption that failure-related action orientation is associated to rumination in general as well as in a specific competition context. Our results complement studies that report relations between action orientation and differences in athletic behavior. Moreover, the results support the assumption that rumination might be a relevant factor in competitive sports.

PREDICTORS OF PRECOMPETITIVE ANXIETY IN DOG AGILITY HANDLERS

STONE, S.1, HARENBERG, S.1, VOSLOO, J.1, WOLF, S.2

1ITHACA COLLEGE; 2UNIVERSITY OF AMSTERDAM

Introduction: Dog agility is a growing sport that requires directive human-dog interaction under competitive pressure. To date, the sport has been largely ignored by sport psychology research even though the dyadic relationship between the dog agility handler and the canine is complex and may provide unique psychological challenges in the preparation for competition. The purpose of the present study was to examine whether precompetitive appraisal, personality traits (i.e., trait anxiety, intolerance of uncertainty) and situational characteristics (i.e., canine precompetitive emotions) predict precompetitive anxiety in dog agility handlers.
Methods: Eighty-one dog handlers (female n=76; MAge=44.63±14.29; MExperience=13.62±6.57) completed the Precompetitive Appraisal Measure (Wolf et al., 2015), the anxiety subscale of the Sport Emotion Questionnaire (Jones et al., 2005) for the handler and canine, the Three Factor Anxiety Inventory (Cheng et al., 2009), and the Intolerance of Uncertainty Scale (Carleton et al., 2007) immediately (i.e., under 2 hours) prior to performing in a regional championship.
Results: A multiple regression model with handlers precompetitive anxiety as the criterion and precompetitive appraisal, personality characteristics, and situational characteristics as predictors accounted for 50.6% of the variance in precompetitive anxiety ($F(8,70)=8.96$, $p<.001$). The significant predictors included cognitive competitive trait anxiety (=.39, p=.002), inhibitory intolerance of uncertainty (=.23, p=.029), and the dogs precompetitive anxiety (=.20, p=.032).
Discussion: The tested model predicted half of the variance in dog handlers precompetitive anxiety. The individual predictors imply that both stable factors of the handlers personality and dynamic situational characteristics need to be considered in the precompetitive preparation of the dyadic pair. From an applied perspective, the findings suggest that interventions should target dog agility handlers pre-

competitive emotion regulation to optimize preparation for performance. Future research could explore further psychological processes in order to optimize the performance interaction between handler and canine.
References: Carleton RN, Norton M, Asmundson G (2007). J Anxiety Disord, 21, 105-117.
Cheng WNK, Hardy L, Markland D (2009). Psychol Sport Exerc, 10, 271-178.
Jones MV, Lane AM, Bray SR, Uphill M, Catlin J (2005). J Sports Ex Psych, 27, 407-431.
Wolf SA, Evans MB, Laborde S, Kleinert J (2015). J Sports Sciences, 33, 579-587.
Contact: sstone@ithaca.edu

TRAIT EMOTIONAL INTELLIGENCE, MOOD STATES & CORTISOL RESPONSE TO A TREADMILL ULTRAMARATHON.

HOWE, C.C.F.1, PUMMELL, E.1, PANG, S.2, SPENDIFF, O.1, MOIR, H.J.1

1: KINGSTON UNIVERSITY, , 2: LGC,

INTRODUCTION: Ultramarathon competitors experience & have to manage & overcome a complexity of physiological & psychological stresses. Trait emotional intelligence (TEI) is an individual's perception & understanding of how their emotions impact their thoughts & behaviours during competition & plays an important role in their ability to employ strategies to regulate them. The aim of this study was to investigate TEI & its effect on performance, mood states & serum cortisol levels over an 80.5km treadmill ultramarathon.
METHODS: Twelve ultramarathon runners completed an 80.5km time-trial on a treadmill & were instructed to cover the distance in the fastest possible time. Runner TEI was measured using the 33-item emotional intelligence scale (Schutte et al., 1998) prior to the trial. A mood state questionnaire (BRUMS: Terry et al., 2003) was completed prior (baseline), immediately before (pre), at 40.25km (halfway) & on completion of 80.5km (post), as were serum cortisol concentrations, measured by competitive ELISA-type electrochemiluminescence assay.
RESULTS: Average completion time was 09:00:18±01:14:07 (hh:mm:ss), at a running velocity of 9.8±1.3km.h-1. Increases in serum cortisol were observed between pre & halfway, & between halfway & post time points ($p=0.001$ & $p=0.003$, respectively). Significant decreases were observed between both baseline & pre time points compared to the post time point for 'Vigor' ($p=0.015$ & $p=0.01$, respectively). Significant increases were also identified for 'Fatigue' between pre & halfway, &, pre & post ($p=0.05$ & $p<0.01$ respectively), along with halfway to post ($p=0.02$). Runners with higher TEI displayed greater post serum cortisol levels ($r=0.78$, $p>0.001$). Significantly higher total mood disturbance (TMD) was also observed between baseline & post, as well as between pre & post time points ($p=0.001$).
CONCLUSION: The findings of the current study highlight the complex interactions of both physiological & psychological stresses imposed by an ultramarathon, demonstrated by the expected increase in fatigue & decrease in vigor over the course of the ultramarathon. Participants with a higher TEI displayed greater post-trial cortisol responses which may suggest that they are more aware of their emotions during an ultramarathon. These findings may give insight into what draws individuals to the sport of ultramarathon running, help to identify the stressors they face & further help develop strategies to aid both completion & performance in ultramarathon events.
REFERENCES: Schutte, N. S., Malouff, J. M., Hall, L. E., Haggerty, D. J., Cooper, J. T., Golden, C. J., Dornheim, L. (1998). Pers Indiv Differ,25:167–77.
Terry P.C., Lane A.M., Fogarty G.J. (2003). Psych Sport Ex,44:125-139.
CONTACT: c.howe@kingston.ac.uk

THE EFFECT OF THE MENTAL IMAGE OF CLIMBING HOLDS IN MOTOR PREPARATORY INFORMATION PROCESSING

SUGI, T., ISHIHARA, M.

TOKYO METROPOLITAN UNIVERSITY, GRADUATE SCHOOL OF HUMANITIES .

Introduction: The mental image of an action has an effect on motor performance. In free-climbing, the image of climbing holds to grasp is important for a climber's performance(e. g., Bläsing et al., 2014). In the present study, we investigated whether such an imagery would facilitate the motor preparation of the action.
Method
Nine climbers participated in the experiment. The task was to react, by pressing the response button, to a visual stimulus presented on a computer display. The visual stimuli were composed of climbing holds (serving as a prime stimulus) and left or right arrow (serving as a target). The climbing holds as the prime were one (i.e., baseline block) or two (i.e., experimental block). The orientation of the hold was experimentally manipulated, these were either the up, down, left or right orientation (randomly presented). The participants were instructed to imagine themselves grasping the prime holds. There was another experimental condition about the "touch", participants were asked to touch a real climbing hold (i.e., touch condition) or just simply no-touch (just watching the hold, i.e., no-touch condition) in each trial of the experiment. The order of the touch/no-touch conditions was counterbalanced in two different days. The reaction times (RTs) were measured in each individual as the time from the target onset to the button pressing. In the experiment, participants were asked to stand in front of the computer display and press one of two buttons (left or right) to the given target as quickly and accurately as possible. After finishing the trial block, participants were asked to answer questions about the task. The RTs obtained from each participant were fed into the analyses of variance.
Results: The difference of the mean RT (dRT) between the experimental block and the baseline showed a congruency effect. The dRTs for the congruent condition appeared to be faster than that for the incongruent condition [$F(1, 8) = 3.61$, $p = .094$]. The facilitatory effect may be due to the influence of the mental image on the appropriate motor preparation to grasp the holds. There was no significant main effect or related interaction for the touch condition (i.e., touch vs. no-touch).
Conclusion
The results suggested that the climbers' mental image of a given action would be mediated by the holds' orientation and/or distribution. The congruity effect observed in the dRTs can be thought to reflect the mental action-related facilitation of the preparation for the appropriate action. The image of the climbing hold's orientation on the climbing wall may contribute to the improvement of the climbing action, such as grasping.
References: Bläsing B E, Güldenpenning I, Koester D, Schack T. (2014). Expertise affects representation structure and categorical activation of grasp postures in climbing. Frontiers in psychology, 5, 1008.
Contact: Email address: sugi-takahiro@ed.tmu.ac.jp

CHANGES IN MOVEMENT IMAGERY DURING THE TRAINING OF AN ELITE PLAYER WITH CONGENITAL BLINDNESS

MOMOSE, Y.

TOKOHA UNIVERSITY

Changes in movement imagery during the training of an elite player with congenital blindness
Momose, Y.1, Ito, H.1, 1: Tokoha University (Shizuoka, Japan)
Introduction: How does a soccer player with congenital blindness, who does not have any visual information, visualize while playing the sport? Is imagery training effective for a person with visual impairment? This study investigates the changes in movement imagery during the training of a Japanese elite soccer player with congenital blindness.
Methods: The subject was a Japanese elite soccer player who was diagnosed with early stage congenital blindness at age two. The measurements were carried out twice: once during the novice period and once at the competitive stage. We also conducted an interview using Personal Attitude Construct analysis to understand the imagery of the player in aggressive situations in the game. The first eight months, where the soccer player participated in only two games, was termed as the novice period. The competitive period was the time when the subject was elected as an all-Japan upbringing reinforcement player a year later.
Results: The main results were as follows: During the novice period, the player was able to receive a pass by only following auditory directions from a guide and callers. On the other hand, during the competitive period, he gathered essential information for an attack by relying on the sound of the ball and the sign-in-action of his supporters and opponents.
Discussion: These results suggest that the imaging of a Japanese elite soccer player with congenital blindness depends on the following: (1) only listening to auditory direction, using which three passes were made—one spatial, one detailed, and one spontaneous—and one shot was attempted to score a goal, and (2) effective use of external imagery, internal imagery and spatial imagery (Momose and Ito, 2017).
References: Momose, Y, Ito, H. (2016). A pilot study for making of the movement image questionnaire for athletes with congenital blindness: A Personal Attitude Construct (PAC) analysis of a male elite blind-soccer player. Faculty of Education Bulletin in Tokoha University, 37, 37-48.
Momose, Y, Ito, H. (2017). A basic investigation of the imagery aspects of elite goal ball athletes with congenital blindness. J Image Psych, 14 (under printing).
Contact: [m-yumiko@sz.tokoha-u.ac.jp]

DEVELOPMENT OF CHINESE VERSION OF "MOVEMENT IMAGERY QUESTIONNAIRE-3"

CHEN, J.Y., CHI, L.K.

NATIONAL TAIWAN NORMAL UNIVERSITY

Development of Chinese Version of "Movement Imagery Questionnaire-3"
Jo-Yun, Chen., Li-Kang, Chi
NTNU (Taipei, Taiwan)
Introduction: Previous studies have proved that imagery can facilitate motor skill learning and performance (Cumming & Williams, 2012; Koehn, Morris, & Watt, 2014). Moreover, imagery ability is essential to ensure the effect of imagery. Therefore, a valid and reliable inventory to measure the movement imagery ability is critical. In order to assess Taiwanese athletes' ability of movement imagery, Movement Imagery Questionnaire-Revision (Hall & Martin, 1997) has been frequently used. However, Movement Imagery Questionnaire-3 (Williams, et al., 2012) has indicated as a better instrument to measure movement imagery ability. The purpose of the present study was to develop a Chinese-Version Movement Imagery Questionnaire-3 (CMIQ-3), and to examine its reliability and validity.
Methods: Participants were 190 college student-athletes (male= 107, female=83) recruited from 7 colleges in Northern Taiwan. After receiving the informed consent, all participants were asked to complete Chinese-Version Movement Imagery Questionnaire-3.
Results: The confirmatory factor analysis was conducted to examine the factorial validity and reliability of the CMIQ-3. The results indicated that the three-factor measurement model of CMIQ-3 (kinesthetic imagery, internal imagery and external imagery) has shown acceptable goodness-of-fit indices ($\chi 2$=45.59 df=32, CFI=.97, NFI=.91, TLI=.96, RMSEA=.047). Regarding the reliability of CMIQ-3, the composite reliability for the subscale of kinesthetic imagery, internal imagery, and external imagery are .76, .69, and .66 respectively.
Discussion: Our findings concluded that CMIQ-3 is a valid and reliable inventory which can be used to measure Taiwanese student-athletes' movement imagery ability.
References: Cumming, J., & Williams, S.E. (2012). Imagery: The role of imagery in performance. In S. Murphy (Ed.), Oxford Handbook of Sport and Performance Psychology. New York,
NY: Oxford University Press.
Hall, C.R., & Martin, K.A. (1997). Measuring movement imagery abilities: A revision of the movement imagery questionnaire. Journal of Mental Imagery, 21(1-2), 143-154.
Koehn, S., Marris, T., & Watt, A.P. (2014). Imagery intervention to increase flow stale and performance in competition. The Sport Psychologist, 28(1), 48-59.
Williams, S.E., Cumming, J., Ntoumanis, N., Nordin-Bates, A.M., Ramsey, R., & Hall, C. (2012). Further validation and development of the movement imagery questionnaire.
Journal of Sport & Exercise Psychology, 34, 621-646.
Contact: clund0222@hotmail.com

Conventional Print Poster

CP-SH01 Motivation, Team dynamics and well-being in sport

RELATIONSHIPS BETWEEN FORMS OF MOTIVATION AND TEAM COHESION AS A FUNCTION OF COMPETITION LEVELS IN YOUNG SOCCER PLAYERS

RÓDENAS, L.

AUTONOMOUS UNIVERSITY OF NUEVO LEON

RELATIONSHIPS BETWEEN FORMS OF MOTIVATION AND TEAM COHESION AS A FUNCTION OF COMPETITION LEVELS IN YOUNG SOCCER PLAYERS

Ródenas, L.1, Castillo, I.2, Galilea, G.3, Soler, M.J.2, Duda, J.L.4, & Balaguer, I.2

1: Autonomous University of Nuevo Leon (Mexico), 2: University of Valencia (Spain), 3: Catalan Sports Council, Barcelona (Spain), 4: University of Birmingham (United Kingdom)

Introduction: Researches have consistently found significant correlations between forms of motivation and types of cohesion in the sport domain. However, little evidence exists about the role of different competitive levels in these relationships. The purpose of this study was to examine whether the relationships between forms of motivation (autonomous, controlled and amotivation), and perceptions of team cohesion (task and social) would vary as a function of two different competition levels: 'alevin' (under 11) and 'infantil' (under 13) or remains invariant despite the competition level.

Methods: Participants were 809 young soccer players (391 alevin and 481 infantil) ranged in age from 9 to 13 years old (M=11.49, SD=1.16) represented 12 different Spanish soccer schools, who completed a questionnaire package tapping the variables of interest.

Results: The results obtained using moderated regression analysis (PROCESS macro for SPSS) showed that competitive level did not significantly moderate the relationship between each of three forms of motivation and task cohesion; and between autonomous motivation and social cohesion. The model showed that autonomous motivation positively predicted task and social cohesion, despite the level of competition.

With respect to the relationship of the other forms of motivation (controlled motivation and amotivation) and social cohesion, competition levels significantly moderate these relationships. Concretely, in 'alevin' category, controlled motivation was positively related to social cohesion, whereas in 'infantil' category this relationship was non-significant. In addition, in 'infantil' category, amotivation was negatively related to social cohesion, whereas in 'alevin' category, this relationship was non-significant.

Discussion: The effect of autonomous motivation on task and social cohesion remain invariant despite the competition level. However, for social cohesion a moderating effect was produced, indicating that controlled motivation (in a positive sense) and amotivation (in a negative sense) have an impact on predicting social cohesion for 'alevin' and 'infantil' categories. Overall, our findings are suggestive of the importance of fostering autonomous motivation, despite categories, as may contribute to more positive social and task cohesion in sport teams.

Funding

The research leading to these results has received funding from the European Community's 7th Framework Programme FP7/2007-2013 (grant agreement no. 223600).

Contact: Luis Ródenas: luistorc23@hotmail.com

TEAM DYNAMICS, EMOTIONAL INTELLIGENCE AND THE COHESION LEVEL GENERATED BY THE COACHES

REYES HERNÁNDEZ, O.1, TRONCOSO AVALOS, S.1, GARCIA-MAS, A.2, LÓPEZ-WALLE, J.1

1.UNIVERSIDAD AUTÓNOMA DE NUEVO LEÓN 2.UNIVERSITY OF THE BALEARIC ISLANDS

The present investigation examines how the trait emotional intelligence coachs and cohesion level (group environment) generated by a coach directly predicts the psychological dynamics of their teams. For this study, the sample was of 33 coaches (Mage = 39.42, SD = 9.81) and 370 athletes (Mage = 20.99, SD = 2.14) from 33 teams of sports teams. The coaches have an average of 8 years of experience (SD = 5.19). The instruments used were the Group Environment Questionnaire (GEQ, Carron, Wildmeyer and Brawley, 1985), the Trait Emotional Intelligence Questionnaire - short form (TEIQue-sf; Petrides and Furnham, 2006) and the Cooperative Workteam Questionnaire (CWQ; Olmedilla, García-Mas, Luo, Llaneras, Ruiz Barquín and Fuster-Parra, 2016). The obtained results show that the Emotional Intelligence in its subscale of Autocontrol positively predicts the Global Cooperation in its "As a player" form (B = .41, p <.05) and in the group environment subscales of task group attraction (B = .46, p <.05) and task group integration (B = .42, p <.05). While the Global Cooperation in its "As if was Coach" form positively predicts the task group Attraction (B = .45, p <.05). On the other hand, Personal Growth in its "As a Player" form positively predicts the task group Integration (B = .38, p <.05) and in its "As if was Coach" form with the task group Attraction (B =. 37, p <.05). Finally, the Emotional Intelligence in its subscale of Self-control positively predicts the Conditional Cooperation from the perspective "As a player" (B = .39, p <.05). According to the results, it can be concluded that when an athlete is trained by a coach who has control over their emotions and impulses, they will value the cooperation that their teammates have with the team. Likewise, it will tend to generate a greater task cohesion and will be willing to cooperate in group activities when their teammates are involved in participation. Finally, the fact that a player perceives personal growth in his group (both from the perspective of player and coach) predicts the cohesion towards the task.

RELATIONSHIPS BETWEEN PROACTIVE PERSONALITY AND 2X2 ACHIEVEMENT GOALS AMONG WOMEN'S BASKETBALL PLAYERS

CHIA-YU, H., LI-KANG, C.

NATIONAL TAIWAN NORMAL UNIVERSITY

Introduction: Proactivity is about drawing and setting plans to pursue a different future. Parker et al. (2010) identified that proactivity requires a goal-driven process involving goal processes and motivational states. According to Achievement Goal Theory (Elliot, 1999), competence was defined and valenced as mastery/performance and approach/avoidance. However, few studies were conducted to develop the relationship between proactive personality and proactive goal process in the sports domain. The aim of this study was to take this perspective to examine the proactivity in the connection with the 2x2 achievement goals for sport.

Methods: In this study, we recruited 136 women's basketball players (Mage=20.10, SD=1.76) from 12 universities in Taiwan. Participants were requested to complete measures consisting of Proactive Personality Scale (Huang, 2009) and 2x2 Achievement Goal Questionnaire of Sport (Li et al., 2005). Data analysis and interpretation were based on Pearson correlation and linear regression analysis.
Results: The correlation analysis revealed that proactive personality is positively correlated with the mastery-approach goal (r=.50, p<0.01), mastery-avoidance goal (r=.27, p<0.01), and the performance-approach goal (r=.48, p<0.01). Otherwise, there was no correlation between proactivity and performance-avoidance goal (r=.10, p>0.05). The results of linear regressions analysis showed that proactivity positively predicted mastery-approach goal (β=.50, p<0.001), mastery-avoidance goal (β=.27, p=0.003) and performance-approach goal (β=.48, p<0.001).
Discussion: The results of this study showed that athletes with higher scores in proactive personality have the association with the mastery-approach goal, performance-approach goal, and the mastery-avoidance goal. No correlation was found between proactivity and performance-avoidance goal. Moreover, proactivity can predict mastery-approach goal and performance-approach goal. In other words, athletes with high proactivity tend to have a higher mastery-approach goal, performance-approach goal, and mastery-avoidance goal. Previous studies from achievement goal theory have found that mastery-approach goal, performance-approach goal, and mastery-avoidance goal are related to adaptive achievement behaviors. Based on the results of this study, proactive personality might be the important antecedent related to achievement goals. More studies in terms of examining the relationship between proactive personality and achievement goal are warranted.

INTERACTION BETWEEN THE PLAYERS' PERCEPTIONS OF THE COACHES' INTERPERSONAL STYLES AND ITS IMPLICATIONS FOR FEMALE BASKETBALLERS' DEVELOPMENT

BALAGUER, I.1, CASTILLO, I.1, ATIENZAR, M.A.1, TOMÁS, I.1, CONDE, C.2, IBAÑEZ, S.3

1 UNIVERSITY OF VALENCIA, SPAIN; 2 UNIVERSITY OF HUELVA, SPAIN; 3 UNIVERSITY OF CÁCERES, SPAIN.

INTERACTION BETWEEN THE PLAYERS' PERCEPTIONS OF THE COACHES' INTERPERSONAL STYLES AND ITS IMPLICATIONS FOR FEMALE BASKETBALLERS' DEVELOPMENT
Isabel Balaguer1, Isabel Castillo1, Mª Ángeles Atienzar1, Inés Tomás1, Cristina Conde2, & Sergio Ibañez3
1 Faculty of Psychology. University of Valencia, Spain
2 Faculty of Education. University of Huelva, Spain
3 Faculty of Sport Sciences, University of Caceres, Spain
Introduction: In this study the relationships between players' perceptions of the coach-created empowering climate and athletes reported personal and interpersonal development were examined, testing the moderating role of players' perceptions of the coach-created disempowering climate in those relationships.
Method
Participants were 399 Spanish young female basketball players aged between 11 and 18 years (M=14.10; SD=1.61), who completed a questionnaire package tapping the variables of interest. On average, athletes had a mean of 6.12 years of experience (SD=2.68), and practiced sport 6.14 hours a week (SD=1.62).
Results: The results obtained using moderated regression analysis showed that the perceived disempowering climate moderated the relationships between the perceived empowering climate and athletes' personal and interpersonal development. When empowering coaching increased, athletes reported higher personal and interpersonal development. However, this positive relationship was stronger when perceived disempowering coaching was low (1 SD below the mean; 1.80 on the 1-5 scale), than when it was high (1 SD above the mean; 3.21 on the 1-5 scale) for personal development, turning out to be non-statistically significant for high values of disempowering (1 SD above the mean; 3.21 on the 1-5 scale) in the case of interpersonal development. More concretely, the relationship between empowering climate and personal development would be positive and significant for any value of disempowering climate lower than 3.26 (on the 1-5 scale); additionally, the relationship between empowering climate and interpersonal development would be positive and significant for any value of disempowering climate lower than 3.13 (on the 1-5 scale).
Discussion: Potential beneficial effects that empowering climate could have on personal and interpersonal development, are diminished, and even blocked when the social environment is highly disempowering. The negative implications of disempowering climates for female athletes´ development and the convenience to create empowering climates in the sport domain are emphasized.
Contact: Isabel.Balaguer@uv.es

PLAYERS PERCEPTIONS OF COACHES CORRECTIVE FEEDBACK AND IMPLICATIONS FOR ATHLETES ILL-BEING

TRISTAN, J.1, LOPEZ-WALLE, J.1, BALAGUER, I.2, VALDEZ, H.3, DUDA, J.4

1: UANL , 2: UV , 3: UES , 4: UB .

Introduction: The way in which corrective feedback is communicated can have differential effects depending on how it is perceived by athletes; these perceptions can lead to differential motivational states and diverse emotional and cognitive outcomes in athletes within the sporting context (Mouratidis, Lens, & Vansteenkiste, 2010). This study examined the relationships between players perceptions of coaches corrective feedback (CF), the legitimacy of this CF and the opportunity to learn from CF to indicators of ill-being (burnout). The hypothesized moderating role of players autonomous motivation in these relationships was also tested.
Methods: Participants were 322 Mexican university athletes, aged 17-28 years (M = 18.82, SD = 2.42). They respond to a set of Spanish versions of the following questionnaires: Corrective Feedback Scale (CFS); Sport Motivation Scale (SMS-II) and the Athlete Burnout Questionnaire (ABQ). For the analyses of the data, the macro PROCESS for SPSS was used.
Results: Corrective Feedback was a positive predictor and explained 36% of reported Burnout. Change in the R2 with the addition of the moderating effect of Autonomous Motivation (AM) was low but significant ($F = 5.64$, $p < .05$). The relationship between corrective feedback (CF) and burnout was significant with athletes of low and medium AM only. The perceived Legitimacy of the CF was a negative predictor and captured 35% of reported Burnout. The observed change in R2 with the inclusion of the moderating effect of AM was low but significant ($F = 4.89$, $p < .05$). The relationship between perceptions of the legitimacy of CF and Burnout was significant only in the case of athletes exhibiting high AM. The Opportunity to Learn from CF negatively predicted and explained 35% of Burnout symptoms ($R2 = .35$). In addition, changes in R2 with the addition of the moderating effect of AM was low but significant ($F = 5.98$, $p < .05$). The relationship between the perceived opportunity to learn from CF and Burnout was significant with athletes of high AM only.
Discussion: Amongst university athletes who are moderate to low in autonomous motivation, corrective feedback corresponds to heightened burnout. In university athletes with high autonomous motivation, perceiving the CF to be legitimate and as an opportunity to learn could reduce the symptoms of burnout. These findings suggest that coaches might be best advised to ensure that their athletes accept

CF, by having it couched in a manner that suggests that learning and improvement can follow, and communicated in an autonomy-supporting way.
Reference
Mouratidis, A., Lens, W., & Vansteenkiste, M. (2010). How you provide corrective feedback makes a difference: the motivating role of communicating in an autonomy-supporting way. Journal of Sport & Exercise Psychology, 32, 619-637.

SELF-COMPASSION AND SELF-DETERMINED MOTIVATION TOWARDS EXERCISE: AN EXPLORATION OR GENDER AND AGE DIFFERENCES OF REGULAR EXERCISERS

LOWRY, R.G., WALLER, K.

UNIVERSITY OF CHICHESTER

Introduction: Self-compassion occurs when an individual displays kindness and understanding rather than criticism in the face of set-backs and failures. A greater capacity for self-compassion is associated with the intention to engage in health promoting activities including exercise and exercise related outcomes. The purpose of this study was to explore, using a cross-sectional design, the concept of self-compassion for regular exercisers whilst accounting for potential age and gender differences. More specifically how self-compassion relates to self-determined motivation towards exercise involvement.
Methods: Participants (n=172), recruited through social media sites aimed at recreational runners were regular exercisers (M = 40, SD = 9; males = 26; females = 146). An online survey containing the Self-Compassion Scale (Neff, 2003), the Behavioural Regulations in Exercise Questionnaire-2 (Markland & Tobin, 2004) and the International Physical Activity Questionnaire Long Form (Craig et al., 2003) was completed.
Results: Total self-compassion was related to higher intrinsic motivation and lower external and introjected regulation. Older exercisers experienced lower levels of negative self-compassion, namely self-judgement, isolation and over-identification than younger adult exercisers. Similarly males, greater total self-compassion and specifically lower negative self-compassion to female exercisers. No relationship was observed between self-compassion sub-scales and the amount of physical activity self-reported by exercisers.
Conclusion: Motivation to exercise is concerned with regulated self-determination such as health and appearance related pressures. Self-compassion was positively, linearly associated with self-determination to exercise however this the concept was not associated with the amount of physical activity completed. Older adults and men involved in exercise appear display greater self-compassion than women and younger exercisers.

THE EFFECT OF AUTHENTIC AND TRANSFORMATIONAL LEADERSHIP OF KOREAN GOLF COACHES ON LEADER-MEMBER EXCHANGE AND GOLFERS' PERFORMANCE

KIM, I., KIM, J., PARK, J.

1: KOREA NATIONAL SPORT UNIVERSITY , 2: GERMAN SPORT UNIVERSITY COLOGNE

Introduction: In 2017, South Korean golfers won 15 times in the LPGA Tour, and 18 Koreans were ranked the top 100 on the LPGA money list (LPGA, 2017). A coach's leadership is considered one of the main factors to determine the performance. The leadership of the coaches have traditionally been described by transformational, servant and transactional leadership. In particular, transformational leadership was regarded as a prerequisite for success or winning in that it allows athletes to have clear objectives and strategies through mutual interaction. However, authentic leadership has recently emerged because authenticity leads to a voluntary devotion and trust, resulting in high performance. As such, the leadership tends to entail dyadic interaction controlling the performance, which is closely related to leader-member exchange (LMX) (Truckenbrodt, 2000). Therefore, the purpose of this study is to investigate the effect of authentic and transformational leadership of Korean golf coaches on LMX and golfers' performance.
Methods: Data were collected from 250 prospective golfers who belonged to golf academies in 2016 by using convenient sampling method. After removing 45 cases of incomplete questionnaires, 205 were used for data analysis. For the study, reliability analysis, Confirmatory Factor Analysis (CFA), correlation analysis and Structural Equation Model (SEM) were conducted by using SPSS 20.0 and AMOS 20.0.
Results: The overall validity and fit did not seem acceptable, $\chi 2(df) = 356.869$ (203, $p<.001$). Nevertheless, CFI = .931, TLI = .922, RMSEA = .061 and RMR = .037 exceeded fit index recommended by Bagozzi & Dholakia (2002), and therefore overall validity and fit can be considered a good model for the study. As a result, authentic and transformational leadership positively affected LMX, respectively, β=.425, t=3.654 and β=.510, t=4.194. Authentic leadership significantly influenced performance, β=.387, t=2.459. However, LMX and transformational leadership were not significant for performance, respectively, β=.315, t=1.742 and β=.072, t=.466.
Conclusion
The findings found that transformational leadership relatively had a higher influence on LMX than authentic leadership, and golfers' performance was positively affected by authentic leadership. It can be inferred that each leadership is effective, but transformational leadership seems more important to LMX as the leaders enthusiastically motivate their golfers to have an inspiration and confidence toward their goals. Also, golf performance is largely dependent upon psychological and emotional aspects, and therefore authentic leadership with rational transparency could positively induce golfers' state of mine and commitment for the high performance.
References: Bagozzi R, Dholakia U. (2002). Journal of Interactive Marketing, 16(2), 2-21.
LPGA. (2017). Statistics. Available from: http://www.lpga.com/statistics [accessed: 19 December 2017].
Truckenbrodt Y. (2000). Acquisition Review Quarterly, 7(3), 23

14:00 - 15:15

Plenary sessions

PL-PS04 PHYSICAL ACTIVITY AND HUMAN ENHANCEMENT DRUGS: A HEALTH HAZARD OR A USEFUL BEHAVIOUR CHANGE TECHNIQUE?

PHYSICAL ACTIVITY AND HUMAN ENHANCEMENT DRUGS: A PUBLIC HEALTH CONCERN?

BACKHOUSE, S.H.

LEEDS BECKETT UNIVERSITY

Superfoods, clean eating and dietary supplements are just a few examples of contemporary diet and lifestyle practices embedding in popular culture as we turn to an expanding list of produce and products that promise to enhance our bodies, performance and well-being. At the same time the widespread availability of human enhancement drugs has enabled growth in their non-medical use for muscularity , weight-loss , endurance and cognitive function . Despite this emerging threat to public health, efforts to prevent, detect and deter HED use are still defined by - and situated within - competitive sport. This context will be discussed in light of the extant evidence base on the psychosocial correlates and determinants of HED use, as well as their potential to cause harm. By acknowledging that the root causes of HED use are incredibly complex, and that short-term solutions will only address the symptoms of use, this paper will call for a systems-based approach to assist in preventing and managing HEDs in physical activity contexts.

TITLE: PHARMACOLOGICAL FACILITATION OF PHYSICAL ACTIVITY BEHAVIOUR

MARCORA, S.

UNIVERSITY OF KENT

Psychoactive drugs that reduce perception of effort and improve endurance are used legally (caffeine) and illegally (e.g., modafinil and ritalin) by many athletes. We argue here that pharmacological reduction of perception of effort may also be used to facilitate physical activity behaviour in the general population and, by doing so, improve many health outcomes. Avoidance of unnecessary effort is one of the main mechanisms that evolved to maintain the relatively high body fat humans with large brains needed to survive in an environment where food was scarce and physical activity mandatory. This inherent laziness motivated humans to create the current hypokinetic environment and is one of the main barriers to regular physical activity in the general population. After describing the psychobiology of how perception of effort interacts with motivational factors to determine physical activity, we present initial experimental evidence that pharmacological reduction of perception of effort using caffeine can positively affect physical activity behaviour. Finally, we will discuss directions for future research and the potential ethical issues related to this proposal.

e-poster not debated

PP-UD01

e-poster not debated

EP-UN01 E-Poster undebated
Adapted Physical Activity

KINETIC ANALYSIS OF CRUTCH RUNNING FOR AMPUTEE SOCCER

NAKASHIMA, D.1, KIMURA, H.2, SAKAMITSU, T.1, HIRATA, K.1, MIKAMI, Y.2, ADACHI, N.3

1,2: HIROSHIMA UNIVERSITY HOSPITAL, 3: HIROSHIMA UNIVERSITY

INTRODUCTION: Amputee soccer is a sport performed by using crutches. Lower limb injuries such as muscle tears of the leg and shin splint during amputee soccer have been reported. However, there are no report on biomechanics of crutch running. The purpose of this study was to clarify the kinetic load of the crutch running and compare it with normal running.
METHODS: Eight healthy young males participated in this study. Sixteen camera Vicon optical motion analysis system, and eight AMTI force plates were used to track and analyze the participants one-leg crutch running motion by using the two Lofstrand crutches and normal running motion. The crutch running method involved two steps of the foot and one step of the crutches. The center of mass (COM) coordinates, ground reaction forces, and kinetics data of the lumbar and lower limb joints were compared between the two conditions.
RESULTS: There was no significant difference in COM forward velocity between the two conditions. The amount of change in COM vertical direction was significantly larger for clutch running (10.9±3.2 %Body Height; BH) than for normal running (5.4±0.8 %BH). Under the crutch running condition, the ground reaction force, vertical (Fz: 3.02±0.29 N/kg), front, and rear components, and the internal lumbar, hip, knee, and ankle joint extension moment peaks (lumbar: 0.12±0.02, hip: 0.13±0.02, knee: 0.31±0.07 at foot contact to loading response phase, ankle: 0.29±0.02 Nm/kg at the push-off phase) increased significantly compared to those under the normal running condition (Fz: 2.52±0.20 N/kg, lumbar: 0.04±0.01, hip: 0.07±0.01, knee: 0.20±0.03, ankle: 0.26±0.03 Nm/kg). In the crutch running condition (0.072±0.036 Nm/kg), the sum of the bilateral hip joints flexion and extension moments calculated as a result of the scissors motion at the foot contact increased significantly compared with normal running condition (-0.003±0.012 Nm/kg, $p<0.01$).
CONCLUSION: The results of the present study show that crutch running was greater kinetic load for lumbar, hip, knee, ankle joint than normal running. Since the crutch running used only one leg, it may be difficult to use the scissors motion. The lack of offsetting of the bilateral hip joints flexion and extension moments increases the mechanical load on the lumbar. The scissors motion may reduce the load on the lower limb joints after foot contact. Therefore, training that reduces the COM vertical variation and increases the flexion moment of the swing leg side may lead to the reduction of the mechanical load of the lumbar and lower limb joints.

EFFECTS OF RHYTHMIC EXERCISE ON CARDIOVASCULAR FACTORS, BLOOD INFLAMMATORY MARKERS AND PHYSICAL FITNESS IN PSYCHOTIC PATIENTS

PARK, H.1, HWANG, Y.H.1, CHO, S.C.2, KIM, S.H.3, LEE, K.H.3, KIM, J.1, KIM, D.H.1

1: CHONNAM NATIONAL UNIVERSITY.(GWANGJU, KOREA), 2: MOKPO NATIONAL MARITIME UNIVERSITY.(MOKPO, KOREA) 3: CENTER FOR SPORT SCIENCE IN GWANGJU. (GWANGJU, KOREA)

INTRODUCTION: Currently, numbers of psychotic patients are getting increased, and it is socially or economically issued. The patients have to take atypical antipsychotic medications for managing their mental problems, but taking these medications leads to health issues such as decreasing level of physical activity and increasing appetite, thus it results in the patients to be obese. Thus this study is to examine effects of rhythmic exercise on cardiovascular factors, blood inflammatory markers and physical fitness in psychotic patients.
METHODS: This study shows the rhythmic exercise program to prevent cardiovascular diseases of psychotic patients and to improve their physical fitness. After the program was used on patients for 12 weeks, examined closely effects of cardiovascular factors (TC, TG, HDL-C, LDL-C, Insulin, Blood glucose, VEGF, NO), blood inflammatory markers (hs-CRP), and physical fitness(muscular strength, muscular endurance, cardiorespiratory endurance, flexibility, body composition). To achieve this aim, 18 psychotic patients were randomly assigned the two groups; one with 9 called exercise group (EX, n = 9) did rhythmic exercise 3 times a week, 60 minutes at a time and the other with 9 called regulation group (CON, n = 9) those who were in daily lives as usual.
RESULTS: The result of this study suggested that a decrease of TG and an increase of VEGF which are cardiovascular factors had positive effects on preventing cardiovascular diseases in EX group. Furthermore, physical fitness could be enhanced by an increase of flexibility and a decrease of BMI which are physical fitness factors in EX group, but not CON group.
CONCLUSION: If rhythmic exercise modified and supplemented is constantly used to psychotic patients, the danger of their potential cardiovascular diseases will be prevented and the quality of lives improved by keeping their body healthy. Rhythmic exercise program, which is neither the limit of places nor the risk of tools, is particularly considered to be used in hospitals and psychotic health care centers.

STUDY OF PARA SPORTS INSTRUCTOR TRAINING PROGRAM AT UNIVERSITY OF PHYSICAL EDUCATION: BASED ON AMPUTEE SOCCER COACHING PRACTICE

WATANABE, T., MAEHANA, H., WATARI, T., SUZUKI, K.

JUNTENDO UNIVERSITY

Study of Para sports Instructor Training Program at University of Physical Education: Based on Amputee Soccer Coaching Practice
Watanabe, T., Maehana, H., Watari, T., Suzuki, K.,
1. Juntendo University, Japan

Introduction: With the Tokyo Paralympic Games scheduled for 2020, various policies related to para sports have been proposed in Japan. One of them is instructor training. In particular, universities of physical education that have instructor training courses are playing a crucial role in promoting para sports. In instructor education, it is important to establish courses to provide basic knowledge regarding special education, the principles of inclusive physical education, the practice and understanding of para sports, and the education, in this regard, of students aspiring to become educators. In this study, we examined sports-instructor training programs at universities of physical education using a case study.
Methods: We conducted a practical study on instructor training courses at departments of health and physical education. We included para sports among the practical courses that students enrolled in. We created an amputee-soccer program based on partial and total learning. The participants were freshmen university students who were taking soccer courses, and several of them were asked to participate in semi-structured interviews. The data obtained from the interviews were analyzed by two specialists.
Results: As a result, we were able to divide the data into four categories:
1) Understanding of para sports: e.g., The interviewee knew about the existence of soccer for amputees.
2) Enjoying the game: e.g., Amputee soccer is just as enjoyable as soccer played by people without physical disabilities.
3) Application in regular soccer practice: e.g., Positioning the ball so that you can pass it off to another player at any time is important even in regular soccer.
4) Expertise as an instructor: e.g., The interviewee would like to introduce it to their own students in the future.
Discussion: Having students, who aim to join the ranks of the teaching staff at a department of health and physical education, experience para sports was effective not only in terms of sparking their interest in para sports but also in terms of deepening their knowledge of existing sports. Furthermore, it became an opportunity for them to contemplate how they would accept a student with disabilities and how they would conduct their classes. We will continue studying how this kind of learning through experience will affect further learning and student life.

CURRENT STATE AND ISSUES OF PARALYMPIC EDUCATION IN JAPAN: RESEARCH FROM THE PERSPECTIVE OF PRACTICAL SESSIONS OF PARA SPORTS

NAGATA, Y., MAEHANA, H., WATARI, T., SUZUKI, K., WATANABE, T.
JUNTENDO UNIVERSITY

Current State and Issues of Paralympic Education in Japan: Research from the Perspective of Practical Sessions of Para sports
Nagata,Y., 1 Maehana, H., 1 Watari, T., 1 Suzuki, K., 1 Watanabe, T., 1
1. Juntendo University, Japan
Introduction: Various policies are being proposed as Japan prepares for the 2020 Olympic and Paralympic Games that will be hosted in Tokyo. One of them is Olympic and Paralympic education. Recently, practical sessions of Paralympic sports (hereafter referred to as para sports) have been conducted at schools and other educational settings as part of Olympic and Paralympic education. However, the concept of Paralympic education itself is not clear, and the effects of practical para sports sessions on the participating students have not been elucidated. In this study, we summarize the concept of Paralympic education and examine the significance of practical para sports sessions.
Methods: We summarized the concept of Paralympic education based on literature obtained using the search engine on the National Institute of Informatics website. In addition, we conducted practical sessions of para sports for elementary and middle school students who were also asked to participate in a questionnaire-based survey, and several of them were asked to participate in semi-structured interviews.
Results: We were able to summarize the concept of Paralympic education based on the following 4 categories: awareness of Paralympic sports, understanding what a sporting event is, understanding what a disability is, and understanding what inclusive society is. Through practical sessions of para sports, the participants were able to experience the highly difficult and competitive, yet interesting, nature of para sports. However, their understanding of disabilities and inclusive society was limited.
Discussion: The effectiveness of using practical sessions of para sports as a means of providing Paralympic education was confirmed even by participants' opinions. However, many of the practical sessions currently conducted in Japan are limited to sports experience, which is similar to the practical sessions conducted in this study. In particular, an understanding of disabilities is also important in order to become an inclusive society. Further research on the content of the program is required to further improve Paralympic education.

TEMPORAL PARAMETERS OF RUNNING ON CRUTCHES OF THE ITALIAN AMPUTEE SOCCER TEAM

NIGRO, F.1, BARTOLOMEI, S.1, CORTESI, M.2, MERNI, F.1, DI MICHELE, R.1, CIACCI, S.1, FANTOZZI, S.3
UNIVERSITY OF BOLOGNA

INTRODUCTION: Amputee soccer (AS) is a relatively recent discipline, where six lower limb amputees play soccer in the field using crutches (CR). CR can be used for assisting the player in moving only. Biomechanical investigations focused on ambulation on CR has been previously examined from a biomechanical point of view but researches were focused on daily life activities (Opila 1987, Goh 1986). Sprinting on CR represents one of the most important motor task characterizing AS. The purpose of the present study was to assess the temporal parameters of running on CR using wearable inertial sensors (IS).
METHODS: 8 male AS players of the National Italian Amputee Football Team performed 3 trials of a 40 meters sprint wearing three IS. One was placed on L5 vertebra and the other two on one CR. Contact time and flight time of the athletes feet and CR were recorded by the IS and collected using Motion Studio software. Data recorded by the L5 IS were processed by MatLab using the algorithms proposed by Bergamini (2011). A specifically developed algorithm was used for the IS on the CR.
RESULTS: Running steps sequence differed depending on whether the athlete was or not already in motion. After some initial cycles, the step became regular and showed a common dynamic in all AS analysed. While the CR alternated between a single flight (mean value 66.7%) and a single support phase (mean value 33.3%), the foot made two support phases (23.6% and 23.5%) alternated with two flight phases (mean values 23.0% and 29.8%). The temporal phases identified during running on CR were explained as follow. The first foot contact with the ground was performed for balance recovery, while the second foot contact for the push. The first foot flight was short and was designed to allow the AS a better push on the ground during the second support phase. This strategy allows performing a second longer flight, that looks like a long-jump on CR. Similar to able bodied athletes, AS players searched for a double support and a double flight phases during the sprints, as if they wanted to keep the rhythm of a two legs runner. All athletes analysed chose the same synchronous running with CR pattern during sprint.

CONCLUSION: The main characteristics of this unique sport gesture is the alternation between the double flight and the double support phases. The development of a CR running model of performance could provide a useful tool for coaches and researchers.
REFERENCES: Bergamini E et al., (2012), Journal of biomechanics, 45(6), 1123-1126;
Opila KA et al., (1987), Journal of Biomechanical Engineering, 109(4), 285-290;
Goh JCH et al., (1986), Prosthetics and orthotics international, 10(2), 89-95.
Wieczorek M et al., (2015), Journal of human kinetics, 48(1), 133-139;

DEVELOPING AN ASSESSMENT BASED ON PHYSICAL FITNESS AGE TO EVALUATE MOTOR FUNCTION IN ELDERLY INDIVIDUALS

NAKAGAICHI, M.

SCHOOL OF HEALTH SCIENCES

INTRODUCTION: the purpose of this study was to identify a method for assessing physical fitness age that is easy to use with elderly women and to examine its validity.
METHODS: Principal component analysis was used to develop a formula of physical fitness age from four motor function variables. The subjects comprised 688 (75.7±6.0 years) elderly women, in order to develop a physical fitness scale. The formula for calculating physical fitness age was expressed as physical fitness age =−0.419× grip strength −0.096× balancing on one leg with eyes open −0.737×30 s chair stand +0.503× figure-of-8 walking test +0.47× chronological age +52.68.
RESULTS: Measures obtained from subjects in the frail elderly (n=11, 73.0±2.3 years) and exercise (n=10, 70.8±3.1 years) groups were used to examine the validity of the assessment. The mean physical fitness age of the frail elderly group (79.0±3.7 years) was significantly higher than its mean chronological age (73.0±2.3 years, p,0.05). The mean physical fitness age of the exercise group (65.6±3.1 years) was significantly lower than the chronological age (70.8±3.1 years, p,0.05).
CONCLUSION: These findings confirm that physical fitness age scores are applicable to frail and healthy elderly women. Physical fitness age is a valid measure of motor function in elderly women.

CORRELATES OF PHYSICAL ACTIVITY AMONG PRIMARY-SCHOOL BOYS DIAGNOSED WITH AUTISM SPECTRUM DISORDER

PAN, C.Y.1, SUNG, M.C.1, MA, W.Y.2, HUANG, C.Y.1, CHEN, P.L.1, CHU, C.H.1

NATIONAL KAOHSIUNG NORMAL UNIVERSITY

Introduction: Children with autism spectrum disorder (ASD) might be at particular risk for inactivity due to social and behavioral impairments associated with the condition. Low levels of physical activity (PA) may contribute to harmful health outcomes. To date, there is no clear evidence documenting the correlates of PA in children with ASD. The personal and social and/or family environment are important to facilitate healthy behaviors in these children. Therefore, the International Classification of Functioning Model (ICF) was used for the current study as the guiding conceptual framework (WHO, 2002).
Methods: Thirty-six families of children with ASD, aged 6-12, participated. Parents (n=36), siblings of children with ASD (n=19), and children with ASD (n=36) wore an accelerometer for 7 days and parents completed a PA support questionnaire. Two primary PA outcome variables were the daily overall PA and average time spent in moderate-to-vigorous PA (MVPA). Fundamental movement skills of children with ASD were assessed by using the Test of Gross Motor Development-2 (Ulrich, 2000). Pearson product-moment correlation coefficients were calculated to evaluate the relationships between each explanatory variable and childrens PA. When a variable was significant in the correlations, it was entered into the hierarchical multiple regression analysis. The probability level was set at $p < .05$.
Results: Findings of bivariate correlations indicate that (a) age ($r = -0.70$, $p < .01$) and fundamental movement skills ($r = 0.38$, $p < .05$) of children with ASD were correlated with time spent in MVPA, (b) sibling overall PA ($r = 0.58$, $p < .01$) and support ($r = 0.40$, $p < .05$) were positively associated with overall PA of children with ASD, and (c) parent PA and support, after-school sedentary pursuits of children with ASD, and peer support were not correlated with PA of children with ASD. Results of the hierarchical multiple regression analyses revealed that (a) childrens age explaining 47% of the variance in time spent in MVPA, and (b) siblings overall PA explaining 30% of the variance in overall PA of children with ASD.
Discussion: Consistent with findings in children with and without disabilities, child age was significant factors affecting PA of children with ASD. As expected, sibling PA was a significant predictor of PA in children with ASD. It was surprising that neither parent modeling nor support were strongly related to or predictive of children with ASD PA. Resources to promote PA based on personal and family environmental factors are needed for this population.
Acknowledgments
Supported by Taiwan MOST grants 106-2410-H-017-022-MY3.
References: Ulrich, D. A. (2000). Test of Gross Motor Development: Examiners manual (2nd ed.). Austin, TX: Pro-Ed.
WHO (2002). Toward a common language for functioning, disability and health: ICF The international classificaion of cuntioning, disability and health. Geneva, Switzerland: WHO.
Contact: chpan@nknu.edu.tw

DEVELOPMENT OF NEW ESTIMATION FORMULA BASED ON ASTRAND-RYHMING STEP TEST PROTOCOL FOR VO2MAX EVALUATION OF ADOLESCENTS (13-18 YEARS)

SONG, J.R., LEE, S.H., KIM, Y.J., KIM, S.J., KWAK, H.B., KIM, C.S., SHIN, Y.A., PARK, D.H.

INHA UNIVERSITY, DONGDUCK WOMEN'S UNIVERSITY, GRADUATE SCHOOL DANKOOK UNIVERSITY

INTRODUCTION: Validity and reliability of the Step test have been examined in several studies (Beutner et al., 2015; Hansen et al., 2016; Astrand and Ryhming, 1954), but mainly in Westerners. To date, the Step test has not been validated using Korean population. The purpose of this study was to develop and validate regression models to estimate maximal oxygen uptake (VO2max) from the new estimation formula based on Astrand-Ryhming step test protocol (AR protocol) in Korean male and female youths aged 13-18 years.
METHODS: One hundred twenty participants performed maximal graded exercise test (GXT) on a treadmill and Astrand-Ryhming step test (AR test) to measure VO2max and VO2max estimates, respectively. Participants in the validation study performed the GXT with the stationary metabolic cart and the Astrand-Ryhming step test twice for test-retest reliability. All tests were conducted at least three days apart and in a random order.

RESULTS: Mean calculated VO2max (40.43±11.57 mL/kg/min) from the Astrand-Ryhming step test equation was significantly low from that measured during the GXT from stationary metabolic cart (47.32±8.75 mL/kg/min, p<.01). New regression equations were developed from present data to predict VO2max for male and female youths: y = (-13.963 × sex) – (0.216 × W) – (0.072 × HR) + 91.296 (r=.772, SEE=5.64 mL/kg/min). The VO2max (47.22±6.76 mL/kg/min) of modified Astrand-Ryhming step test equation showed no significant difference from the VO2max measured through GXT.
CONCLUSION: It is concluded that this equation developed in this study provides valid estimates of VO2max of Korean male and female youths aged 13-18 years. A further study needs to develop a step test estimation equation targeting adults and elderly people in which validity and reliability are secured.

Biomechanics

FATIGUE EFFECT ON BIOMECHANICAL PARAMETERS OF TRAIL RUNNING.

CIACCI, S.1, TOTTI, V.1, BARTOLOMEI, S.1, STELLA, F.1, NIGRO, F.1, FANTOZZI, S.2

UNIVERSITY OF BOLOGNA

INTRODUCTION: Fundamental biomechanical parameters in trail running are step length (SL) and frequency (SR), contact (CT) and flight time (FT), and shock attenuation (SA) (Derrick et al., 1998). SA is considered a significant indicator for injury prevention (Mizrahi et al. 2000) and is influenced by several factors such as fatigue and foot strike pattern (Giandolini et al. 2014). The aim of the present study was to investigate the effect of fatigue on the kinematic parameters of step and SA during downhill trial running.
METHODS: Eleven well trained participants (10 men and 2 women, age: 31.5±11.4 years, height: 173.9±5.6 cm, mass: 34.1±6.5 Kg) were enrolled. Four inertial sensors (EXLs3, 200 Hz) were attached to the pelvis, tibia, heel and second metatarsal head of the foot (Giandolini et al., 2014). Data were collected during a 290m downhill running (mean inclination 13°). The task was performed before and after an 18km trail running and filmed by a videocamera (Panasonic HC-V700, 50hz). The self-selected running speed was similar in both pre- and post-trial acquisitions. 854 steps were analyzed. For each step, the following parameters were estimated SL, SR, step time (ST), CT, FT, SA, center of mass acceleration (CA), tibial acceleration (TA) and foot strike pattern (Giandolini et al. 2014).
RESULTS: Reduced FT (p<0.009) and CA (p<0.047) were found comparing pre- and post- trial acquisitions. TA and FT (r=-0.664) and TA and SA (r=0.818) were found to be correlated. Considering foot strike pattern, forefoot strike decreased both TA and CA with respect to midfoot (p=0.013 and 0.013, respectively) and rearfoot strike (p=0.015 and 0.013, respectively). Comparing post- with respect to pre-trial acquisition, athletes used more the forefoot strike pattern (+7.38%).
CONCLUSION: According to Mercer et al. (2002), the reduced SL, enhanced by a lower FT with similar SR and velocity, leaded to a lower TA. This result is confirmed by the negative correlation between FT and TA and by the positive correlation between TA and SA. Forefoot strike sustained the significant reduction of TA, according to DeWit et al. (2000). In the fatigued condition, the athletes tended to diminish FT and to use a forefoot strike pattern with the aim of reducing the impact of the tibia to the ground.
References: De Wit B, De Clercq D, Aerts P. (2000). J Biomech, 33(3), 269-278.
Derrick TR, Hamill J, Caldwell GE. (1998). Med Sci Sports Exerc, 30(1), 128-135.
Giandolini M, Poupard T, Gimenez P, Horvais N, Millet GY, Morin JB, Samozino P. (2014). J Biomech, 47(7), 1588-1593.
Mercer JA, Vance J, Hreljac A, Hamill J. (2002). Eur J Appl Physiol, 87(4-5), 403-408.
Mercer JA, Bates BT, Dufek JS, Hreljac A. (2003). J Sports Sci, 21(11), 911-919
Mizrahi J, Verbitsky O, Isakov E, Daily D. (2000). Hum Mov Sci, 19(2), 139-151.

RELATIONSHIP OF RESISTED SLED SPRINTING, BODY MASS AND MAXIMUM STRENGTH

SMIRNIOTOU, A., KESOGLOU, I., PANTELI, F., THEODOROU, A.

KAPODISTRIAN UNIVERSITY OF ATHENS

INTRODUCTION: Research studies and track coaches indicate the importance of the resisted sled sprinting as a crucial training aid for sprinters' work outs. Various sled loads as a percentage of athlete's body mass(BM) have been under investigation, based on the fact that the larger muscle mass can produce greater muscle output. This study aims to identify the relationship of sprinting acceleration(SA) and maximum velocity(MV) phases with different sled loads to the BM and the maximum strength(MS).
METHODS: Eight 400m male track athletes (20-27yrs), with 5 years' experience of training/ competition, participated. They were tested on 2 separate days. The 1st day an anthropometric assessment (height 1.78±0.6m, BM: 76.8 ± 3.8kg) and an MS test (half-squat 1RM:172.5 ± 10.84kg) were carried out. 2nd day athletes were randomly assigned to complete unloaded and loaded (10%,15% & 20% of BM) 50m sprints. EMG activity of gastrocnemius, bicep femoris, rectus femoris, lateral femoris & max gluteus was recorded. 0-30m set as the SA and 30m to 50m as the MV phase. The repeated-measures analysis used to determine if any significant differences existed between conditions and Pearson (r) used for bivariate analysis.
RESULTS: The loaded conditions significantly affect both the SA (F=120.14, p<.001) and the MV phase, (F=44.16, p<.001). BM is positively related(r=.66) to MS as well as BM shows significant and negative correlation to the unloaded SA phase (r=-.867, p=.025). MS also indicates moderate to weak correlations to SA for all conditions. Finally, the MS is related positively but no significantly to the MV of 15%BM(r=.52) and 20%BM(r=.53) conditions.
CONCLUSION: Squat 1RM correlated with MV when loads more than 10%BM were applied, thus, stronger athletes tend to sprint faster under loaded conditions. But as the BM increases the unloaded acceleration time gets slower. The EMG activity is differentiated depending on the sprinting phases and the load of the weighted sled.
References: Martínez-Valencia M, et al. (2015). J Hum Kin, 46(1), 139-148
Petrakos G, et al. (2016). Sports Med, 46, 381-400
Morin JB, et al. (2017). Int J Sports Phys Perf, 12(6), 840-844
Nedeljkovic A, et al. (2009). Int J Sports Med, 30(2), 100-106
Contact: asmirn@phed.uoa.gr

COMPARISON OF LOWER LIMB SEGMENTS KINEMATICS IN A TAEKWONDO KICK ON DIFFERENT ANGLE OF ELECTRONIC BODY PROTECTOR

TSUN-TE LIU.1.2, JUNG- SAN CHANG.1, YI-CHUN LIN.1, WEN-TZU TANG.1

NATIONAL TAIWAN SPORT UNIVERSITY / TAMKANG UNIVERSITY

INTRODUCTION: The most used technique to score in taekwondo competition.is the roundhouse kick directed to the thorax . In combat, the actions of opponents are.unpredictable,.Velocity and accuracy of kick are important factors that help in achieving victory . Additionally, to generate enough impact energy to score points on electronic protectors, a high linear velocity of leg segments is required . Therefore, the aim of this study was to analyze the peak velocity of lower limb segments by roundhouse kicking in three different angle of EBP.
METHODS: An EBP (Daedo) was used for the experiment. Eleven TKD male athletes were asked to perform the roundhouse kick five times within three different impact angle in the thorax area . The linear velocity of the pelvis (anterior superior iliac spine), knee (lateralcondyle of femur), ankle (lateral malleolus) and CG foot (Center of Gravity of foot) during the kicking phase were recorded for comparisons.
RESULTS: The results revealed a significant difference in pelvis. Comparative analysis within three different impact angle for the pelvis segment. In 90◦ impact angle demonstrated greater linear velocity than 30◦impact angle.
CONCLUSION: Previous research suggest that during the roundhouse kick in taekwondo inter-segment motion seems to be based on a proximo-distal pattern.. In the present study, we analyzed the peak velocity of lower limb segments by roundhouse kicking in three different angle of EBP , with the evidence showing that the pelvis, plays a main role increased the foot segment reaching the highest peak velocity of kicking leg. In order to generate enough impact energy to score points on electronic protectors, a high linear velocity of pelvis segments is required.

THE COMBINED EFFECT OF THIGH MUSCLES STRENGTH ASYMMETRY AND FMS SCORE LEVEL TO CYCLISTS POSTURAL STABILITY AND PERFORMANCE DURING SPRINT CYCLING

RANNAMA, I., PEDAK, K., REINPÕLD, K., PORT, K.

TALLINN UNIVERSITY

INTRODUCTION: The core muscles state affects cycling kinematics (Abt et al, 2010), but relationships with the performance are unclear. It is found that knee extensors and upper-body movement asymmetry affects negatively sprint cycling performance (Rannama et al, 2015), but is the effect of asymmetry depending also on cyclists body functional state? The aim of the present study was to investigate combined effect of cyclists Functional Movement Screen (FMS) score level and existence of thigh muscles asymmetry (ASY) to postural stability and performance during 30 sec sprint cycling.
METHODS: 33 competitive road cyclists (18.5±2.0 y.; 1.82±0.07 m; 74.1±7.4 kg) were categorized based on FMS test (Cook et al, 2006) results in low (LS, n=17; FMS≤14) and high (HS, n=15; FMS>14) score group and based on thigh muscles bilateral isokinetic testing in symmetry (SYG, n=21; ASI<10%) and asymmetry (ASG, n=12; ASI>10%) group. The pedalling power (POW in W/kg) was captured during 30s isokinetic (100 rpm) seated sprint cycling test. The Cyclus2 ergometer was mounted on Kistler force plates and cyclists' postural stability (PS) indexes were computed by normalizing the standard deviation of GRF (Ground Reaction Force) with produced POW measured during 30 sec. The two-way MANOVA was performed to measure the combined effect of FMS score level and ASY existence to linear combination of PS and POW. Significance level was set to $p<0.05$.
RESULTS: The FMS level did not had ($p=0.79$) main effect to combination of PS and POW, but asymmetry existence had main and also existed combined effect of 2 factors to cycling performance. The Cyclist in LS had significantly higher POW in SYG (10.7±0.8 W/kg) than in ASY (9.7±0.8) group, but no differences were in HS (10.4±0.9 v 10.0±0.3). Also there was different direction effect of asymmetry to LS and HS. The cyclists' in LS group improved PS with asymmetry existence but in HS the existence of asymmetry caused more postural swaying.
CONCLUSION: The results of present study indicate that the effect of thigh muscles strength asymmetry to sprint cycling performance is depending on cyclist's upper body functional state. Low FMS level with combination of thigh muscles asymmetry reduce sprint cycling performance, but for cyclists with high FMS score it will cause more swaying on the bicycle. This supports our previous findings between 5 sec. sprint performance and knee extensors and upper body kinematics asymmetry (Rannama et al, 2015).
REFERENCES:
Abt et al. (2007) J Strength Cond Res, 21(4), 1300-1304
Cook et al. (2006) . Int J Sports Phys Ther, 9(3), 396-409
Rannama et al. (2015) J Hum Sport Exerc, 9(1): S247-S258

EFFECTS OF WHOLE-BODY VIBRATION TRAINING ON DYNAMIC BALANCE IN OLDER PERSONS WITH LOCOMOTIVE SYNDROME: A RANDOMISED CONTROLLED TRIAL

FUJITA, K.1, OGASAWARA, I.2, HASHIZUME, K.2, SHIMAMOTO, H.1, NAKATA, K.2

OSAKA UNIVERSITY

INTRODUCTION: Locomotive syndrome (LS) is defined by the Japanese Orthopaedic Association as a functional disorder of movement. Whole-body vibration (WBV) training has been used to improve dynamic balance in older persons with LS. However, prior studies did not adequately document the training effects of WBV on dynamic balance (Bogaerts et al., 2007, 2011). We previously reported that dynamic balance measurement of average and peak centre of pressure (COP) velocity in the two-step forward test (2ST) might be useful for predicting the risk of LS in older persons (Fujita et al., 2016). This study examined the effects of a 12-week WBV intervention on dynamic balance measured using COP parameters in the 2ST in community-dwelling older persons with LS in Japan.
METHODS: After baseline measurement, we randomly assigned 31 older persons with LS (12 men, 19 women; 74.3±6.7 years) to an intervention (WBV; n = 15) or control (CON; n = 16) group. The WBV group received 27 training sessions using a vibration platform (Power Plate®) over 12 weeks. The outcome measures in this study were the length, and average and peak velocities of COP after the second-step landing in the 2ST. These parameters were analysed for 3 intervals separated by 100 and 200 ms. Analysis of covariance adjusted for age, sex, and body mass index was used to assess between- and within-group differences.
RESULTS: The length of the COP in the second step of the 2ST tended to decrease in the WBV group but increased significantly in the CON group ($p < 0.01$), with a significant between-group difference ($p < 0.05$). A similar tendency was observed in the width of the COP in the sagittal direction. The mean COP velocity in the second step of the 2ST decreased significantly in the WBV group ($p < 0.05$) but tended to increase in the CON group, with a significant between-group difference ($p < 0.01$). The most significant change in mean COP velocity in the WBV group was found after 201 ms ($p < 0.05$). A similar tendency was observed in the mean COP velocity in the sagittal direction.

Peak COP velocity tended to increase during the 20–100 ms and 101-200 ms intervals, and showed a decreasing tendency after 201 ms in the WBV group, but an increasing tendency during all intervals in the CON group.
CONCLUSION: This is the first report of the effects of WBV training on dynamic balance using measurement of COP parameters during the 2ST in older persons. In the WBV group, some COP parameters improved after landing in the 2ST. These findings suggest that WBV training has the potential to enhance dynamic balance in older persons with LS.
REFERENCES:
Bogaerts, A. et al. (2007). Gait & Posture, 26(2), 309-316.
Bogaerts, A. et al. (2011). Gait & Posture, 33(3), 466-472.
Fujita, K. et al. (2016). The Japanese Journal of physical fitness and sports medicine, 5(6), 527.
CONTACT:
fujita@celas.osaka-u.ac.jp

INFLUENCE OF KNEE HYPEREXTENSION ON UNDERWATER DOLPHIN KICK PERFORMANCE

IIZUKA, S., TORII, S., KANEOKA, K.

WASEDA UNIVERSITY

INTRODUCTION: Hyperextension of the knee joint is observed in swimmers with increased joint laxity. Knee hyperextension is thought to enhance performance, but this has not been verified. Therefore, this study investigated the effect of knee joint laxity on underwater dolphin kick performance.
METHODS: This study included 17 elite male college competitive swimmers. All subjects performed an underwater dolphin kick at a maximum speed from the swimming pool wall. LED markers were placed on the greater trochanter, popliteal fissure, lateral malleolus, and toe. A high-speed camera was placed in the water. Knee and ankle angles were measured, and swimming speed was calculated using movement analysis. Joint angles and swimming speed were examined using Pearsons product-moment analysis.
RESULTS: Knee hyperextension (r=0.43, p=0.09) and ankle plantar flexion had significant positive effects on swimming speed (r=0.43, p=0.08). The smallest knee angle (r=0.54, p=0.03) showed a significant positive correlation with swimming speed. During swimming, an increase in resistance leads to a decrease in swimming speed. It is thought that resistance is produced in the femoral region, and increased knee flexion causes deceleration. Both the knee and ankle are necessary to achieve high propulsive force. Articular flexibility is necessary to transmit energy from the trunk to lower extremity efficiently when the whip-like underwater dolphin kick is performed.
CONCLUSION: Knee hyperextension, the smallest knee angle, and ankle plantar flexion were correlated with the speed of the underwater dolphin kick.

NEUROMUSCULAR CHARACTERISTICS DURING DOLPHIN-KICK SWIMMING AND ITS FUNCTIONAL IMPLICATION OF ELASTIC UTILIZATION.

SANO, K.1, DANNO, Y.2, ISHIKAWA, M.2

1: RITSUMEIKAN UNIVERSITY, 2: OSAKA UNIVERSITY OF HEALTH & SPORT SCIENCES

INTRODUCTION: The joint flexibility and long muscle fascicles are characteristics by competitive swimmers. Therefore, it is expected that their muscle behavior can specifically play important roles during swimming. On land, impact force can be utilized as the storage and release of elastic energy during terrestrial gait. The specific muscle-tendon interaction has been examined during human running and jumping (e.g. Ishikawa & Komi 2008). In swimming, however, it remains questionable how swimmer can enhance the swimming efficiency and whether elastic strain energy is utilized during swimming. Without impact forces, it is not clear how human can utilize the muscle and tendon elasticity during swimming. Therefore, the purpose of the present study was to examine the muscle-tendon behavior together with EMG activities of vastus lateralis muscles (VL) during the human dolphin-kick of swimming.
METHODS: In the swimming pool, each subject (n=8) performed the 25 m dolphin-kick swimming with two different speeds (normal (NORMAL) and maximal effort (FAST) conditions). Surface EMGs in the VL and biceps femoris (BF) muscles as well as the knee joint angular data by goniometer were measured. In addition, fascicle lengths of VL were measured by using ultrasonography. Instantaneous muscle-tendon unit (MTU) length of VL during swimming were estimated by knee joint angular data. The tendinous length of VL was calculated by subtracting the horizontal part of fascicle length in the direction to the aponeurosis from the MTU length.
RESULTS: In the dolphin–kick swimming, stretching and shortening amplitudes of the VL MTU length did not show any differences for both NORMAL and FAST. The VL EMG was activated from the late MTU stretching (up-beat phase) and the early MTU shortening phases (down-beat phase). The stretching and shortening amplitudes of the VL tendinous length were increased significantly in FAST than in NORMAL. Instead, the amplitudes of the VL fascicle length were smaller in FAST than in NORMAL.
CONCLUSION: During dolphin-kick swimming, the VL fascicles and tendinous tissues can perform a stretching-shortening action (Komi 1992). Therefore, the tendinous elasticity can play important roles not only on land but also under water.

COMPARISON OF CONTRACTILE PROPERTIES ON RECTUS FEMORIS AND BICEPS FEMORIS MUSCLES AMONG TRACK AND FIELD ATHLETES.

TSUNODA, N.1, HIRATSUKA, K.1, MIYAZAKI, D.1, SIMUNIC, B.2, DJORDJEVIC, S.2

1: KOKUSHIKAN UNIVERSITY , 2: UNIVERSITY OF PRIMORSKA

INTRODUCTION: The Tensiomyography (TMG) method as non-invasive technique was developed to evaluate the contractile properties of selective muscle (Dahmane et al., 2006). Measurements of muscle belly responses to electrical stimuli (TMG method) have revealed differences among athlete (Loturco et al., 2015). However, characteristics of contractile properties in Track and field athletes are not clear by TMG method. Therefore, in this study, it is to clarify the contractile properties of thigh muscles in sprinters, long distance runners and throwers.
METHODS: Seventy male collegiate athletes of sprinters (SP; n=19; mean ± SD age, height and weight were 20.0±1.8years; 173.2±4.4cm and 64.8±5.1kg), long distance runners (LDR; n=24; mean ± SD age, height and weight were 19.6±1.0years; 170.8±5.7cm and 55.5±4.2kg) and throwers (TH; n=27; mean ± SD age, height and weight were 20.4±1.9years; 177.9±5.7cm and 89.7±12.9kg). The contractile properties of rectus femoris (RF) and biceps femoris (BF) in thigh were assessed by TMG method. Contractile properties of contraction time (Tc), maximal displacement of the muscle belly (Dm) and normalized velocity (Vrn) were analyzed in each groups.

RESULTS: In TH, Dm of RF obtained lowest value among the each groups. Tc of RF in LDR was observed long contraction time. Whereas, Tc for RF in SP and TH were significant shorter contraction times than LDR. And also, same values of Vrn were observed on SP and TH. In LDR, Dm of BF obtained highest value among the each groups. Tc for BF in LDR were significant longer contraction times than SP and TH. Dm of RF/BF ratio in SP and TH were significantly higher value than LDR. Tc of RF/BF ratio in LDR were significantly lower value than LDR. And Tc of RF/BF ratio in SP and TH were showed same values.
CONCLUSION: In this study, contraction properties for rectus and biceps femoris in throwers were significantly different to the long distance runners. Also, the ratio of RF per BF on Tc and Dm in throwers and sprinters were showed significantly higher values to the long distance runners. From these results, it was considered that Tc as a contractile properties on knee extensor and flexor muscles in thigh may reflect to the muscle fiber composition in athletic events.

THE EFFECT OF BALL TEMPERATURE ON BALL SPEED AND CARRY DISTANCE IN GOLF DRIVES

CARLSSON, T.1, NILSSON, J.1,2, HELLSTRÖM, J.3, TINMARK, F.2, CARLSSON, M.1

DALARNA UNIVERSITY

INTRODUCTION: Previously it was reported that golf-ball temperature has influence on the golf balls' coefficient of restitution, impact duration, and maximal deformation (Allen et al., 2012). They concluded that their research was the first step in a process for determining the effect of temperature on a golf drive. However, how large influence the golf-ball temperature has on golf drives remains to be investigated. The purpose was to investigate the effect of ball temperature on impact ball speed and carry distance during golf drives in a blind randomized test design.
METHODS: The balls were exposed to a temperature-controlled environment (4°C, 18°C, 32°C, and 46°C) for twenty-four hours prior to the test, and each of the four different ball-temperature groups consisted of 30 balls. The 120 drives were performed by an elite male golfer (handicap: 0.0) in an indoor driving range. All drives were measured by a Doppler-radar system to determine club-head speed, launch angle, spin rate, ball speed, and carry distance. Differences between the four ball-temperature groups were investigate using a one-way analysis of variance.
RESULTS: The results indicate that there are ball-speed and carry-distance differences within the four ball-temperature groups ($P < 0.001$ and $P < 0.01$, respectively). The post-hoc analyses showed that the ball temperatures 18°C and 32°C had both greater ball speeds and carry distances compared to the balls in the ball-temperature groups 4°C and 46°C (all $P < 0.05$); the intervals for the between-group differences were 2.0 to 2.4 km/h and 2.9 to 3.9 m for ball speed and carry distance, respectively.
CONCLUSION: The novel results of the current study show that the ball's temperature has a significant effect on the ball speed after club-head impact and carry distance for drives performed by an elite golfer. The ball temperatures 18°C and 32°C gave significantly increased ball speeds and carry distances compared to the ball-temperature groups 4°C and 46°C. This knowledge could be used to maximise the carry distance and/or to minimise the carry-distance variability related to ball temperature.
REFERENCES:
Allen T, Bowley A, Wood P, Henrikson E, Morales E, James D. (2012) Procedia Eng, 34, 634-639.

CROSS-SECTIONAL INVESTIGATION OF AGE-RELATED DEVELOPMENT OF SKATING MOTION IN JAPANESE SPEED SKATERS

YUDA, J.1, YOKOZAWA, T.2

1: JAPAN WOMENS COLLEGE OF PHYSICAL EDUCATION, 2: JAPAN INSTITUTE OF SPORTS SCIENCES

INTRODUCTION: Skating velocity is affected by external power output of a skater, as well as air and ice resistances. In addition, skaters can attain skating speed by propulsive support leg extension in a crouched skating posture with a small knee and trunk angle. Therefore, both power output and lower limb technique are important for speed skaters. This study identified the characteristics of age-related development of skating motion in speed skaters.
METHODS: In total, 118 skaters <67 men and 51 women> provided informed consent and served as study subjects. The skaters participated in a 500-m speed skating competition in Japan or a time trial. The subjects were divided into 6 groups based on their age for each sex. However, senior skaters were divided into 2 groups based on the average 500-m race time. The age groups for men were as follows: 9.8 ± 0.4 y, 11.6 ± 0.5 y, 14.1 ± 0.7 y, 16.8 ± 0.9 y, 20.1 ± 1.4 y, 23.4 ± 3.8 y; the groups for women were 9.4 ± 0.5 y, 11.8 ± 0.4 y, 13.9 ± 0.8 y, 16.8 ± 0.9 y, 21.3 ± 4.4 y, and 24.0 ± 3.9 y. Skaters were videotaped with 3 synchronized high-speed video cameras <300 fps> positioned at the middle of the home straight <~50 m from the start line>; the recorded images were analyzed using a panning direct linear transformation technique. The three-dimensional coordinates of the segment endpoints and blades were determined to calculate the kinematic variables during the right stroke.
RESULTS: Tilt angles of the body and shank of the right support leg increased gradually during the right stroke in both men and women. These findings indicate that skaters push the ice sideward, with the body and shank tilting in a medial direction. From the middle to the end of the stroke, the tilt angles gradually increased with growth in both men and women.
CONCLUSION: Greater tilt angles of the body and shank from the middle to the end of the stroke are important in the development of skating performance in the straight phase. It was found that this technical ability gradually increased with growth.

ANTHROPOMETRIC CHARACTERISTICS AND VERTICAL JUMP HEIGHT IN CLASSICAL BALLET DANCERS

RAKOVAC, M.1, SAJKOVIC, D.1,2

1: UNIVERSITY OF ZAGREB, FACULTY OF KINESIOLOGY , 2: UNIVERSITY CLINIC OF TRAUMATOLOGY

INTRODUCTION: Vertical jump ability is an indicator of lower limb power, important for performance in many sports activities (Caia et al., 2016). Vertical jumping is also an integral element in classical ballet performance (Wyon et al., 2006). Many factors possibly influencing vertical jump height in classical dancers have been previously studied (Wyon et al., 2006). However, the influence of different anthropometric measures has not yet been thoroughly explained. The aim of the study was to investigate the relationship between the selected lower limb anthropometric characteristics and vertical jump height in professional ballet dancers.
METHODS: The participants were professional classical ballet dancers, members of the ensemble of the Croatian National Theatre in Zagreb (n=37, 24 females; age (mean±SD) 31.8±7.8 yrs; height 170.2±7.5 cm; body mass 58.6±10.3 kg). Pelvic width, thigh length, lower leg length, foot length, thigh girth, calf girth and Q-angle were measured. Vertical jump ability was tested by Sargent jump test. A multiple

regression analysis with vertical jump height as criterion and anthropometric parameters as independent variables was performed using a forward stepwise procedure.
RESULTS: The average vertical jump height was 43.6±9.9 cm. The results of the regression analysis indicated four predictors explaining 51% of the variance in vertical jump height (R2=0.51, F(4,32)=8.22, p<0.0001). The anthropometric characteristics significantly predicting vertical jump ability were foot length (beta=0.33, p=0.028), calf girth (beta=0.66, p=0.001), thigh girth (beta=-0.49, p=0.012), and Q-angle (beta=-0.27, p=0.048).
CONCLUSION: Expectedly, foot length was positively related with vertical jump height, but the previously determined relationship between other longitudinal leg dimensions with jump height was not confirmed. While larger lower leg muscle mass, indicated by a larger calf girth, was positively related with jump height, there was a significant negative relationship between thigh girth and jump height, a result discordant with previous studies (Wyon et al., 2006). This result could possibly be attributed to a positive relationship between thigh girth and body fat percentage, previously indicated as a negative predictor of jump height (Caia et al., 2016). Increased Q-angle can be related with both decreased jumping performance and increased risk of knee injuries (Russell, 2013).
REFERENCES:
Caia et al. (2016). J Strength Cond Res, 30(11), 3073-3083.
Russell (2013). Open Access J Sports Med, 4, 199-210.
Wyon et al. (2006). J Dance Med Sci, 10(3-4), 106-110.
CONTACT:
marija.rakovac@kif.hr ; dubravkasajkovic@gmail.com

A NEW CALIBRATION METHOD FOR ESTIMATING SCAPULAR POSTURE DURING SHOULDER MOVEMENTS

MATSUMURA, A., UEDA, A., NAKAMURA, Y.

GRADUATE SCHOOL OF HEALTH AND SPORTS SCIENCE

INTRODUCTION: The acromion marker cluster is a standard technique used for the measurement of scapular posture. The AMC was attached to the skin overlying the flat portion of the acromion. A motion capture system was used to locate the AMC and to estimate scapular posture. When the arm elevation angle exceeded 120°, the estimation error for scapular posture increased. Therefore, this conventional method cannot adequately represent complex shoulder movements, including activities of daily life and sporting motions. The aim of this study was to develop a new calibration method using scapular posture measurements during shoulder movements. This enabled scapular posture for shoulder movements in ADL to be estimated.
METHODS: Ten healthy males were recruited. A motion capture system recorded the location of the AMC and the position of anatomical landmarks on the scapula, humerus, and thorax. To estimate scapular posture, the positional relationship between the AMC and the landmarks was calibrated. To derive calibration tables, the AMC and the landmarks were measured in 10 positions including 0° and 180° of arm elevation, and 90° and 150° of arm elevation in each elevation plane. The calibration tables used spline interpolation. The location of the AMC, the arm elevation angles, and the elevation plane angles were inputted into the calibration tables. The conventional method , was used as the reference; with a fixed relationship between the AMC and the landmarks at an arm elevation angle of 0°.
To evaluate the accuracy of the new and conventional methods, four tasks , were applied. The International society of biomechanics recommendations were used to calculate scapular angles. To determine the differences between our method and the conventional method, the root mean square error was calculated for each task.
RESULTS: Our new method decreased the RMSE of all the scapular angles, as compared with the conventional method. The RMSE for our method was approximately 5° . For tasks requiring greater arm elevation angles , the RMSE of our new method was less than that of the conventional method.
CONCLUSION: The positional relationship between the AMC and the landmarks was not constant across shoulder positions due to soft tissue artifacts, particularly when the arm was elevated above 120°. Therefore, the error associated with the conventional method increased. Our new calibration method could improve this estimation error, since it considered the positional relationship between the AMC and the scapular landmarks using several shoulder movements with >120° of arm elevation in each elevation plane.

DETERMINE UPSTAIRS AND DOWNSTAIRS MOTION WITH IMU SENSOR

SHIANG, T.

NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: Researchers can estimate people's daily physical activity and energy expenditure by counting their total number of steps in a day. However, for a single step, energy expenditure can differ considerably during upstairs and downstairs walking. In addition to level walking, common walking patterns include stairs walking. Previous studies have shown that the motion characteristics among the aforementioned walking types differ considerably regarding the angle of the trunk and limbs, ground reaction force, landing strategy, stride frequency, and step length, despite identical motion phases. This is because different motions and strength can have distinct effects on muscle stimulation and energy expenditure. Therefore, the purpose of this study was to identify differences of upstairs and downstairs walking by using an inertial measurement unit (IMU) to improve the accuracy of daily physical activity assessment.
METHODS: Thirty healthy participants were recruited for this study. The IMU was stabilized on the exterior of the left shoe. Participants were asked to perform normal walking under 3 distinct conditions: level walking, upstairs walking, and downstairs walking. The IMU chip used in this study was an MPU6050 (InvenSense, CA, USA), the sampling frequency was set at 100 Hz. Repeated measures one-way ANOVA was used to determine the differences of signal features among the three conditions.
RESULTS: The results revealed significant differences in most axial directions of the three walking conditions except for the angular velocity of inversion–eversion (G–X) during the HS phase and the angular velocity of internal–external rotation (G–Y) during the TO phase. Specifically, the results of the angular velocity of dorsi–plantar flexion (G–Z) in the HS phase completely conformed to our expectations ($p < .01$). Combining the results of the angular velocity of dorsi–plantar flexion in the HS and toe-off phases or the results of the angular velocity of dorsi–plantar flexion and anteroposterior acceleration in the HS phase can facilitate more precisely determining the differences among the three conditions.
CONCLUSION: The signal feature of the IMU can be used to identify walking patterns under different conditions such as up and downstairs. A dual-index approach such as the angular velocity of dorsi–plantar flexion in the ankle joint during the HS phase combined with the acceleration of anteroposterior direction, or with the angular velocity of dorsi–plantar flexion in the TO phase can facilitate a more accurate differentiation of similar patterns under different conditions. The techniques designed for identifying movements in different

terrains can more accurately calculate physical activity levels and can be utilized in the fields of sports medicine and rehabilitation for recording the daily activities.

Coaching

THE EFFECT OF CHANGE IN THE DIRECTION OF A MALE SWIMMER'S FACE DURING THE SETTING BEFORE THE START SIGNAL ON HIS START PERFORMANCE IN COMPETITIVE SWIMMING

TAKASHI, K.

NATIONAL INSTITUTE OF FITNESS AND SPORTS IN KANOYA

INTRODUCTION: In the swimming start phase, it is reported that the head of swimmer reaches 15m distance point early if the swimmer increases the horizontal velocity at the front foot-off and approaches the take-off angle forwards horizontal (Takeda et al., 2006; Yoshida and Saito, 1981). Regarding the start action, various improvement methods are founded. However, few of them are unclear. This study focused on a posture with the swimmers face turning in an anterior direction before the start signal. Hence, the purpose of this study was to clarify the effect of change in the direction of a male swimmer's face during the setting before the start signal on his start performance in competitive swimming.
METHODS: Six Japanese male college swimmers participated in this study. The subjects performed 6 trials of the competitive start. The first half is their usual start (US). The second half is the start with their faces turning forward during setting before the start signal (FS). The subjects were instructed to perform each start with maximum effort, followed by a 15 m freestyle swim. Trials were recorded at 250 fps using two synchronized high-speed cameras (MEMRECAM FX-K5, nac, Japan) equipped.
RESULTS: The results of 15-m time were 7.09 ± 0.18 s (FS), 6.97 ± 0.30 s (US) respectively. No significant difference was recognized between FS and US, but the time of US tended to be shorter than FS. In the experiment, only subject B reached 15 m distance point in FS faster than US. Those results were 7.28 s (FS), 7.46 s (US) respectively.
A decrease in subject B's take-off angle brought about the outcome. The other subjects tended to take off downward in both FS and US. However, subject B had a tendency to take off obliquely upward in US. On the other hand, he was inclined to take off linearly in FS. Additionally, his flight distances in FS and US were almost the same. Thus, it is indicated that 15-m time became shorter in FS because the distance was shorter from his start position to his entry position due to his face which was turned upward. Consequently, FS can be effective for competitive swimmers like subject B who have a tendency to take off upward.
CONCLUSION: It was clarified that the change in the direction of a male swimmer's face during the setting before the start signal don't always have an effect on his start performance.

BIOMECHANICAL ANALYSIS OF VOLLEYBALL OVERHEAD PASS WITH DIFFERENT DISTANCES

OZAWA, Y.

WASEDA UNIV.

INTRODUCTION: Volleyball overhead pass is an important skill for setting a ball to attackers. The higher the performance of setters, the higher the performance of attackers (Nikolaos et al. 2009). However, there is no biomechanical investigation of the overhead pass. In this research, we investigated the difference in movements of the elbows and wrists, and in activities of the muscles responsible for these joint movements during overhead passes of three different distances.
METHODS: Four male subjects participated in this study. All of them were top level university volleyball players. Subjects were told to pass a ball with overhead pass into a ring (diameter: 1 m, height: 2.43 m) set at 3, 6 or 9 meters ahead from a subject. They repeated trials at each distance until they times. Forty-one reflective markers were placed on the ball and the subject's body to obtain joint centers and joint angles. EMG activities were recorded from the Triceps Brachii (TB), Biceps Brachii (BB), Extensor Carpi Ulnalis, and Flexor Carpi Radialis (FCR).
RESULTS: The contact time the duration from ball touch to ball release, did not differ among 3 m, 6 m and 9 m. And there was no common tendency in the contact time among subjects. While a subject had the longest contact time in the 3 m trials, another subject had the longest contact time in the 9 m test. The elbow angular velocity had also no common tendency. In the TB, all subjects had lower activity for the 3 m trials than the other distances. In the 3 m trials, the angular velocity of the wrist tended to be lower than the other distance in three subjects. In all tests, the onset time of FCR activity occurred tens of milliseconds before the ball touch in all subjects. The rise in FCR activity was slowest in the 3 m trials, and fastest in the 9 m trials.
CONCLUSION: There was no clearly difference in the contact time among three different target distances. However, the longer the target, the higher the TB activity. In addition, the longer the target, the steeper the FCR activity was. The subjects controlled the distance of overhead pass not by controlling the contact time but muscle outputs, especially that of the FCR, just after ball touch when the wrist pull the ball, and the adjust the activity of the TB during the contact of the hands and the ball.

Health and Fitness

MODERATE AEROBIC EXERCISE OR HIGH INTENSITY INTERVAL PROGRAMS: WHAT'S BETHER TO THERAPEUTIC IN OBESE BOYS?

LEITE, N., PIZZI, J., MILANO-GAI, G.E., SCHIAVONI, D., RADOMINSKI, R.B., MOTA, J.

FEDERAL UNIVERSITY OF PARANÁ AND UNIVERSITY OF PORTO

INTRODUCTION: Physical activity was used as preventive and therapeutic actions to obese and comorbidities in pediatric population. The aim of this study was to compare the effect of 12-week intervention using two aerobics programs on anthropometrics, body composition and cardiometabolic parameters in obese adolescents.
METHODS: Fifty-six boys, aged 10 to 16 years, with body mass index Zscore ≥2 were evaluated. Weight, height, systolic blood pressure and diastolic , waist circumference , waist-to-height ratio , body composition, direct maximal oxygen uptake relative and absolute , heart rate at rest , glucose, insulin, triacilglycerol , total cholesterol and fractions HDL-c and LDL-c were assessed at the beginning and after 12 weeks. Homeostasis Metabolic Assessment and Quantitative Insulin Sensitivity Check Index were determinated. Participants were divided into three groups: aerobic moderate , high intensity interval training and control group . AMG bout session consisted of 45-minute indoor cycling and 45-minute walking, starting first weeks with 35-45% of heart rate reserve and progressive increasing up to 50-60%. HIITG bout session consisted of 45-minute with exercises of heating, HIIT in the form of race/walk indoor, with interval intensities of 100% and

50% of HRreserve, and the cooling phase at the end. Exercise groups performed three times a week, totalizing 36 sessions. Control group was only engaged in physical education at school. All participants were followed for 12 weeks and took part in nutritional guidance. ANOVA was used for comparisons at baseline and after 12 weeks and the effect size was calculated for each group, to compare the magnitude of each type of physical exercise.
RESULTS: No statistical significant differences were found between groups at baseline, except for BMI-Zscore and WHtR higher in HIITG and fat mass lower in AMG . After 12-weeks, exercises groups presented a significant reduction in HRrest and, respectively AMG and HIITG, the EF <0.77 vs 0.40>, and increase in height <0.33 vs 0.07>, VO2ml/kgmin <0.88 vs 0.15> and VO2l/min <0.33 vs 0.12>. Only AMG showed a significant reduction in BMI , BMI-Zscore , WC , WHtR , FM in % and kg , TG and an increase in HDL-c . HIITG presented a significant reduction in TC and DBP and an increase in LDL-c . CG increase only height .
CONCLUSION: Regular PA such as aerobic or HIIT provides health benefits in cardiorespiratory fitness. The HIITG presented some clinical improvements, but the AMG was able to improve modifications in anthropometric, body composition and cardiometabolic parameters, and higher ES. We concluded that moderate aerobic exercise presented better therapeutic response in obese boys.

INHIBITORY CONTROL PERFORMANCE AND LEPTIN RESPONSE TO ACUTE MODERATE-INTENSITY INTERVAL EXERCISE IN OBESE SEDENTARY FEMALE ADULTS

WEN, H.J., ANG, B.S.

1:TZU-CHI UNIVERSITY, 2:UNIVERSITI SAINS MALAYSIA

INTRODUCTION: Obesity is a concerned public health problem and contributes to huge medical expenses . It is frequently accompanied by a subclinical systemic inflammation which is marked by the increase in circulating levels of leptin . It's also associated to adverse neurocognitive outcomes and reduced brain volume. Currently, moderate-intensity interval exercise is a popular exercise modes that combine aerobic exercise and resistance training, which was effectively reduced body weight and percentage of body fat in a shorter time . The purpose of this study was to explore the acute effect of MIIE on inhibitory control performance and leptin response in obese sedentary female adults.
METHODS: Nineteen age-matched obese and normal weight female adults were recruited for this study. Both groups were required to attend a single bout specifically designed 30 minutes supervised MIIE. Percentages of body fat and cardiovascular endurance were determined within one week before the MIIE. Blood samples and behavioral performance were obtained before and 2-hour after the 30 minutes supervised MIIE. The MIIE program consists of 5 minutes warm-up, 30 minutes interval training at 55% of heart rate reserve and 5 minutes cool down. There were 4 cycles in a session, and six sets per cycle, 1 minute per set, 15 seconds break between each set. The exercise intensity was monitored to ensure the participants reached the target HR.
RESULTS: The results showed that at baseline, the OG was significant higher in percentage body fat and leptin levels than CG, but no difference in cardiovascular endurance . On the inhibitory control performance, both groups have a similar high accuracy rate in both condition, and the accuracy rates were sustained after the 30 minutes of MIIE. However, the reaction time in OG was significantly improved after the 30 minutes of MIIE , but no change in CG . The serum concentration of leptin in both groups were significantly decreased after the MIIE session , and no change in C-reactive protein concentrations.
CONCLUSION: The leptin in obese females were significantly higher than that in normal weight. The effect of a single bout of 30 min MIIE showed an acute effects on the inhibitory control, which improved the reaction time, and reduced leptin levels. The long-term effects of MIIE were recommended for further study.

LIPID AND GLYCEMIC PROFILE OF EUTROPHIC, OVERWEIGHT AND OBESE SCHOOL ADOLESCENTS

RIBEIRO DA SILVA, A., LURDES CENCI TSUKUDA, V., MARIA BACELAR SANTOS, L., EMANOELLA SILVA MARTINS DE SOUZA, S., LEÔNIDAS SOARES, J., LINS DE MAGALHÃES, G., DE FRANÇA BARROS, J.

UNIVERSIDADE DE BRASÍLIA

INTRODUCTION: Objective: of this work was to evaluate the changes on the lipidic and glicemic profile in adolescents with overweigh and obesity compared to eutrofic group.
METHODS: The criterion for the diagnose was the body mass index suggested by Cole et al., <2000>. The association between waist circumference. The first part of the study 769 students were evaluated and from wich were selected 133 adolescents, aged 12 to 18 years old, of both sex, distributed in eutrofic , overweight and obese . In these groups were measured lipoproteins, glucose, body mass index, triceps and subscapular skinfold waist circumference.
RESULTS: Showed that overweigh and obesity leads to an increase in blood levels of total cholesterol, LDL cholesterol, and triglycerids and a decrease in HDL cholesterol levels. Glucose level increased only in the femmale group. The waist circumference, a visceral fat indicator, was also associated with an abnormal lipid profile but not with increase in glucose level.
CONCLUSION: This work emphasyses the needs to inget public health measures to control overweigh and obesity among adolescentes.

EFFECT OF EIGHT WEEKS MODIFIED HIGH-INTENSITY CIRCUIT TRAINING USING BODY WEIGHT ON BODY COMPOSITION IN SEDENTARY OBESE WOMAN

AJJIMAPORN, A., WIDJAJA, W., KHEMTONG, C.

COLLEGE OF SPORTS SCIENCE AND TECHNOLOGY, MAHIDOL UNVERSITY, SALAYA CAMPUS, NAKHON PATHOM

INTRODUCTION: It is well documented that a sedentary lifestyle along with poor eating behavior is directly associated with obesity. Exercise prescription is one of the powerful treatments for this population offered by healthcare providers. However, physical training for obese people should consider safe movements without pain or risk for injury but with an intensity and duration aimed to improve body composition. Positive effects of high-intensity circuit training design using body weight (BW) as the only form of resistance (HICTBW) on health-related fitness conditions have been observed in recreationally active men and women (Schmidt et al., 2016). The aim of the present study was to examine the effects of 8 weeks modified HICTBW program on body composition parameters in sedentary obese women.
METHODS: Twenty-four sedentary obese females (age = 34±4 years, BMI = 27±7 kg·m-2) were randomly assigned into 2 groups: a HICTBW group (n=12) and a control group with no training (n=12: CG). Participants in the HICTBW group performed 8-weeks, 3 times weekly, a modified HICTBW training which consisted of 30-sec work and 10-sec rest for 12 exercise positions per 1 round, continuously increased by 1 round every 2 weeks. Whereas CG group performed the usual physical activity for 8 weeks. Both groups were advised not

to change their dietary habit throughout the program. Body composition including BW, fat mass (FM), skeletal muscle mass (MM), visceral fat area (VF), and percent body fat (%BF) was measured before and after the 8-week training program.
RESULTS: At baseline, no differences for all parameters were observed between the two groups. Post-training, improvements for the HICTBW group were observed for FM, MM, VF and %BF ($p<0.05$) but not BW ($p>0.05$) compared to baseline values. No changes were observed for the CG group from baseline to week 8.
CONCLUSION: This study showed an improvement in body composition and prevention of weight gain from 8 weeks of a modified HICTBW program in previously sedentary obese women. A HICTBW program seems to provide benefits for sedentary obese women and the exercises may be performed daily as the program is simple, inexpensive, practical, and seemingly low risk for injury.
References:
Schmidt D, Anderson K, Graff M, and Strutz V J (2016). Sports Med Phys Fitness 56: 534-540.
This study was funded, in part, by the research grants from Physical Activities Research Center (PARC), Thai Health Promotion Foundation and the Faculty of Graduate Studies, Mahidol University, Thailand.
Contact:
[amornpan.ajj@mahidol.ac.th]

COMPARISON OF DAILY SEDENTARY TIME BETWEEN CHILDREN ENGAGING IN MORE AND LESS THAN 2-HOUR SCREEN TIME

OKAZAKI, K.1, KOYAMA, Y.2, OHKAWARA, K.3

1: TOHOKU-GAKUIN UNIV. , 2: SEIKEI SENIOR HIGH SCHOOL , 3: UNIV. OF ELECTRO-COMMUNICATIONS

INTRODUCTION: The questionnaire of the Health Behaviour in School-aged Children (HBSC) is one of the commonly and widely used questionnaires to evaluate sedentary behaviour (SB). This study aimed to objectively measure and compare SB assessed via the HBSC questionnaire in Japanese children.
METHODS: A total of 94 children (boys=46 and girls=48) from the fourth to the sixth grade were asked to complete the questionnaire and wear a traxial accelerometer for more than seven consecutive days. The HBSC questions (Morgan et al, 2016; Booth et al., 2001) asked children to report three type of screen-based SB patterns on weekdays and weekends. Responses to these types of SB were summed separately for weekdays and weekends to calculate average daily screen time. Following this, children were classified into the low sedentary group (LS; ≤2 hrs per day) and high sedentary group (HS; >2 hrs per day). The minimal amount of objective data on SB that was considered acceptable was 4 days of wearing time with at least 10 waking-hours per day, including at least one weekend day. Children's mean time spent in objective SB was calculated for weekdays and weekends.
RESULTS: Among the children who completed the study on week days (N=87), there was no significant difference in the mean time spent on SB per day between LS (429 min) and HS (429 min) in the independent t-test. Similarly, the mean time spent in SB on weekends (N=71) did not differ significantly between LS (476 min) and HS (462 min).
CONCLUSION: Our findings suggested that the amount of SB per day between LS and HS on weekdays and weekends did not differ among Japanese children. One possible explanation for this finding is that the HBSC questionnaire evaluated screen-based patterns focusing on media use only. Therefore, whether SB assessed via the HBSC questionnaire can reflect objectively measured SB per day needs further discussion. Although screen-based SB, including watching TV, using a computer, and playing video games, is becoming a central component of the daily lives of children (Tremblay et al, 2011), it is possible that there are no differences in the amount of daily SB among children who are classified as 2 h cut-off value's recommendation (Barlow, 2007).
References:
Morgan K, Hallingberg B, Littlecott H, Murphy S, Fletcher A, Roberts C, Moore G (2016) BMC Public Health, 16, 569.
Booth M, Okely A, Chey T, Bauman A (2001) Br J Sports Med, 35(4), 263–267.
Tremblay M, LeBlanc A, Kho M, Saunders T, Larouche R, Colley R, Goldfield G, Gorber S (2011) Int J Behav Nutr Phys Act, 8, 98.
Barlow S (2007) Pediatrics, 120, 164-192.
Contact:
Kanzo Okazaki, Ph.D., Tohoku-gakuin Univ. [kokazaki@mail.tohoku-gakuin.ac.jp]

ASSESSMENT OF A SHORT-FORM FALL RISK QUESTIONNAIRE FOR COMMUNITY-DWELLING ELDERLY PEOPLE

SONG, C.Y., TSAUO, J.Y., FANG, P.H., FANG, I.Y., CHANG, S.S.

NATIONAL TAIPEI UNIVERSITY OF NURSING AND HEALTH SCIENCES

INTRODUCTION: The worlds population is ageing. Fall prevention is an important global health issue in long-term care. This study aimed to develop a practical fall risk assessment questionnaire for identifying high-risk fallers in the community.
METHODS: Three hundred and forty-four community-dwelling individuals (73 men and 271women) aged 65 years or older who voluntarily participated in a community- and exercise-based fall-prevention program were assessed with a 12-item fall risk questionnaire (FRQ) (Rubenstein et al., 2011) to evaluate risk factors associated with falls.
RESULTS: Of the participants, 136 (39.5%) experienced at least one fall in the previous year (average fall= 1.7 times). The FRQ scores were higher in fallers than in non-fallers (5.7 and 2.3, $p<0.005$). The item score of gait/balance problems, muscle weakness, fear of falling, and incontinence was significantly different between fallers and non-fallers (all $p<0.05$). The area under the receiver operating characteristic curve for the simple sum of the 6 significant items was 0.65 ($p<0.05$). The best cutoff point was 2, with sensitivity and specificity of 62.9% and 61.1%, respectively. Logistic regression analysis showed the odds ratio= 2.68 ($p<0.001$).
CONCLUSION: This study found the risk factors associated with falls for community-dwelling elderly people which contribute to development of early preventive exercise interventions in community settings. Future research may explore psychometric properties of the 6-item short-form of the FRQ for assessing risk of falling.

EFFECT OF RESPIRATORY STRETCH GYMNASTICS FOR SENIOR CITIZEN PEOPLE.

AKAE, K.

TOKYO ARIAKE UNIVERSITY OF MEDICAL AND HEALTH SCIENCES

INTRODUCTION: Respiratory patterns are influenced and altered by various emotional changes. In the present study, that we investigated how respiratory patterns differ from individual to individual during quiet breathing.

METHODS: We examined the State-Trait Anxiety Inventory (STAI) and various respiratory parameters in 13 healthy male subjects. Subjects sat on a chair wearing a facemask with a transducer connected to a respiratory monitor for measuring respiratory pattern and metabolism in a quiet room. All statistical analyses were performed with commercially available statistical package (SPSS). A P value of <0.05 was considered statistically significant. Pearson's correlation coefficient (r) was used to study the relationships between trait anxiety and state anxiety or various respiratory parameters.
RESULTS: Tidal volume was significantly larger and respiratory rate (RR) was significantly higher in both the higher trait (HT) and higher state (HS) anxiety groups compared to the lower trait (LT) and lower state (LS) anxiety groups. There was no significant difference in minute ventilation (VE) between these two groups. End-tidal CO2%, heart rate (HR) and oxygen uptake (VO2/W) also showed no significant differences.
CONCLUSION: These results suggest that the respiratory rhythm reflected by RR is affected by the activity generated in the higher center in accordance with the level of trait and anxiety during quiet breathing in awake humans. The study showed that respiratory rate and anxiety score has an undivided relationship. Second, we examined how respiratory stretch gymnastics affect on RR and anxiety score. 70 senior citizen in Kawaguchi city were participated in this study. RR and state anxiety score were decrease after performing the respiratory stretch gymnastics. The results suggest that the respiratory stretch gymnastics is an useful gymnastics for senior citizen people to decrease anxiety.

FATS ARE HIDING UNDER CLOTHES! ~STUDY ON THE BODY COMPOSITION OF ELDERLY WOMEN IN THE EXERCISE CLASS~

NISHIZAWA, T.

SIGAKKAN UNIVERSITY OF JUNIOR COLLEGE

INTRODUCTION: We measured the fat balance (abdomen, upper limb and lower limb) of the elderly women participating in the exercise class. Aims To verify relationships between physical activity (steps per day) and obesity (components of body composition) among postmenopausal women.
METHODS: Obesity were assessed among 23 healthy postmenopausal women (54-85years). With regard to the body build, obesity was diagnosed based on weight, BMI (the body mass to the square of the body height), and waist-hip ratio (WHR, i.e. the circumference of the waist to hips; ratio above 0.85 means abdominal obesity). We measured the fat balance (abdomen, upper limb, lower limb) of the elderly women, using the body composition analyzer InBody 430 (Biospace Co.). The amount of physical activity was measured using a Lifecoder (suzuken Co.)for 2 months. Physical test was measured for elderly women at the first and 2 months after exercise class. Items were sit up, balance, walking for 6 minutes(endurance), walking with obstacles and grip strength.
The exercise classroom was held for 2 months. The program content was a 30-minute aerobics and resistance circuit. On the circuit training, I made three laps of sit-up, push-up, side raise, arm curl and rat pull-down. Exercise time was 1 minute exercise and 30 seconds rest.
RESULTS: The results of WHR showed 40% above 0.85. The BMI result was obesity 18%, standard 82%. The fat balance for each part by number of people was abdominal fat percentage high 57%, standard was 43%, low value was 0%. The results of upper limbs and lower limbs were standards for everyone. The value after 2 months was 57% for high, 40% for standard and 3% for low value. The average number of steps per day was 75**%** with more than 5,900 steps and 25**%** with less than 5,900 steps. As a result of the physical fitness test after 2 months, 6 minutes walking (endurance) and walking of obstacles improved. Sit up could not be done by six people. There was no change even after two months.
CONCLUSION: There was no significant change in body composition in the exercise class for 2 months. The results showed that while BMI was normal and fat percentages in upper limbs and lower limbs were standard, there were many people with abdominal fat. In addition, the amount of physical activity was not low. Therefore, degree of obesity should not be judged by BMI or the body composition of the whole body, and fat percentage by body part must be emphasized. Fats are hiding under clothes. One of the reasons why fat in the lower abdomen of elderly women is large is considered to be a decrease in female hormone associated with menopause. Also, it may be one of the causes that sit up can not be done.

TRAINING INDUCED IMPROVEMENTS IN STRENGTH OF THE KNEE EXTENSORS IS ASSOCIATED WITH INCREASED PHYSICAL ACTIVITY LEVEL 4 YEARS AFTER TRAINING IN ELDERLY MEN

BERNTSEN, S.1, BJØRNSEN, T.1, LOHNE-SEILER, H.1, STEA, T.H.1, PAULSEN, G.2

1. UNIVERSITY OF AGDER, KRISTIANSAND, NORWAY, 2. NORWEGIAN OLYMPIC SPORT CENTER, OSLO, NORWAY

INTRODUCTION: Skeletal muscle power and strength are important determinants of physical function in older adults, and strength-training induced increases in the power and strength of the leg muscles is associated with increased walking speed. However, whether such training induced improvements in the legs translates into a more physically active lifestyle in the long run is unknown. The aim of the present study was to determine whether increases in leg muscle strength and -size during 12 weeks of strength training are correlated with objectively recorded physical activity level and sedentary time four years after training, in elderly men.
METHODS: Thirty-five elderly males (64 – 85 yrs old) participated in a supervised heavy-load strength training regime (2/wk with 8-10RM load and 1/wk with 3-5RM or 13-15RM) for 12 weeks, Muscle strength, -tickness, lean mass of the legs and objectively recorded physical activity were measured before and after the strength training period, as well as four years after the training period. Muscle size was assessed as changes in lean mass with Dual Energy X-ray absorptiometry and thickness of m. rectus femoris and m. vastus lateralis with ultrasound imaging. Strength was measured as 1-repetition maximum (1RM) in leg press and knee extension. Physical activity was recorded by the activity monitor SenseWear™ Mini (BodyMedia inc, US) for seven consecutive days. Data were analysed using Spearman rank correlation.
RESULTS: Percentage increase in knee extension during 12 weeks of strength training was significantly and positively correlated to moderate-to-vigorous intensity physical activity (ρ=0.49, p=0.003), but negatively correlated to sedentary time (ρ= -0.49, p=0.003), four years after training. Neither improvements in leg press, lean mass of the legs nor muscle thickness were correlated with moderate-to-vigorous intensity physical activity or sedentary time.
CONCLUSION: Improvements in knee extensor muscle strength during twelve weeks of strength training seems important for maintenance of a physically active lifestyle in older adults, suggesting that physical activity programmes may need to include strength exercises involving knee extensors. Our findings should be confirmed in a ranomized controlled setting with a control group not participating in strength training.

EFFECTS OF AQUATIC EXERCISE ON METABOLIC SYNDROME RISK FACTORS, CARDIOVASCULAR FITNESS, KNEE ISOKINETIC FUNCTION, AND WOMAC INDEX IN PATIENTS WITH OSTEOARTHRITIS WOMEN

YOON, J.R., HA, G.C., YOO, C.G.

KOREA NATIONAL SPORT UNIVERSITY

INTRODUCTION: Purpose: The purpose of this study was to investigate to effects of aquatic exercise on metabolic syndrome risk factors, cardiovascular fitness, knee isokinetic function, and WOMAC index in patients with osteoarthritis women.
Purpose: The purpose of this study was to investigate to effects of aquatic exercise on metabolic syndrome risk factors, cardiovascular fitness, knee isokinetic function, and WOMAC index in patients with osteoarthritis women.
METHODS: Method: The subjects were 19 women who were osteoarthritis. Aquatic exercise program has performed the 60min per day, 3days per week. The changes of body syndrome risk factors, cardiovascular fitness, knee isokinetic function, and WOMAC index were measured and analyzed at pre- and post- exercise program for verifying exercise effectiveness.
RESULTS: Result: The results were as follows; After 12 weeks of exercise program, % fat, fasting glucose, systolic blood pressure, and diastolic blood pressure were significantly decreased. Left and right extensor knee muscle function were significantly increased. In the WOMAC index, stiffness and physical activity were significantly decreased.
CONCLUSION: Discussion: In conclusions, aquatic exercise program showed beneficial effects on metabolic syndrome risk factor management, knee muscle function increase and WOMAC index improvement in osteoarthritis women.

FALLS IN ELDERLY PEOPLE PRACTICING PHYSICAL EXERCISE

FERNANDES, V.L.S., FREITAS, I.P., AUGUSTO, G., RODRIGUES, F.F., VENTO, D.A., TACON, K.C.B., MENEZES, R.L.

CENTRO UNIVERSITARIO DE ANÁPOLIS - UNIEVANGELICA

INTRODUCTION: Due to the repercussion on the health of the elderly, the fall is considered a limiting event, it is a public health issue, where there is a decrease in self-confidence which can lead to a lower level of physical activity, a reduction in muscle strength and, consequently, an increase in risk of falls. The aim of the study was to identify the incidence of falls and associated factors in active elderly participants of the Open University Project for Third Age - UniATI.
METHODS: Longitudinal study, approved CEP n. 1.456.257, the history of falls was evaluated with the following question: "Have you suffered a fall in the last 12 months?" The fall was recorded regardless of the severity of the injury. A questionnaire was applied to identify sociodemographic profile and health conditions. The Mini Mental State Examination (MMSE) served as a screening of cognitive function. Physical-functional tests, such as the Timed Up and Go (TUG) and Manual Hold Force (FMP) were used. Inferential analysis was performed with means, standard deviation, minimum, maximum, confidence interval, frequency and percentage. Comparison of the means of 'fallen" and "non-fallen" subgroups in the scalar variables (age, weight, height, BMI) using the Students T-test for the parametric variables and the Mann-Whitney test for the non-parametric variables.
RESULTS: A total of 146 subjects of both sexes, with cognitive preservation, participated in the study, most of them women (87%), mean age of 68 ± 2.90 years, BMI 27.37 ± 4.48. All subjects were active in practising physical exercise, at least twice a week, with an average duration of 40 minutes, being water gymnastics 60 (41%), bodybuilding 74 (51%) and zumba 12 (8%). The occurrence of falls in the last 12 months was present in 32.2% of the active elderly. Participants were classified into two subgroups, "fallen" (n = 47) and "non-fallen"(n = 99). The groups were homogeneous in relation to gender, age, and anthropometric variables, such as weight, height and BMI ($p > 0.05$). There was no significant difference for functional physical variables such as TUG and FPM between groups ($p > 0.05$). Variables that contributed to falls were personal / family income, living alone, and health conditions, such as diabetes, urinary incontinence, poor perception of health and vision, and hospitalization ($p<0.05$).
CONCLUSION: Falls are considered a public health problem, and even the healthy and physically active elderly are also vulnerable to falls, and the reasons can be associated with social and health issues. In the present study, one third of the elderly had a fall episode in the last 12 months, reinforcing data from the literature that states that the causes of falls are multifactorial and that the approach must involve a multiprofessional team.

INTEGRATED YOGA THERAPY ON QOL, HEALTH STATUS AND FITNESS OF LIFE IN SENILE PEOPLE

KIM, H.

DONG-EUI UNIVERSITY

INTRODUCTION: The purpose of this study was to investigate the effects of yoga therapy and integrated yoga program on the activities of daily living , muscle mass, mood state, physical fitness, and disease prevention in senile people. We also analyzed yoga program and yoga therapy through many experimental and review papers in terms of elderly exercise practices.
METHODS: In this purpose, we searched the Pubmed data base for the articles and review papers having the terms nonpharmacological therapy and yoga program in the elderly in the title, published from 2005 untill 2017. A total over 100 papers displayed, out of which almost 30 papers were closely relevant to this papers. All these data were selected and analyzed. Appropriated cross-references within the papers along with cochrane reviews were also examined.
RESULTS: In this paper, we analyzed and evaluated two main points such as the importance of yoga
therapy in the elderly and disease prevention of yoga program in the
elderly . This paper evaluated that yoga programs might be performed in the elderly people and elderly patients and also this program might help in the prevention of age-related degeneration by changing cardiovascular diseases, immunological disease, bone health, muscle function, autonomic function, brain function and even mental health.
CONCLUSION: These findings also indicate that yoga therapy improves many psychological outcomes, and enhance the QOL by improving their overall mental health status.This might be caused because the yoga practice resists the autonomic changes and celluar impairment in the elderly. Therefore, we have to consider adding yoga therapy to ongoing inpatient rehabilitation and participants recognized the benefits of having the yoga therapy. Further study about the disease treatment and the treatment mechanism of yoga program is needed in this area.

ASSOCIATION BETWEEN MUSCULOSKELETAL AMBULATION DISABILITY SYMPTOM COMPLEX (MADS) AND HABITUAL FISH AND SHELLFISH INTAKE IN COMMUNIY-DWELLING ELDERLY WOMEN

OHKI, K.

SUGIYAMA JOGAKUEN UNIVERSITY

INTRODUCTION: Regular physical activity is essential to better health and wellness. However, falls must be prevented, because they are prone to losing their balance during physical activities. Recent research has shown that older people who perform poorly on standardized tests of lower extremity strength and balance are at a higher risk of developing disabilities. It is well known that balance ability is one of the items of muscleskeletal ambulation disability symptom complex (MADS). Dietary habits also important factor in our heathy life. The purpose of this study is to clarify the association between MADS and dietary habits in Japanease community -dwelling elderly women.
METHODS: 94 local elderly women residents aged 65 yrs. or older were recruited. The subjects were divided into two groups: 1) one-leg standing time with eyes open for more than 15 sec. (high-level group; n=66, HG) , 2) one-leg standing time with eyes open for less than 15 sec. (low-level group: n=28, LG). Hand-grip strength, chair-stand test, functional reach test (FR), time up go test, 10-m maximal walking speed (MWS), mini-mental state examination (MMSE), trail making test (TMT), fall efficacy scale (FES), psychological functions and brief-type self-administered diet history questionnaire (BDHQ) were examined.
RESULTS: As the results, one-leg standing time with eyes open was 59.5+43.9 sec., and HG subjects, accounted for 70.7% of the total subjects. Significant differences ($p<0.05$) were observed in the age (HG;71.5+4.2, LG;74.3+4.4 yrs.), hand-grip strength (HG;29.6+6.2, LG;24.8+5.6 kg), FR (HG;79.6+8.2, LG;61.2+18.0 cm), MWS (HG;2.0+0.2, LG;1.8+0.2 m/sec.), MMSE (HG;28.5+1.9, LG;26.7+3.2 pts.) and FES (HG;37.6+3.9, LG;32.7+4.5 pts.) between the two groups. The results of BDHQ revealed that fish and shellfish intake (HG;60.1+43.3g, LG;10.6+3.5 g, $p<0.01$) were associated with physical function and MADS. When comparing the two groups after adjusting for age, a significant difference ($p<0.05$) was observed only in TMT (HG;92.2+22.0, LG;128.8+56.2 sec.).
CONCLUSION: It was suggested that the elderly women with lower level of balance ability and lower frequency of eating fish and shellfish were markedly influenced to their healthy life.

RELATIONSHIP BETWEEN ANTHROPOMETRIC VALUES, HEALTH AND PHYSICAL ACTIVITY PARAMETERS IN HEALTHY ADULTS AND ELDERLY PEOPLE

VIRGALA, J., ARIZAGA, N., ZARRAZQUIN, I., FERNÁNDEZ-ATUTXA, A., IZAGIRRE, A., MARTÍNEZ-LAGE, P., IRAZUSTA, A., KORTAJARENA, M.

UNIVERSIDAD DEL PAÍS VASCO

INTRODUCTION: Different authors have described the positive effect of the physical activity (PA) in cardiovascular disease (CVD) after doing PA interventions or observing population. The aim of this study was to observe PA patterns in a sample of adults and elderly individuals and health parameters related to CVD to determinate how does their everyday PA influence in the CVD risk.
METHODS: 374 people between 42 and 82 years participated in the study (Mage60.72 • 6.94). Blood samples were collected to measure the lipid profile (total cholesterol (TC), LDL-c, HDL-c,), glucose (GLU) and triglycerides (TG). Blood pressure (BP) was determined, anthropometry was measured (weight, height, waist circumference (WC)) and body fat percentage was measured by bioimpedanciometry. Body mass index (BMI) and waist-to-hip ratio were calculated and PA was assessed by accelerometers (Actigraph GT3X).
RESULTS: All the anthropometric parameters named before had negative correlation with HLD-c ($p<0.001$) and positive correlation with GLU, TG and BP ($P<0.001$).
When we analyzed PA, total counts, counts per minute (CPM) (MCPM 731.29±195.88), steps/day (Msteps/day 10150.62±3349.69) and moderate-to-vigorous PA (MVPA) min/day (MMVPAmin/day 53.84± 27.97) were negatively correlated with all the anthropometric parameters ($p<0.05$). Total counts, CPM and steps/day had positive correlation with HDL ($p<0.05$) and negative correlation with TG and GLU ($p<0.05$), except steps/day. Moderate PA (MPA) and MVPA min/day had negative correlation with GLU ($p<0.05$). BP only had negative correlation with vigorous PA (VPA) min/day ($p<0.05$).
CONCLUSION: Cigarette smoking, elevated BP, elevated TC and LDL-c, low HDL-c, Diabetes Mellitus and advancing age are described as the major independent Risk Factors for CVD. The American Heart Association describes obesity, abdominal obesity and physical inactivity as major predisposing risk factors (that worsen the independent ones). The correlations of our study between anthropometric and blood parameters also support some of the risk factors described before.
In our study, we have seen that people with lowers levels of PA had worse health parameters, which back the idea of the beneficial effect of the PA on obesity, and therefore in related disorders like hypertension and dyslipidemia.
Even though the risk of CVD decrease increasing PA, we have not almost found significant correlations between MVPA and the lipid profile and TG. That could be because not all the participants reach the recommended amount of steps/day or MVPA per week.
- Grundy SM, et al. (1999) .Circulation, 100: 1481–1492
- Gondim OS, et al. (2015). PLoS One, 10(10):e0140596.
- Williams PT. (2001). Med Sci Sports Exerc, 33(5):754–761.
- Riebe D., et al. (2015). Med Sci Sports Exerc, 47(11): 2473-2479

USING PHYSICAL ACTIVITY IN ACUTE PSYCHIATRIC INPATIENTS

CODRONS, E., BRONDINO, N., BARETELLA, G., BERGAMASCHI, G., DELFINO, F., PEZZULLO, M., FIZZOTTI, S., CORREALE, L., VANDONI, M.

UNIVERSITY OF PAVIA

INTRODUCTION: The benefits of physical activity for psychiatric patients are well known. However, there is a paucity of data regarding the use of exercise programs in inpatients, especially in patients admitted to a psychiatric ward for acute treatment. To the best of our knowledge, trials designed to test the effect of physical activity in inpatients involved patients hospitalized in residential facilities for minimum 6 weeks. To the best of our knowledge there is no evidence on the potential benefit of physical activity in acute psychiatric inpatients. We introduced physical activity in an open-label fashion in the routine of the psychiatric ward.
METHODS: For the first part of the trial (feasibility study), physical activity consisted in a one 1-h weekly session of supervised aerobic floor exercises. Patients participation during hospitalization was recorded. Mean hospitalization length, number of violent behaviors, necessity of seclusion, global clinical impression were recorded for both participants and patients who did not join the exercise program during

one year. We additionally measured the need for rescue medication in the night of the physical activity sessions was recorded for all patients.
RESULTS: From October to December 2017 80 patients were admitted in the psychiatric ward (75 had a single admission, while 5 had multiple admission)Patients who attended at least one session of physical activity did not differ significantly from those who did not participate in hospitalization length (15.75±9.37 vs 14.17±10.76, t=-0.64, p=0.52), severity of symptoms at baseline (CGI-S 4.80±0.95 vs 4.42±1.21, t=-1.15, p=0.26) or improvement (CGI-I 2.21±0.53 vs 2.33±0.70, t=0.63, p=0.53). We did not observe a significant correlation between the number of physical activity sessions and severity at baseline (r=0.09, p=0.54) or improvement (r=-0.02, p=0.88). Patients with comorbid substance abuse attended physical activity sessions more frequently than patients who did not abuse (Chi-square=5.25, p=0.02). No significant difference was observed between patients who attended physical activity sessions and patients who did not in the need of rescue medications for the night following the session (Chi-square=0.31, p=0.54).
Discussion:
These are the preliminary findings of an open-label study designed to test the effect of a physical activity program in an acute psychiatric ward. The study will continue for other six months and we will expect an improvement in patients symptoms and in the relationship between patients
and personnel.
References: Daley, A. J. Exercise therapy and mental health in clinical populations: is exercise therapy a
worthwhile intervention? Adv. Psychiatr. Treat. 8, 262-270 (2002).
Malchow, B. et al. The effects of physical exercise in schizophrenia and affective disorders.
European Archives of Psychiatry and Clinical Neuroscience 263, 451-467 (2013).

EFFECTS OF TWO DIFFERENT TYPES OF EXERCISE ON PHYSICAL PERFORMANCE IN HEMODIALYSIS PATIENTS

BOGATAJ, S., PAJEK, J., BUTUROVIC PONIKVAR, J., BUCAR PAJEK, M.

UNIVERSITY MEDICAL CENTRE LJUBLJANA

INTRODUCTION: Systematic literature review shows that physical activity has many positive effects on the health of dialysis patients. Many previous studies report the effects of intradialytic training on a customized ergometer, which can currently be considered as the gold standard of the training type for dialysis patients. The aim of this study was to determine the effect of functional exercise guided by a kinesiologist in addition to the basic exercise program of cycling during dialysis on physical performance of dialysis patients.
METHODS: Twenty-nine dialysis patients participated in the study. We first tested their physical condition with selected motor tests. Our main outcome measurements were: 6-minutes walking test (6MWT), 10 repetitions sit-to-stand test (STS10 test) and sit-and-reach test (SRT). After baseline testing we randomized patients in two groups - one experimental and one active control group. The exercise program for both groups was performed three times per week over the course of eight weeks. The experimental group attended a guided functional exercise before the dialysis procedure and after that performed a cycling session during dialysis. The active control group participated in intradialytic exercise program only (intradialytic cycling equal to cycling program of experimental group). Intensity of exercise was determined by Borg scale of perceived exertion. After eight weeks we repeated the baseline tests.
RESULTS: Twenty-seven patients completed eight weeks of training. Statistical analysis revealed that both groups have a statistically significant increase in 6MWT (experimental group (baseline: 510,08±68,69 m; after 8 weeks: 561,62±94,98 m; p=0,002), active control group ((baseline: 456,86±78,86 m; after 8 weeks: 487,07±76,16 m p=0,000)) and in STS10 test (for both groups: p=0,000) compared with baseline values. In SRT there was a statistically significant difference in experimental group (p=0,000), with no statistically significant difference in active control group (p=0,407) when comparing with their baseline values. When comparing both groups, we can see a greater increase in experimental group in STS10 test (p=0,004) and in SRT (p=0,001) compared to the active control group. There were no statistically significant difference between groups in 6MWT (p=0,053).
CONCLUSION: Both types of exercise are effective in improving aerobic endurance and strength of lower limbs. However we believe that, if we want to improve various motor skills, cycling during dialysis alone is not enough. Our research showed us that functional training led by kinesiologist in dialysis centre is practical, feasible and effective in improving the physical function of hemodialysis patients.

THE RELATIONSHIP BETWEEN FIRE FIGHTER PERFORMANCE AND BODY COMPOSITION

WILLIFORD, H., ALLEGRO, D., REILLY, E., RUSSELL, A., ESCO, M., NICKERSON, B., SCHAEFER, G.

AUBURN UNIVERSITY MONTGOMERY

INTRODUCTION: Fire fighting is a demanding occupation that requires a high level of performance and physical fitness. Fire fighters must be able to perform carrying heavy loads, and the weight of their turn out gear and SCBA may exceed 25kg. Research in our laboratory has shown that body composition is an important variable to consider as it relates to both the fire fighters health and performance. The purpose of this investigation was to evaluate the relationship of body composition to a simulated fire fighter job performance test (FFJP).
METHODS: Eighty-two male fire fighters performed a maximal FFJP test, wearing turn-out gear and self-contained breathing apparatus (SCBA). The test consisted of the following: stair climb, hoist, forcible entry, hose drag, and dummy drag. The results were recorded in seconds. In addition the fire fighters were evaluated in the laboratory for body composition by Bod-Pod. The body composition analysis included height (m), weight (kg), percent body fat (%), and fat free mass (FFM).
RESULTS: The descriptive statistics included M and SD: age 34.9 ± 7.5 (yrs), height 1.81 ± .06 (m), weight 96.37 ± 10.05 (kg), percent fat 25.13 ± 6.09 (%), and FFM 71.81 ± 6.45 (kg). The total time to complete the FFJP test was 262.57 ± 48.61 (sec). Pearson correlation was performed between FFJP and each of the body composition variables including percent fat ($r = 0.42$, $p = .000$) and FFM ($r = -0.46$, $p = 0.00$). The multiple regression analysis produced two significant models. Model 1 included FFM and explained 21% of the variance ($R2 =.21$, $F(1,81)=21.33$, $p<.01$), ($\beta = -3.48$, $p<.001$). Model 2 included FFM and percent fat which explained 31% of the variance ($R2=.31$,$F(2,81)=17.68$, $p<.01$), ($\beta = -2.83$, $p<.001$, FFM), and ($\beta = 2.59$, $p<.001$).
CONCLUSION: The results of this investigation found significant a significant negative relationship between FFM and FFJP and a significant positive relationship between percent fat and FFJP. This indicates that FFM is a positive predictor of performance while body fat is a negative predictor of performance. The nature of fire fighting requires the fire fighter to perform at a high level while carrying a significant amount of weight in addition to the body fat that is stored in the body. Fire fighters should attempt to develop or maintain a high level of FFM with low percent body fat in order to perform at optimal levels.

INFLUENCE OF PILATES ON THE MENTAL AND PHYSICAL HEALTH BY EVALUATING AUTONOMIC NERVOUS FUNCTION

MURAKAMI, K.

KOKUGAKUIN UNIV

INTRODUCTION: "Pilates" is an exercise done by sleeping or sitting on the mat, aiming to develop a body that is easy to move with no distortion by balancing the whole body muscles while utilizing the breathing method. From the Pilates practitioner, there are voices saying that besides improving the physical function, it has effects on mental stability and relaxation. Although the effect of improving physical function is clear, there is no research that report an objective evaluation of "mental stability effect". Therefore, in this study, we aimed to observe the mental and physical influences due to Pilates by evaluating autonomic nervous function and to obtain objective data to prove that Pilates is an effective exercise for mental and physical health.
METHODS: 1. Subjects
We targeted 4 adult women who regularly participated in a 60 minute Pilates lesson from November 2016 to April 2017. A subject W, 26 years old, is diagnosed with autonomic imbalance. Regarding the subject, we decided the period when the subjective symptoms appeared, February - June 2016, was taken as the first half of W, and the symptoms improved, November 2016 - March 2017, was taken as the latter half of W. Three other subjects Y (31 years old), K (46 years old), N (55 years old) are healthy adult women.
2. Measurement items
Acceleration pulse wave measurement system Altet (made by Yumedika) was used for autonomic nerve function measurement, and acceleration pulse wave was recorded before and after the lesson was performed. LF and HF values were obtained by software in the system, LF / HF values were calculated and evaluated as "index of stress". In addition, the heart rate variation coefficient (CV %) was obtained and it was taken as "ability to respond to stress".
RESULTS: Table 1 and Table 2 show the average value and standard deviation of the LF / HF value and CV% before and after the lesson, and also show the t-test results. As shown in Table 1, as a result of comparing before and after the lesson, the subject W was evaluated as "a normal state" of the later value 2.1 from the evaluation of the "strong stress state" of the previous value 7.2. Subject N has significantly changed from 2.0 "normal condition" to 0.69 "very relaxed state" ($p < 0.05$), which can be inferred that Pilates caused a relaxation effect. As shown in Table 2, when comparing CV% as well, the values of CV% showed a tendency to rise in all the subjects after the lesson than before the lesson. There was a clear increase in subjects W and N in particular. Because CV% reflects the overall autonomic nervous activity and tends to rise at the time of mental health improvement and fatigue degree recovery, Pilates is presumed to have a beneficial effect on "mental and physical health ". Moreover, comparing the data of the first half and the second half of the subject W who continuously observed for one year, the autonomic nervous function improvement were found that the LF / HF value before the lesson decreased from 7.21 to 1.86 and the CV% increased from 2.89 to 3.76.
CONCLUSION: 1. If the LF / HF value shows a high value before the lesson, a tendency to show a low value after the lesson was confirmed.
2. In the heart rate variability coefficient (CV%), it increased after the lesson and the tendency that the autonomic nerve activity became active was confirmed.
From these results, we could obtain objective data that prove mental stability and relaxation effect by Pilates.

MASSAGE INTERVENTION USING MASSAGE CHAIR DECREASES BLOOD PRESSURE

YAMAMOTO, K.

TEIKYO HEISEI UNIVERSITY

INTRODUCTION: Massage is often used to facilitate recovery from fatigue in sports. On the other hand, a recent systematic review suggested that massage is useful for lowering blood pressure in hypertensive patients. The present study investigated whether a 4-week massage intervention by a massage chair decreases blood pressure or not.
METHODS: Systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate (HR) were measured every week during the course of study in a massage group (n=6) and before and after the 4-week period in a control group. The massage group was massaged for 4 weeks, 3 days a week, and the duration of massage was 30 min. The massage chair is designed for a full body massage from neck, shoulders, and arms to feet, calves, and buttocks. This massage chair scans the whole body curve and makes adjustments, focusing on the lumbar, neck and shoulders. The control group led normal lives during the 4-week period.
RESULTS: The 4-week massage intervention decreased SBP from 138±5 (mean ± SE) to 129±6 mmHg ($P<0.01$) and DBP from 84±6 to 76±6 mmHg ($P<0.01$). SBP (132±6 mmHg) and DBP (79±6 mmHg) at 3rd week were not significantly lower than those measured before the massage intervention began in the massage group, suggesting that the massage intervention requires at least for 4 weeks to decrease blood pressure. HR did not change during the intervention period. There were no significant changes in SBP, DBP and HR in the control group during the 4-week period.
CONCLUSION: These results indicate that the massage intervention using massage chair decreased blood pressure. Hypertension is a global problem that typically presents as an asymptomatic, cardiovascular disease. Unfortunately, only 30% to 40% of patients currently taking antihypertensive drug treatments are meeting blood pressure goals in Japan. The present study suggests that massage, even using massage chair, has an important role in the management of blood pressure as complementary therapy.

STABILITY OF SEDENTARY BEHAVIOURS IN ADOLESCENTS: A 4-YEAR FOLLOW-UP STUDY

MISIGOJ DURAKOVIC, M., STEFAN, L., SORIC, M.

FACULTY OF KINESIOLOGY UNIVERSITY OF ZAGREB

INTRODUCTION: Recent studies have shown association of sedentary behavior, primarily screen time with increased risk for obesity and cardio-metabolic risks in adolescents. Moderate stability of this trait has been reported in previous studies. However, little is known about stability of other domain of sedentary behavior during late adolescence.
METHODS: In this longitudinal study, participants were 844 high-school students (mean age at the baseline 15.6 years, 49% of the girls). To assess different sedentary behaviours, School Health Action, Planning and Evaluation System (SHAPES) questionnaire was used. Four types of sedentary behaviours were: (1) total sedentary behaviour, (2) screen-time, (3) studying and (4) other sedentary behaviour activities. General estimating equations (GEE) were used to calculate stability coefficient, stratified by gender.
RESULTS: Over a 4-year of follow-up, stability coefficients for total sedentary behaviour, screen-time, studying and other sedentary behaviour were similar in both boys (0.63, 0.60, 0.66 and 0.72) and girls (0.60, 0.64, 0.70 and 0.63).

CONCLUSION: Our results show moderate tracking of sedentary behaviours over a 4-year of follow-up in high-school students. Thus, policies and strategies that promote higher levels of physical activity and decline the time spending in sedentary behaviours are warranted.

RELATIONSHIP BETWEEN NON-COGNITIVE FUNCTIONAL CHARACTERISTICS AT AGE 6 AND PHYSICAL FITNESS CHARACTERISTICS AT AGE 10

KASUGA, K., NAKANO, T., OGURI, K.

GIFU UNIVERSITY, NAGOYA GAKUIN UNIVERSITY, GIFU SHOTOKU GAKUEN UNIVERSITY

Introduction: Human non-cognitive functioning is developed mostly in early childhood. It is speculated that the characteristics of non-cognitive functions will influence various subsequent behaviors. It may be that physical characteristics during childhood affected by daily exercise behaviors are also affected by non-cognitive functional characteristics in the early childhood.
Purpose
The purpose of this study was to examine the relationship between non-cognitive functional characteristics at age 6 and the physical fitness characteristics at age 10.
Methods: Subjects included 223 children (110 boys and 113 girls) who performed the physical fitness test at 10 years of age. We administered physical fitness tests comprising eight exercises (grip strength, standing long jump, softball throw, 50-m run, side-step, sitting trunk flexion, sit-up, and 20-m shuttle run) to gauge the children's physical fitness status. In order to understand non-cognitive functional characteristics at 6 years of age, a questionnaire of 21 questions consisting of 8 items (self-recognition, motivation, perseverance, self-control, social appropriateness, resilience and coping ability, creativity, and personality) was used. Evaluation of non-cognitive function was carried out by three kindergarten teachers who had the experience of being their homeroom teacher. The mode of 3 evaluations was adopted to achieve a representative value of non-cognitive functional characteristics. When the evaluations were different, the median of the evaluation was used as a representative value.
From the evaluation obtained, grouping was performed with the upper group (UG), the middle group (MG), and the lower group (LG) based on the evaluation value of each non-cognitive function. We applied a principal component analysis on the test results and used the first principal component score as an indicator of overall physical fitness.
Statistical analysis of the data was conducted using a one-way ANOVA and multiple comparisons (Tukey's HSD test) to compare physical fitness among the groups. In the items with lower group samples less than 5, a t-test between the upper group and the middle-lower group (MLG) was applied.
Results: Results of the analysis revealed significant differences in physical fitness in all items except "nervous" among the 21 questions. UG of each item was significantly higher than LG. In particular, there was a very high effect size (ES) in "persistent efforts" (ES: 1.99), "ingenuity" (ES: 1.92), and "ability to pull out" (ES: 1.85).
Conclusion
It was suggested that children with increased non-cognitive functions such as condition judgment ability and tenacity in early childhood have a good effect on physical fitness at school age.
Supported by Grant-in-Aid for Scientific Research (B) (No.16H03271) from Ministry of Education, Culture, Sports, Science and Technology in Japan.

THE METABOLIC SYNDROME CAUSE ARTERIOSCLEROSIS IN JAPANESE CHILDREN

OGURI, K., KASUGA, K., NAKANO, T.

GIFU SHOTOKU GAKUEN UNIVERSITY

INTRODUCTION: Information on whether metabolic syndrome (MetS) is involved in development of arteriosclerosis in children is sparse. The ratio of high-density lipoprotein cholesterol (HDL-C) to low-density lipoprotein cholesterol (LDL-C) ratio (L/H ratio), adiponectin, remnant-like particle cholesterol (RLP-C), small dense LDL particle size (LDL size) and level of high sensitive C-reactive protein (hsCRP) are known to be novel markers characterizing the atherosclerotic process at an early stage. Therefore, this study compared the L/H ratio, adiponectin, RLP-C, LDL size and hsCRP level among obese children with MetS, normal and non-obese children without MetS. And this study compared the relationships between body fat percentage, visceral fat mass and subcutaneous fat mass with arteriosclerosis risk factors in obese and non-obese children.
METHODS: The subjects were 112 children (age: 7.5-12.6 years) who consented to participate in this study. They were divided into an obese group (68 children, age: 9.7±1.5 years) and a non-obese group (44 children, age: 9.6±1.4 years) with an obesity index score of 20% or higher the cutoff for determining obesity. The Bod Pod system was used to measure body density and body fat percentage was then calculated. MRI with 0.2T magnetic field strength was used to calculate visceral fat and subcutaneous fat cross-sectional areas in the horizontal plane between lumbar vertebrae 4 and 5. Fasting levels of adiponectin, LDL size, hsCRP, glucose, insulin, lipid profile and blood pressure were determined, and L/H ratio and the homeostatic model assessment (HOMA) index were calculated. Systolic and diastolic blood pressure was measured three times and the lowest values for each were used as data. MetS was determined upon abdominal obesity (waist circumference: ?75 cm) plus at least two other factors from elevated triglyceride (?120 mg/dl), HDL-C (<40 mg/dl), high systolic or diastolic blood pressure (?125 or ?70 mmHg), and fasting glucose (?100 mg/dl). Obese children were grouped into with (n=8) and without (n=60) MetS.
RESULTS: Obese children with MetS had significantly smaller LDL size and adiponectin than normal and obese children without MetS ($p<.05$). Obese children with MetS showed higher L/H ratio, RLP-C hsCRP and HOMA index than normal and obese children without MS ($p<.05$). No differences between normal and obese children without MetS were observed for all markers. Comparison of the correlation coefficients of test items with body fat percentage, subcutaneous fat area and visceral fat area in obese children indicated that the correlation coefficient of visceral fat area for LDL size (r=.513), RLP-C (r=.444), adiponectin (r=-.418), HOMA index (r=.491), L/H ratio (r=.478), LDL-C (r=.458), triglycerides (r=.594), systolic blood pressure (r=.564) was significantly higher than for the other two indices.
CONCLUSION: Our findings suggest that metabolic syndrome more than obesity per se may be involved in early arteriosclerosis in children.

NUTRITIONAL STATUS, PHYSICAL ACTIVITY AND EATING HABITS OF HUNGARIAN YOUTH

UVACSEK, M.1, NÉMETH, A.2

1.UNIVERSITY OF PHYSICAL EDUCATION, BUDAPEST 2.EÖTVÖS LORÁND UNIVERSITY, BUDAPEST

INTRODUCTION: The Health Behaviour in School-Aged Children (HBSC) study is a World Health Organization- (WHO) collaborative cross-national data collection initiative, in which Hungary has taken part for more than three decades. One of the aims of the study is to monitor the health and risk behaviour of youth, analyse sex/age group differences and trends based on the national representative samples.
METHODS: In the present study we analysed data regarding 8,096 and 6,153 11- to 18-year-old children, collected in 2010 and 2014, respectively. We aimed to compare the results of the last two representative sample's data concerning nutritional status, breakfast consumption, physical activity and daily fruit and vegetable consumption. The questionnaire results were categorized and the frequencies were compared with chi-square-tests using Statistica for Windows 13.2.
RESULTS: Young people's prevalence in different nutritional status groups was very similar in 2010 and 2014; less than 3% of them were obese, a bit more than 12% were overweight, 70% were of normal weight, and 15% were underweight. The prevalence of youth achieving the daily MVPA recommendation did not change significantly, at 17% versus 19%. The frequency of regular breakfast consumption is higher in boys, and comparing the last two results neither the boys' (51.5% vs. 53.6%) nor the girls' frequency (46.8% vs. 45.2%) changed significantly. Daily fruit consumption (31.1% vs. 32.6%) has also remained unchanged, while daily vegetable consumption (23.6% vs. 30.4%) increased in Hungary between 2010 and 2014. Though almost all tendencies are positive regarding physical activity and eating habits, the results are far from meeting the international dietary recommendations.
CONCLUSION: According to HBSC data, there are some positive changes in the health behaviour of Hungarian youth; however, considering protective factors like physical activity and regular breakfast consumption, the group lags far behind in terms of international recommendations.

PHYSICAL ACTIVITY, BODY STRUCTURE AND PSYCHOSOMATIC SYMPTOMS IN CHILDREN

SZMODIS, M., FARKAS, A., BOSNYÁK, E., PROTZNER, A., TRÁJER, E., ALMÁSI, G., RICHTER, R., SZOTS, G., TÓTH, M.

UNIVERSITY OF PHYSICAL EDUCATION

INTRODUCTION: The beneficial effects of regular physical activity on body structure seem evident. Anthropometric parameters of children differ by their activity levels. Somatic and mental well-being can be associated with each other. The main goal was to find and analyse the relationships between physical activity, anthropometric variables and psychosomatic symptoms in children.
METHODS: Participants were 7-19-year-old Hungarian children . The children came from twelve different schools in various regions, including the capital, other cities, small towns and villages. Anthropometric measurements were taken according to the suggestion of International Biological Program. Objective level of habitual physical activity was measured with accelerometer , the psychosomatic symptoms and health profile were examined by questionnaire. Differences of the subgroups and correlation patterns were analysed .
RESULTS: Two-third of the children reached the international recommendation of physical activity level, mainly the boys. Their daily activity in the MVPA zone was significantly more that for the girls' <138.3±49.8 vs. 117.4±44.5 min; p=0.003>. Psychosomatic symptoms were more common in girls <18.9±5.5 vs. 21.7±7.0; p=0.001> and as they get older, the symptoms get more frequent . The body image of boys was better <4.1±0.9 vs. 3.5±1.0; p=0.003>.
Physical activity had positive effects on health-image and body image , furthermore, those children who were more satisfied had less psychosomatic symptoms .
CONCLUSION: The results of this survey emphasize the necessity of physical activity, the data relative to nutrition and „the way you feel" comfort feeling can give a good perspective for the professionals, concerning healthy lifestyle. However, more examination is needed in order to reveal the more relationship.

RELATIONSHIPS BETWEEN AEROBIC FITNESS AND NOVEL RISK FACTORS FOR CARDIOVASCULAR DISEASE AND INFLAMMATORY MARKERS IN CHILDREN

DENCKER, M., THORSSON, O., KARLSSON, M.K., WOLLMER, P., ANDERSEN, L.B.

SKÅNE UNIVERSITY HOSPITAL

INTRODUCTION: Inflammation is present in a variety of diseases. Moreover, there is continuous emergence of novel risk factors for cardiovascular disease. However, limited information exists about possible relationships between novel risk factors for cardiovascular disease and inflammatory markers versus aerobic fitness in children.
METHODS: We performed a study in 166 <88 boys and 78 girls> healthy children aged 8-11 years. Maximal oxygen uptake was assessed by indirect calorimetry during a maximal exercise test and scaled to body mass . A total of 10 biomarkers for cardiovascular disease and inflammation were analyzed in frozen serum samples by the Proximity Extension Assay technique.
RESULTS: Partial correlations, with adjustment for sex, between VO2PEAK versus the different biomarkers indicated weak to moderate correlations in either positive or negative direction, all concordant with the hypothesized direction. Summary of the findings: Interleukin-1 receptor antagonist protein , Interleukin-6 , Galectin-3 , Chitinase-3-like protein 1 , TNF-related activation-induced cytokine , Tissue-type plasminogen activator , Furin , CUB domain-containing protein 1 , Interleukin-18 receptor 1 , Stem cell factor , $P<0.05$, for all.
CONCLUSION: This study shows that a weak to moderate relationship exist between aerobic and inflammatory markers and novel risk factors for cardiovascular and in children aged aged 8-11 years.
magnus.dencker@skane.se

TIME SPENT IN PHYSICAL ACTIVITY BY PRESCHOOL CHILDREN - COMPARISON ACROSS ONE YEAR -

ISHIZAWA, J.1, SASAKI, R.2, YOSHITAKE, Y.3

1: SHIRAYURI UNIV. , 2: KEIO UNIV. , 3: NIFS IN KANOYA

INTRODUCTION: According to previous research, children's physical activity (PA) is associated with their health and movement ability (Harriet G. et al., 2008; Fisher et al., 2005). Some cross-sectional studies have examined the PA of preschool children in Japan (Tanaka et al. 2013). However, little is known about the longitudinal course of preschool children's daily PA levels. This study aimed to compare children's PA level variation in the first year of kindergarten with that one year later.

METHODS: Participants were 34 children in the first year of kindergarten (19 boys, mean age 4.9±0.3 years; 15 girls, mean age 5.0±0.3). Their PA was measured using a triaxial accelerometer (Active Style Pro, Omron) for eight consecutive days except during unavoidable circumstances, such as sleeping and bathing. We examined their PA by measuring the step counts and time spent in moderate and vigorous physical activity (MVPA). One year later, we examined their PA again in the second year of kindergarten. We compared their PA between the first and second year.
RESULTS: On weekdays, first year boys and girls engaged in MVPA for 81.7±20.1 mins/day and 75.3±13.7 mins/day respectively. Second year boys and girls engaged in MVPA for 93.0±20.4 mins/day and 81.1±14.9 mins/day respectively. Their total second year MVPA was significantly higher than in the first year ($p<0.01$). Analyzing classifications of movement showed that during the second year, their locomotive activity time during MVPA was higher than in the first year. On the other hand, there were no significant differences in the total MVPA and step counts on weekends. The children's first year total MVPA correlated with that of the second year on weekdays.
CONCLUSION: This result shows that compared to the first year, children's MVPA increased one year later in both boys and girls on weekdays. Furthermore, these findings suggest that the quantity of total MVPA in the first year tended to continue into the second year. Therefore, promotion of children's PA might commence before the first year of kindergarten.
References:
Harriet G. et al. (2008) Obesity, 16 (6), 1421-1426
Fisher et al. (2005) Med. Sci. Sports, 37(4), 684-688
Tanaka et al. (2013) Jpn. J. Hum. Growth. Dev. Res., 58,18-24
Contact:ishizawa@shirayuri.ac.jp

EFFECT OF A CHILD HEALTH EDUCATIONAL PROGRAM ON THE PHYSICAL ACTIVITY LEVEL, DIETARY INTAKE AND PHYSICAL FITNESS OF OBESE CHILDREN

RIBEIRO, H.L., RAUBER, S.B., OLIVEIRA-SILVA, I., VENÂNIO, P.E.M., CAMPBELL, C.S.G.

UNIEVANGÉLICA

INTRODUCTION: Childhood obesity has increased exponentially, this factor is consider worrying and a big problem of this century. Sedentary behavior, poor diet have been affecting the population and increasing a lot of diseases. Innovative practices of intervention have been used with the goal of prevention and promotion of childrens health. The aim the study was to investigate the impact of a 5-day KIDS educational program and 12-week follow-up on Physical Activity Level (PAL), dietary intake (DI), and physical fitness (pre and post camp) of obese children.
METHODS: Twelve children participated in the HEPchild program, they were divided into two phases. Phase 1 of pre-assessments; and Phase 2 corresponded to 12 weeks of follow-up to assess PAL and FI over time with questionnaire use and pre and post camp to assess physical fitness variables (flexibility, muscle strength, explosive strength of upper and lower limbs, aerobic capacity). The Shapiro-Wilk test was used for data normality. The descriptive statistics used for mean, standard deviation (± SD) and 95% confidence interval. The t-test paired to identify the effect of the camp on the variables of physical fitness. The magnitude of the pre and post changes with the effect size Cohens D (ES). It was calculated for each variable the percentage of the change (% Δ). The significance level was set at $p <0.05$.
RESULTS: After all the follow-up, 25% of the children were active (> 1500 and <3000 METs per week). The number of sedentary children (<600 METs per week) decreased by 15% and insufficiently active (600 to 1500 METs per week) increased by 15%. The leisure time PAL increased significantly during the week (26.0%) and at the weekends (14.1%) after the follow-up compared to before the KIDS. Before KIDS, 91.6% of the children consumed soft drinks ≥ 3x / week and after HEPchild reduced to 50%. Fruit consumption (≥ 5 portions / day) increased 51% and vegetables (≥ 5 portions / day) increased from 8.4% to 66.7%. There was a significant improvement in body mass (~ 1.2kg), body mass index (~ 0.8kg/m2), waist circumference (~ 1.9cm), summation of skin fold (5.7mm) and flexibility (~ 4.58cm), horizontal jump (7.33cm). However, the effect size was low. The only result that besides significance had high effect size (i.e. .77) was the upper limb strength (~ 43cm).
CONCLUSION: Five days of camping and health education, with emphasis on promoting a healthy lifestyle, can be effective for improving physical fitness variables and increasing PAL of obese children.

TRACKING OF MOTOR SKILLS FROM CHILDHOOD TO ADOLESCENCE IN JAPANESE.

HIRANO, T.

NAGOYA COLLEGE

Introduction: Childhood is one of the most important times to develop healthy lifestyle habits. Several studies have reported that high levels of physical fitness and motor skills in childhood predict high-level adult physical fitness and exercise capacity. The aim of this study was to investigate the tracking of selected aspects of motor skills from childhood to adolescence in Japanese.
Methods: The subjects were about 400 boys and girls school students. A 50m sprint, a standing long jump, a soft ball throw, a grip strength, a flexibility of the lower back, and a repeated lateral jump were used to assess motor ability. These activities were measured every year, and the subjects were followed from 6 to 17 years old. The physical size and motor skills of the subjects didn't have significant differences to those in the nationwide survey. The subjects were asked about daily activities after school using a questionnaire.
Results: Correlation coefficients of the 50m sprint between 6 and 17 years old revealed statistically significant tracking among boys (0.36) and girls (0.33). The standing long jump and the soft ball throw between 6 and 17 years old were consistent with this tracking. Correlations for the repeated lateral jump are moderate between 10 and 17 years old. The longer of years to belong to athletic activities and sports clubs, the higher value at the 17 years old physical fitness score. Due to the habit of sports activities, there was a case where the relative exercise capacity increased from school childhood to adolescence.
Contact: hirano@nagoyacollege.ac.jp

EFFECTS OF AEROBIC EXERCISE ON MENTAL WORKLOAD OF FLIGHT SIMULATION BEHAVIOR

LIU, H.1, HU, H.H.2

NANJING UNIVERSITY OF AERONAUTICS AND ASTRONAUTICS

INTRODUCTION: This paper wants to explore the effect of long-term moderate-intensity aerobic exercise on improving the cognitive ability of the pilots and the possibility of mental load, to provide the basis for the importance of student pilots participation in physical activity, to provide effective design of the content and extracurricular exercise mode reference.

METHODS: The experimental groups were divided into three groups: experimental group <31 subjects> and control group <31 subjects>. The experimental group was treated with exercise bike and basketball during the morning exercises. The exercise intervention time was 11 weeks, 3 times a week, The duration of exercise was 45 minutes, the intensity of exercise was moderate <220-age> × <60% -70%>, and the change of mental load was simulated before and after the intervention.
RESULTS: The multiple linear regression equation showed that there was significant difference in the mental workload between different groups of flight simulation driving. The weighted total load of the experimental group has a decreasing trend after exercise intervention（F（6,55）=2.216，p=0.055），and the time requirement of the experimental group after exercise intervention was significantly reduced（F（6,55）=2.606，p=0.027）.
CONCLUSION: Moderate-intensity aerobic exercise can relieve the mental workload stress of the the civil aviation student pilots flight simulation, and the pressure relief effect of the mental workload stress, which can be described as follows: Of the experimental group is higher than that of the control group.

THE IMPACT OF ACUTE PHYSICAL EXERCISE ON PERCEPTUAL-COGNITIVE PERFORMANCE IN SOCCER PLAYERS

OLM, T.1, BASKIN, K.2, HERDE, K.2

TALLINN UNIVERSITY

INTRODUCTION: The aim of this study is to examine the influence of acute physical exercise on the simple and the choice reaction times in soccer players of different ages.
METHODS: Professional soccer players of the best clubs of Estonia (n=236) aged 17 to 31 years were examined. The athletes were divided into 3 age groups. The test battery included anthropometrics, ECHO and ECG, and BLa concentration, VO2max and the anaerobic threshold were recorded. The simple and choice reaction times were measured before and after incremental treadmill test to volitional exhaustion, using the software Win Psycho Test (K.Thomson).The ANOVA-test was used. Statistical significance was assumed at $p<0.05$. Pearson product moment correlation coefficients were calculated.
RESULTS: Before the acute exercise the average simple reaction time was the shortest in the oldest athletes group. The same can be said about their mean choice reaction time. The best response accuracy (the error rate) was the smallest in the youngster group. After the acute physical exercise the averages of the simple reaction time didn't change in any age group. However, the averages of the choice reaction time shortened significantly, especially in older players. The error rate increased in all groups. The smallest change was in the oldest athletes' group. Correlation analysis shows that all four averages of the reaction times have strong positive correlation between themselves and a moderate one with the error rates and with anaerobic metabolic indices.
CONCLUSION: Soccer requires fast reaction and accurate decisions from players. Perceptual-cognitive performance of athletes must stay on as good level as possible. There are many contradictory investigations about the influence of acute physical load on the nervous system. Basing on results this study, we can agree with researchers who suggested that athletes´ perceptual-cognitive performances in speed-related tasks are improved by moderate and high intensivity physical exercise (McMorris et al., 2012) and the results of accuracy are deteriorated (Casanova et al., 2013). In our previous study and this one we are finding many strong relationships between the characteristics of different organic systems but the relationships between the nervous system characteristics and the characteristics of other systems was surprisingly rare. We can conclude. a)Older, experienced players with high anaerobic working capacity were more positively influenced by acute physical exercise than the younger ones. b)To correctly evaluate the functional state of athletes without assessing the nervous system characteristics is impossible.
REFERENCES: Casanova F, Garganta J, Silva G, Alves A, Oliveira J, Williams AM. (2013). Med Sci Sports Exerc. 45(8):1610-7.
McMorris T, Hale BJ. (2012). Brain Cogn. 80(3):338-51.
CONTACT: tiiu.olm@gmail.com

CHRONIC NONCOMMUNICABLE DISEASES: FAMILY HISTORY, EATING HABITS AND SEDENTARY

BANKOFF, A.D.P., ZAMAI, C.A., BISPO, I.M.G.P., RODRIGUES, M.D.

UNIVERSIDADE FEDERAL DE MATO GROSSO DO SUL E UNIVERSIDADE ESTADUAL DE CAMPINAS

INTRODUCTION: Chronic non-communicable diseases (NCD) currently are the ones that cause the most deaths in Brazil and worldwide. Every human being is subject to the daily routines of life, regardless of age and socioeconomic status. It is within our home and within the family that we learn our daily habits of life, which accompany us (Bankoff, Zamai, 2012,2013). As for college students, when they enter, most of them become sedentary, and also because of the circumstances they acquire not very healthy eating habits, making them more vulnerable to chronic noncommunicable diseases early (Bankoff et al, 2013, 2012).
METHODS: Were assessed using a questionnaire developed itself to the project, students of both sexes and 140 men aged 23.6 years and Standard Deviation 4,591; 140 women aged 22.5 years and Standard Deviation 4,007. The questionnaire-prioritized questions relating to eating habits, sedentary, lifestyle, chronic noncommunicable diseases and family history. For better understanding, the questionnaire was applied in the classroom using Power Point presentation to students. The research coordinator remained in the classroom while the questionnaire was answered to answer questions when necessary.
RESULTS: For women the family history of chronic noncommunicable diseases: Obesity 67.85%, Hypertension 62.14%, Diabetes 54.28% and Cardiovascular Diseases 24.38%. For men, the family history of chronic noncommunicable diseases: Obesity 56.12%, Hypertension 48.34%, Diabetes 43.79% and Cardiovascular Diseases 45.26%. The authors concluded from the statistical results that these students are strong early candidates for family history to be afflicted by chronic noncommunicable diseases. In relation to the habits of life, the following results were found for women: Consumption of red meat twice daily 98.12%, Alcoholic beverage 84.43%, Consumption of daily soda 92.47% and Sedentarism 97.67%. For men: Red meat consumption twice a day 96.83%, Alcoholic beverage 97.24%, Consumption of daily soda 92.37% and Sedentarism 67.71%. The Body Mass Index found for men was 26.02 and for women 25.54. When we analyze the results by BioEstat 5.3 program using the Contingency Correlation Coefficient C the results for both sexes were significant (p) = <0.0001. This shows very high degree of correlation between family history and early onset of chronic diseases in the research participants.
CONCLUSION: It is within the family that starts the history of chronic diseases considering the eating habits and lifestyles. Through the results in percentage, there was strong relationships for both sexes, research participants and family heritage in relation to chronic diseases.

THE ASSOCIATIONS BETWEEN CHRONOTYPE, DIETARY INTAKE, AND PHYSICAL FITNESS IN YOUNG JAPANESE WOMEN.

USUI, C.
WASEDA UNIVERSITY

INTRODUCTION: An individuals chronotype is a trait which reflects differences in their timing of sleep (e.g., bedtimes, rise times) and in their preferences for the times of rest and activities. Several studies have reported that eveningness tends to be associated with an unhealthy lifestyle. However, no study has examined the relationship between chronotype and physical fitness. In this study, I examined the associations between chronotype, dietary intake, and physical fitness in young Japanese women.
METHODS: The subjects were 124 female university students aged 18-20 years in Japan. Body weight, height, and body fat percentage were measured, and body mass index (BMI) were calculated. Chronotype was assessed using a Japanese version of Horne and Östberg's morningness–eveningness questionnaire (MEQ). The MEQ score was divided into tertiles of which the lowest tertile demonstrated eveningness and the highest tertile demonstrated morningness. The dietary intake was assessed by a brief, self-administered diet history questionnaire (BDHQ). Grip strength, sit-ups, sit & reach, side step (100 cm), standing long jump, vertical jump, 20 m shuttle run, and 5 minute run were measured as physical fitness.
RESULTS: The MEQ score was significantly negatively associated with the percentage of body fat (coefficient = −0.19; p = 0.04), BMI (coefficient = −0.20, p = 0.03), salt intake (coefficient = −0.18; p = 0.05), and noodles intake (coefficient = −0.20; p = 0.03). In addition, it was also significantly positivity associated with soy intake (coefficient = 0.18, p = 0.05) and vertical jump score (coefficient = 0.25, p = 0.01). Furthermore, subjects in the highest tertile (morningness) had significantly higher score in standing long jump compared to the lowest tertile (eveningness), even though no correlation between scores of these.
CONCLUSION: This study revealed that the chronotype is associated with dietary intake of certain nutrients and foods and physical fitness (particularly, muscle power of legs) in young Japanese women.

RELATIONSHIP BETWEEN ANTHROPOMETRIC VALUES, HEALTH AND PHYSICAL FITNESS PARAMETERS IN HEALTHY ADULT AND ELDERLY PEOPLE

ARIZAGA, N., VIRGALA, J., ZARRAZQUIN, I., CEPEDA, S., IZAGIRRE, A., MARTÍNEZ-LAGE, P., IRAZUSTA, A., KORTAJARENA, M.
UNIVERSIDAD DEL PAÍS VASCO-EUSKAL HERRIKO UNIBERTSITATEA

INTRODUCTION: Physical activity reduce the risk of morbidity and mortality and is associated with healthy aging. The aim of this study was to know the relationship between anthropometric values, health parameters and physical fitness of healthy adults with a family history of Alzheimer´s disease (AD).
METHODS: This study was carried out with 374 participants, between 42 and 82 years old (Mage60.72 • 6.94), (Myearsofeducation14.02 • 3.72), in the CITA-Alzheimer foundation in San Sebastian (Spain). The inclusion criteria were: no diagnosis of dementia and age between 40 and 82 years. Anthropometric values, health parameters and physical fitness were measured. Dynamometry tests, Senior Fitness Test (SFT) and Short Physical Perfomance Battery (SPPB) were used to measure the physical fitness of the participants.
RESULTS: It has been found that a positive ($p<0.05$) correlation was established between LDL cholesterol and lower-body flexibility in men, although not in women ($p>0.05$). On the other hand, HDL cholesterol was positively related with lower body strength and 6 minutes walk in men ($p<0.05$).
When we analyzed the relationship between anthropometry and physical fitness we observed a positive correlation between the strength of both hands and, fat-free mass and muscle mass, both in men and women ($p<0.05$). There was a negative relation between 6-minutes-walk and body fat, in both sexes ($p<0.05$).
CONCLUSION: Other studies, also presented a correlation between physical fitness and cardiovascular health and cholesterol, and those health parameters are associated with more cardiovascular diseases. The results of this study are in line with other studies, regarding the relationship between physical fitness (more specifically the aerobic resistance), weight and percentage of body fat. Over weight is associated with worse aerobic resistance. Although, there are some studies that predict future physical capacity in elderly people, further studies are needed to assess the relation between cardiovascular health parameters and physical fitness in adult and elderly people.
REFERENCES: Fujie, S et al. (2015). American Journal of Physiology - Heart and Circulatory Physiology, 309(10):H1642-7.
Polonsky TS et al. (2017). Journal of the American Heart Association, 6(3):1-12.
Jerome, GJ et al. (2016). Journals of Gerontology - Biological Sciences and Medical Sciences, 71(12):1661-1666.
Seki, E et al (2008). Circulation Journal, 72:1230-1234.
Haslacher, H et al (2017). Plos one, 12(5):1-14.

EFFECT OF HIGH INTENSITY INTERMITTENT TRAINING COMBINED WITH DIET CONTROL ON BODY COMPOSITION

HOU, X., SONG, B., MO, K.
GUANGZHOU SPORT UNIVERSITY

INTRODUCTION: In recent years, high-intensity intermittent training has been gradually extended to the health management field of the general population for the training of professional athletes. However, there are few studies on the influence of high-intensity intermittent training on body composition, especially high-intensity intermittent training and diet control. The purpose of this study is to explore the effects of high intensity intermittent training combined with dietary control on body composition.
METHODS: A total of 152 clients who participated in the Reducing Training Camp at the Sports Medicine Rehabilitation Center were enrolled in the intensive (15 days) intensive intermittent training and controlled by diet. Training content arrangements: warm-up 13 minutes, high-intensity intermittent training for 30 minutes, relax and stretch for 17 minutes. Training duration and frequency: 60 minutes / time, 7 days / week. Dietary requirements: Reduce the period, the need for intake of double low food, that is, low calorie calorie (GL) food, low glycemic index (GI) food. The first five days of dinner (fruit salad) to participate in the slimming training camp are provided by the researchers. Other diet reference diet recommendations. The body mass index, body fat percentage, waist - to - hip ratio, skeletal muscle, muscle mass and basal metabolic rate were analyzed before and after the experiment.
RESULTS: The body mass index of the subjects was significantly lower than that before the experiment (Before,22.49 ± 3.36, then 22.35 ± 3.21, $P<0.05$). The percentage of body fat was significantly lower than that before the experiment （Before, 27.85±6.23 , then 26.45±5.86, $P<0.01$）; the skeletal muscle WHR was significantly lower than that before the experiment (Before, 0.84 ± 0.06, then 0.82 ± 0.05, $P<0.01$). The skeletal muscle was significantly increased before the experiment (Before, 24.01±5.84 , then

24.31±5.62, P<0.01) . The number of muscle was significantly higher than that before the experiment (before, 41.32 ± 9.09, 41.79 ± 8.77, P <0.01) The basal metabolic rate was significantly higher than before the experiment (before 1319 ± 207.86, after 1330 ± 200.48, P <0.01).
CONCLUSION: 15 days of high intensity intermittent training with diet control can effectively reduce the body mass index, body fat percentage, waist to hip ratio, increase skeletal muscle, muscle mass and basal metabolic rate.

CHALLENGING THE MONT VENTOUX WITH MULTIPLE SCLEROSIS: A HOME-BASED RANDOMIZED CONTROLLED CYCLING AND AWARENESS PROJECT.

KEYTSMAN, C., VAN NOTEN, P., SPAAS, J., NIESTE, I., VAN ASCH, P., O EIJNDE, B.

RESEARCH REHABILITATION CENTER HASSELT UNIVERSITY - BELGIUM

INTRODUCTION: Despite substantial clinical effects (e.g. +22% exercise capacity, 12w) of high intensity training (HIT) in MS, implementation of such interventions in actual rehabilitation programs is not common yet. Possibly, rehabilitation regimens consisting of HIT only are too demanding (1-5 exercise bouts 6s- 4min, recovery periods of 30s–4min, 90-100% maximum heart rate) and require self-guidance and external motivational factors to adhere longer term. Therefore any exercise therapy strategy in MS that includes HIT but ensures longer term training adherence is worthwhile investigating. Possible strategies to achieve this are common in the exercise/sports community and include training periodization, ergogenic supplementation (e.g. β-alanine supplementation), home-based exercise and goal setting. In keeping with the above line of reasoning, we investigated the feasibility and effects on exercise performance of a periodized (low and high intensity exercise and recovery), long-term (6m), home-based cycling exercise program in
METHODS: In this double-blind, randomized, placebo-controlled trial, exercise capacity (maximal graded exercise test) and body composition (DEXA) were assessed at baseline (PRE). Following baseline screening, persons with MS and HC were randomized into a β-alanine supplementation (β-alanine supplements: MSβ, HCβ), or a placebo (placebo tablets identical in taste and appearance: MSpla, HCpla) group. Next, all participants received an activity tracker (Polar® M200) and were enrolled in a 6m home-based exercise program. Training involved cycling on their personal bicycle. Subjects were supervised remotely using the Polar® Coach module. Following 8 training cycles POST measurements were performed similar to baseline. Hereafter, subjects climbed the Mont Ventoux.
RESULTS: Six months of home-based training induced main time effects for body weight (-1.4%, p=0.004), BMI (-2%, p=0.02), total mass (-1.2%, p=0.021), VO2max (+5,4%, p=0.001), workload (+10.8%, p<0.0001), time until exhaustion (+11,2%, p<0.0001), recovery heart rate (+1.8%, 0.0017) and lactate max (+35,4%, 0.002). Furthermore, all persons with MS safely reached the top of the Mont Ventoux, except for two (ceased at 2km and 1km from the top because of exhaustion). No injuries or adverse events occurred during the challenge.
CONCLUSION: The 6m home-based, periodized and HIT oriented cycling program appeared to be feasible and provided good adherence, showed significant improvements in exercise capacity and body composition, and trained persons with MS sufficiently to climb the Mont Ventoux safely. Supplementation of β-alanine showed no additional effects.

THE EFFECT OF EXERCISE TRAINING ON FUSOBACTERIUM AND CORAL RECTAL CANCER RISK FACTORS IN SEDENTARY YOUNG ADULTS

WU, C., CHEN, W., CHIU, C., HUANG, Y., CHANG, C., WU, S.

NATIONAL CHUNG HSING UNIVERSITY

INTRODUCTION: The influence of exercise on human microbiota in literature was very limited. Recent findings showed the strong link between Fusobacterium and Colorectal cancer (CRC). Exercise has been proposed one of the major factors of reducing colorectal cancer (CRC) risks. However, the underlying mechanism is still unclear. We hypothesize exercise may influence anaerobe - Fusobacterium, and butyrate concentration to reduce CRC risks.
METHODS: Twenty-seven healthy, inactive subjects participated in either high intensity exercise group (HEX) (13) or low intensity exercise group (LEX) (14). HEX was instructed to perform walking exercise at 70% predicted heart rate max (HRmax), while LEX at 50%HRmax, for 30 min, 3 times/week for 6 weeks after 4 weeks original inactive life style. Samples collection time will be at week 0, week 4, and week 10. Blood samples were analyzed for cytokines (TNF-α, IL-1β, IL-6, and CRP), leucocyte counts (lymphocyte, neutrophil) and biochemistry markers (glucose, triglyceride, cholesterol, HDL-C). Stool samples were used to investigate the Fusobacterium using the qPCR technique.
RESULTS: Results showed that there both group were significantly decreased in wait and hip circumference and body fat after training. There were no significant difference in biochemistry markers (glucose, triglyceride, cholesterol) and leucocyte counts (lymphocyte, neutrophil). The HEX showed decreased in RBC, hemoglobin, hematocrit after training. The stool Fusobacterium concentrations showed no difference between two groups.
CONCLUSION: Exercise intervention improved anthropometric measurement and body fat in sedentary young adults. The different exercise training intensity did not affect the Fusobacterium concentrations and other CRC risk factors.

THE EFFECTS OF AN EXERCISE TRAINING PROGRAM OF 21 DAYS IN THE FACTORS OF METABOLIC SYNDROME IN ELDERLY WOMEN

SILVA, A.A., PRESTES, J., BATTAGLINI, C., SOUSA, P.F., FRANÇA, N.M., MELO, G.F.

CATHOLIC UNIVERSITY OF BRASILIA

INTRODUCTION: The metabolic syndrome (MS) is characterized by a group of metabolic risk factors such as abdominal obesity, hypertension, dyslipidemia (high triglycerides and low HDL) and insulin resistance or type 2 diabetes mellitus, reaching a prevalence of 43% in the elderly. How to evaluate the effects of a consecutive 21-day program combined exercise (aerobic and resistance training) and feed restriction on the MS risk factors in older women.
METHODS: The training program was held lasting 2 hours and 15minutes of stretching, resistance exercise 1 hour (bench press, leg press, table abductor, adductor table, crucifix, biceps, triceps and calf sitting) - 3 sets of 8 to 12 repetitions with rest of 130"; half hour walk intensity ranging from 65 to 75% of the heart rate and 15 minutes of stretching. Caloric restriction has 30% of the metabolic rate.
RESULTS: Therefore, part of the sample 22 women diagnosed with MS as criteria of NCEP / ATP III, mean age 66.32 ± 3.99 years. The results showed a significant reduction (p = 0.05) of all the factors of MS and improved body composition of elderly women. There was a 2.9% percent reduction in body fat, waist circumference 6.67%, 21.97% in triglycerides, LDL and 19.23% increase in HDL by 14.9%.
CONCLUSION: With these results we can conclude that 21 days combined in moderate exercise intensities in conjunction with a dietary restriction is able to change the MS risk factors in elderly women.

A PRACTICAL MODEL OF VERY LOW-VOLUME HIGH-INTENSITY INTERVAL TRAINING IMPROVES CARDIOMETABOLIC HEALTH IN OBESE INDIVIDUALS: PRELIMINARY RESULTS OF A RANDOMIZED-CONTROLLED STUDY

ZOPF, Y., RELJIC, D.

UNIVERSITY HOSPITAL ERLANGEN

INTRODUCTION: Obesity, particularly in conjunction with further cardiometabolic risk factors, such as hypertension, hyperglycaemia or hyperlipidemia, is associated with an increased risk for cardiovascular disease and mortality. Regular physical activity (PA) plays a central role for improving cardiometabolic risk factors. Guidelines recommend at least 150 min of PA/week to achieve relevant health benefits. However, many adults with obesity do not achieve these PA-levels and lack of time is among the reasons most commonly cited for insufficient PA. Recently, high-intensity interval training (HIIT) has emerged as a time-efficient exercise strategy for inducing physiological adaptations that are linked to improved health outcomes. However, evidence regarding the efficacy of particularly time-efficient "low-volume" HIIT is based mainly on "all-out" protocols that may not be practical and safe for obese individuals. Here, we present preliminary data from a randomized-controlled study examining the effects of a practical very low-volume "non-all-out" HIIT model (14 min/session and 28 min time-effort/week, respectively) on cardiometabolic health, as assessed by the Metabolic Syndrome Z-Score (MetS), in obese individuals.
METHODS: Thirteen obese subjects (55±19 yrs, BMI: 36.6±4.6, %body fat: 44.7±3.4) at increased risk for metabolic syndrome (≥2 cardiometabolic risk factors) were randomized to either a training group (HIIT-group, n=9, baseline MetS: 4.1±4.5) performing 5x1 min HIIT at 85-95% maximal heart rate on cycle ergometers (2x/week for 6 weeks) or an inactive control group (CON, n=4, baseline MetS: 0.2±3.2). Body mass/composition, MetS and insulin resistance, as determined by homeostatic model assessment (HOMA-IR), were assessed baseline and after 6 weeks. MetS was determined from fasting blood glucose, HDL-cholesterol, triglycerides, waist circumference and mean arterial blood pressure according to Johnson et al. (2007). HOMA-IR was calculated from fasting blood glucose and insulin.
RESULTS: HIIT was well tolerated and no adverse events occurred. There was 100% compliance to the exercise sessions. Body weight/composition remained relatively unchanged in both groups. In the HIIT-group, there was a significant reduction in MetS by 1.4 units ($P<0.05$). HOMA-IR tended to decrease by 4.2 units without reaching statistical significance ($P>0.05$). In CON, MetS and HOMA-IR remained unchanged.
CONCLUSION: The preliminary results of this study indicate that low-volume (non-all-out) HIIT that requires as little as 28 min/week may induce clinically relevant improvements in cardiometabolic health in obese individuals after only 6 weeks, even in the absence of weight loss. The final data of this still ongoing study will allow more definitive conclusions.
REFERENCE:
Johnson JL, Slentz CA, Houmard JA et al (2007). Am J Cardiol, 100:1759–1766
Contact: dejan.reljic@uk-erlangen

THE EFFECTS OF PHYSICAL ACTIVITY ON HEART RATE VARIABILITY IN TYPE 1 DIABETES. A CASE REPORT

PERINI, R., NICOLI, A.

UNIVERSITA DI BRESCIA

INTRODUCTION: Regular physical activity in type 1 diabetes reduces many cardiovascular risk factors and related co-morbidities. Less consistent are the data on the benefits on glycemic control. Nonetheless, exercise is considered an important part of type 1 diabetes management. Cardiac autonomic neuropathy (CAN) is a frequent manifestation of type 1 diabetes, being probably hyperglycemia its main determinant. An early sign of CAN is the reduction in Heart Rate Variability (HRV), especially in vagal indices. We report the case of a young man with long-lasting type 1 diabetes, who restarted physical activity after 3 years of inactivity due to an injury. HRV was evaluated to verify if cardiac autonomic function could benefit from regular exercising.
METHODS: A 24 yrs male cycled outdoors for 70-90 minutes at an intensity eliciting 50-60% of HRmax 3 times a week for 6 months. At the beginning (pre), after 3 months (middle) and at the end (post) of the period: a) body weight (BW), waist circumference (WC) and BMI were assessed; b) HbA1c was determined; c) HR was continuously recorded in supine and sitting position (10 min each) and HRV was analyzed in time (SDNN, rMSSD) and frequency domain (total power, LFnu, HFnu, LF/HF) and by Poincaré plots.
RESULTS: A decrease in anthropometric parameters occurred from pre to post (BW from 94 kg to 88.5 kg; BMI from 27.5 to 25.8; WC from 102 cm to 97 cm). HbA1c was 9.2% in pre, decreased to 8.1% at middle and further decreased to 7.5% at post. At pre, all HRV parameters were similar in the two body positions. At middle and post, an increase was found in SDNN and rMSSD (both 40% and 80% vs pre, respectively), in total power (3 times and 4.5 times vs pre, respectively) and in SD1 and SD2 (both doubled at post) in supine position. LFnu and HFnu powers remained almost stable during the 6 months in both positions, showing HFnu a tendency to be lower at post than at pre in sitting position. The difference in LF/HF between the two positions was negligible at pre and at middle and became positive at post (+1.9).
CONCLUSION: Performing regular physical activity induced a reduction in anthropometric parameters, so that after 6 months BMI attained a value only slightly beyond the upper limit of normality. At the same time, a progressive decrement in HbA1c was observed, suggesting that glycemic control was improved by the kind of exercise carried out by the subject. At pre, HRV parameters were very similar in supine and sitting position, possibly as a reflection of altered autonomic function. After 6 month of physical activity, assuming the sitting position induced a slight increase in LF/HF ratio, suggesting that a shift in autonomic interaction occurred. This together with the observed increment in HRV indices in supine position seems to indicate that physical activity could have a positive effect on autonomic control of HR in type 1 diabetes.
renza.perini@unibs.it

AEROBIC CAPACITY BUT NOT ENDOTHELIAL FUNCTION IS ASSOCIATED WITH PHYSICAL ACTIVITY IN HEALTHY POST-MENOPAUSAL WOMEN

HOPKINS, N., BRISLANE, A., HOLDER, S.M., JONES, H., LOW, D.

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Aerobic capacity and endothelial function are important predictors of future cardiovascular morbidity and mortality. Both can be modified by physical activity (PA) and sedentary time (ST). Typically, post-menopausal women display reduced endothelial function and aerobic capacity, yet the roles of PA and ST in modulating these reductions are poorly defined. The aim of this study was therefore to examine the relationships between aerobic capacity and endothelial function with PA and ST in healthy post-menopausal women.

METHODS: Forty-seven healthy, post-menopausal females (58.6 ± 5.6 years old, time from menopause: 6.3 ± 4.1 years, BMI: 25 ± 4 kg/m2) were recruited. High-resolution ultrasound was used to assess brachial artery vasodilator response to 5 minutes distal limb occlusion, and VO2max was determined using a cycling ramp protocol to volitional exhaustion. ST and PA were measured over 7 days using an inclinometer (ActivPal) and an ActiGraph accelerometer, respectively. Relationships between daily ST and PA, and VO2max and endothelial function were evaluated using Spearmans rank correlation.
RESULTS: Endothelial function (3.99 ± 3.43%) was not associated with ST (488.7 ± 103.5 minutes; r=-0.25, P=0.17), total PA (334.3 ± 119.9 minutes; r=0.31, P=0.06) or any intensity of PA (light PA 283.7 ± 108.2 minutes, r=0.31; moderate PA 45.2 ± 24.6 minutes, r=0.11; vigorous PA 5.5 ± 6.7 minutes, r=-0.18; P>0.05). Aerobic capacity (25.0 ± 6.3 ml.kg-1.min-1) was associated with moderate PA (r=0.44, P<0.01), but was not associated with ST (r=0.18, P=0.92), total PA (r=0.17, P=0.28), light PA (r=0.06, P=0.71) or vigorous PA (r=0.22, P=0.16).
CONCLUSION: In healthy post-menopausal women there were no relationships between endothelial function and PA or ST, whilst aerobic capacity was related to moderate PA only.
Maintenance or improvement of moderate PA therefore appears important for post-menopausal women to prevent age-related decline in aerobic capacity and the associated mortality risk.

CARDIOVASCULAR RISK FACTORS ASSOCIATED WITH FOOD FREQUENCY OF SUBJECTS ASSISTED AT A SPORTS NUTRITION OUTPATIENT CLINIC

AMORIM, A.1, VIEIRA, E.1, GOMES, M.1, OLIVEIRA, K.1, ARAUJO, M.1, SILVA, T.1

<1> FEDERAL UNIVERSITY OF MARANHAO, SAO LUIS, BRAZIL

INTRODUCTION: Cardiovascular diseases are the main cause of morbidity and mortality in Brazil and worldwide. Nutrition and physical exercise are important risk components in this scenario. Therefore, the objective of this study was to evaluate cardiovascular risk according to anthropometric and food frequency indicators in patients attending Federal University of Maranhaos Sports Nutritional Care Project.
METHODS: A cross-sectional study was executed with 121 subjects, assisted at a sports nutrition outpatient clinic. The subjects were considered physically active according to the American College of Sports Medicine (ACSM). Weight, height, body-mass index (BMI) and waist circumference (WC) determinations were assessed according to International Society for the Advancement of Kinanthropometry (ISAK) guidelines. World Health Organization (WHO) parameters were utilized to classify cardiovascular risk. In addition, a food frequency questionnaire was used, which analysed the intake of adapted food pyramid's groups. Quantitative (average±standard deviation) and qualitative (%) data were analyzed through t test and qui-square, respectively, at a p<0,05 significance, by Epi InfoTM software.
RESULTS: The patients' age ranged form 17 to 67 years-old. From those, 68 (56.2%) were physically active (PA) and 53 (43.8%) were considered physically inactive (PI). It was verified that only 32.1% of the PI were eutrophic (p=0,001 vs PA group). With regard to waist circumference, it was observed that in the PI group 14.7% had a high cardiovascular risk and 29.4% had a very high cardiovascular risk. In the PA group, the values were 11.3% and 22.6% for high and very high cardiovascular risks, respectively. Concerning the food frequency questionnaire, the most common frequency of consumption for both PA and PI groups was "Daily". It was noticed that the most consumed groups on a daily basis were pasta and cereals, fats, sugars, meats/eggs and dairy products. The PA group appointed daily intake of vegetables at 36,8%.
CONCLUSION: Cardiovascular risk factors were more prevalent among physically inactive subjects. Overweight, obesity and large WC were more prevalent among the PI group. However, the PA group presented lower consumption of fruits and vegetables compared to the PI group. That's a worrisome data, since these food groups have higher caloric density than fruits and vegetables, which, in contrast, have high content in fiber, vitamins and minerals. A possible reason is that sedentary people are aware of the risks in their condition and try to compensate the lack of physical activity by eating more fruit and vegetables in their diet. In addition, it would be interesting to evaluate a 24-hour food recall to corroborate the information in the food frequency questionnaire. Finally, it's important to apply and amplify the range of intervention programs focused on lifestyle change.
Acknowledgement: UFMA and FAPEMA
e-mail: amorimag@gmail.com

ACUTE EFFECTS OF ENDURANCE EXERCISE ON INSULIN-INDUCED VASORELAXATION AND NITRIC OXIDE PRODUCTION IN AGING HYPERTENSION

LIU, J.L.1, YANG, A.L.1, SU, C.T.2

1: UNIVERSITY OF TAIPEI ; 2: FU JEN CATHOLIC UNIVERSITY

INTRODUCTION: Epidemiological studies claim that more than half of the elderly have hypertension. Advanced age is associated with the prevalence of hypertension. Moreover, the endothelial dysfunction and early atherosclerosis could be observed in aging individuals . Endurance exercise has been found to reduce several risk factors of cardiovascular disease in the elderly . However, whether acute endurance exercise positively influences the endothelium-dependent insulin-induced vasorelaxation, as well as its underlying mechanisms, in the aging population with hypertension remains unknown. Therefore, the purpose of this study was to investigate acute effects of endurance exercise on the insulin-induced vasorelaxation and nitric oxide production in aging hypertension.
METHODS: The 12-month-old spontaneously hypertensive rats and normotensive Wistar-Kyoto rats were used in this study. The SHR rats were divided into sedentary and acute exercise groups. The SHR-AEX group was conducted by running on a motor-driven treadmill at the moderate speed of 21 m/min <0% slope> for 60 min. After the single-bout exercise, thoracic aortas were immediately isolated for the evaluation of vascular function by organ bath system. Also, the NO production was measured immediately after the exercise. In contrast, no exercise intervention was conducted for the SHR-S and WKY groups.
RESULTS: After the single-bout exercise, we found that the insulin-induced vasorelaxation was significantly improved in the SHR-AEX groups compared with the SHR-S group. However, no significant changes were found in the denuded aortas among three groups. Moreover, the single-bout exercise acutely increased NO production in the SHR-AEX groups compared with the SHR-S group.
CONCLUSION: Our findings indicated that the endurance exercise acutely improved the insulin-induced vasorelaxation and NO production in 12-month-old hypertensive rats. It suggested that the single-bout endurance exercise would ameliorate the vascular function, which was associated with the increased NO production, in the aging population with hypertension.
References: Ferrari AU, Radaelli A, Centola M. <2003>. J Appl Physiol, 95<6>, 2591-2597.
Heckman GA, McKelvie RS. <2008>. Clin J Sport Med, 18<6>, 479-485.
Orkaby AR, Forman DE. <2018>. Expert Rev Cardiovasc Ther, 16<1>, 1-10.
Contact: s41902@gmail.com; yangailun@gmail.com

RELIABILITY OF THREE PHYSICAL ACTIVITY QUESTIONNAIRES FOR ELDERLY PEOPLE: THE RESULTS FROM POLISH ADAPTATION

KRÓL-ZIELINSKA, M.1, KANTANISTA, A.1, CIEKOT-SOLTYSIAK, M.2, SZEKLICKI, R.3, OSINSKI, W.3, ZIELINSKI, J.2

POZNAN UNIVERSITY OF PHYSICAL EDUCATION

Introduction: There is lack of reliable and validated physical activity questionnaire adapted to Polish elderly population to improve research quality on physical activity. The aim of the study was to estimate reliability of three different physical activity questionnaires for older adults, adapted to Polish culture. The following questionnaires have been selected: Community Healthy Activities Model Program for Seniors - CHAMPS (Stewart et al. 2001), Physical Activity Questionnaire for the Elderly – PAQE (Voorrips et al. 1991) and Yale Physical Activity Survey – YPAS (DiPietro et al. 1993).
Methods: In order to assess the measurement reliability of the adapted version of each questionnaire in terms of the stability aspect, repeated measurements were performed. The reliability of the CHAMPS, PAQE and YPAS was assessed by test-retest within 1 week (1st examination) and after 3, 6, and 9 month. Of the 104 independently living elderly people (age 72.2 ± 5.7) who completed each questionnaire twice within 1 week, 73 older adults filled in again each questionnaire in next three examinations. Spearman's rank correlation coefficients were calculated.
Results: The one week test-retest reliability correlations for all physical activity measures ranged from 0.62 to 0.70 for the CHAMPS, from 0.49 to 0.78 for the PAQE and from 0.39 to 0.78 for the YPAS. Caloric expenditure of all physical activities assessed with the CHAMPS in 1st examination was correlated to the results obtained 3, 6 and 9 month later (coefficients: 0.58, 0.69, and 0.51, respectively). For the PAQE, the 3-month, 6-month and 9-month stability of activity score was 0.57, 0.45 and 0.32, respectively. Reliability coefficient for energy expenditure evaluated by the YPAS was 0.60 after 3 month, 0.66 after 6 month, and 0.62 after 9 month.
Conclusion
Polish adaptations of CHAMPS, PAQE and YPAS questionnaires have similar reliability to their original versions and are suitable for use among older Polish people.
References: DiPietro, L., Caspersen, C. J., Ostfeld, A. M., Nadel, E. R. (1993). A survey for assessing physical activity among older adults. Medicine & Science in Sports & Exercise, 25(5), 628-642.
Stewart, A. L., Mills, K. M., King, A. C., Haskell, W. L., Gillis, D. D., & Ritter, P. L. (2001). CHAMPS physical activity questionnaire for older adults: outcomes for interventions. Medicine & Science in Sports & Exercise, 33(7), 1126-1141.
Voorrips, L. E., Ravelli, A. C., Dongelmans, P. C., Deurenberg, P. P., Van Staveren, W. A. (1991). A physical activity questionnaire for the elderly. Medicine & Science in Sports & Exercise, 23(8), 974-979.
This study was supported by a Polish National Science Centre grant no. 013/09/B/HS6/02622.

OBJECTIVELY ASSESSED LEVELS OF PHYSICAL ACTIVITY OF ADOLESCENTS IN BEIJING, CHINA

WANG, C., HE, G., JI, G.

CAPITAL UNIVERSITY OF PHYSICAL EDUCATION AND SPORTS

INTRODUCTION: Objective data on adolescents' physical activity (PA) in China are rare. The aim of this study was to objectively assess the PA level of adolescents in Beijing, China using accelerometer.
METHODS: 1100 students were randomly recruited as participants from ten junior high schools located in ten Districts of Beijing, China. Age and sex were reported by participants. Body weight and height were measured by investigators, and body mass index (BMI) was then calculated. According to the standard developed by the Working Group on Obesity in China, participants were classified as overweight and non-overweight based on their BMI. Participants wore the ActiGraph GT3X+ accelerometer for seven consecutive days for objective assessment of PA. Time spent in light PA (LPA), moderate PA (MPA), vigorous PA (VPA), and moderate-to-vigorous PA (MVPA) were derived based on the cut-offs specifically developed for Chinese youth (Zhu et al., 2013). Independent sample T-test was performed to compare the differences of PA time between sexes and weight status. Paired sample T-test was used to examine the difference of PA time on weekdays and weekend days.
RESULTS: 673 participants who provided valid accelerometer data (number of boys = 262; mean age = 12.6 ± 0.6 years) are included in the data analysis. Of which, 20.5% were classified as overweight. Participants spend an average of 142.7 ± 36.7 min, 19.6 ± 7.2 min, 22.1 ± 11.5 min, and 41.8 ± 16.7 min daily on LPA, MPA, VPA, and MVPA, respectively. Only 13.2% of the overall sample meet the recommended 60min/d MVPA guideline. Participants are more active on weekdays than on weekend days (MVPA: 47.1 ± 18.4 min/d vs. 27.2 ± 20.9 min/d, $p < 0.05$). Boys spend more time on MVPA (48.3 ± 17.4 min/d vs. 35.9 ± 13.8 min/d, $p < 0.05$) and have a higher proportion that meet the PA guideline than girls (21.0% vs. 5.4 %). Daily LPA (136.7 ± 33.1 min/d vs. 150.3±36.1 min/d, $p < 0.05$) and MPA time (18.5 ± 6.8 min/d vs. 20.9 ± 7.3 min/d, $p < 0.05$) of non-overweight adolescents are lower than those of overweight counterparts.
CONCLUSION: PA levels of Chinese adolescents are extremely low. Intervention programs may take girls and weekend days as the targets for PA promotion.

History
Molecular Biology and Biochemistry

THE EFFECT OF INACTIVITY ON THE FUNCTION OF SATELLITE CELLS

YUYA, O.

UNIVERSITY OF TSUKUBA

INTRODUCTION: Muscle specific stem cells, termed satellite cells, play pivotal roles in postnatal growth, maintenance, repair, and regeneration of skeletal muscle. It is reported that exercise increases the number of satellite cell and improves its function. On the other hand, inactivity is reported to decrease the number of satellite cells, however it remains unclear the effects of the function of satellite cells like activation, proliferation or self-renewal. To investigate the effect of inactivity on the function of satellite cells, we adopted hindlimb suspension and reloading and single fiber immunostaining.
METHODS: 5 weeks of age male C57/BL6 mice were divided into two groups: CON (normal keeping) and HS-RL (1 week hindlimb suspension 2 weeks reloading). After 3 weeks keeping, mice were sacrificed and gastrocnemius, soleus and extensor digitorum longus (EDL) muscles were quickly dissected out from each mouse for subsequent analyses. Single fibers were obtained from EDL muscle. Single fibers were cultured in plate medium. After culture, each single fiber was fixed and immunostained to evaluate satellite cells function.

RESULTS: There are no changes in body weight and muscle wet weight between two groups. Immunostaining indicated the reduction of satellite cells proliferation number in HS-RL group mice EDL fiber cultured 48 hours.
CONCLUSION: Inactivity decrease the satellite cell number (Arentson-Lantz et al., 2016). However, its effect on satellite cells function is unclear. On the other hand, exercise improves its function (Fujimaki et al., 2016). In this study, we revealed that hindlimb suspension impairs satellite cell proliferation like aging (Zhang et al., 2016) even after 2 weeks hindlimb reloading. To conclude, inactivity depress the satellite cell function.

EFFECTS OF EXERCISE TRAINING ON ANTI-INFLAMMATION CYTOKINES OF THE MYOCARDIUM AND SKELETAL MUSCLE IN OBESE AGED RATS

AHN, N., KIM, K.

KEIMYUNG UNIVERSITY

INTRODUCTION: Depression of cardiac muscle function is the important factor of the increasing prevalence of metabolic syndrome through the increase of inflammatory cytokines. Especially, myocardium may drive the stimulation of the anti-inflammatory cytokine expression with different mechanism as compared to skeletal muscle. We should try to develop the effective exercise training program of cardiac function for the prevention of metabolic syndrome, and we can suggest the importance of combine exercise training for activation of anti-inflammatory function. Therefore the purpose of this study is the analysis of the anti-inflammation cytokines expression mechanism of cardiac muscle for improves cardiovascular function.
METHODS: 50 male, middle-aged Sprague-Dawley rats were induced to become obese with 8 weeks of a high-fat diet, and were randomly divided into four experimental groups: normal diet (ND), normal diet exercise (NDEx), high-fat diet (HFD), high-fat diet exercise (HFDEx). The exercising groups underwent high-intensity intermittent training using a ladder-climbing and weight exercise and treadmill-running exercises 3 days/week for a total of 12 weeks. Myocardium and skeletal muscle were analyzed the protein expressions of Heat shock protein (HSP) and interlukin 15 (IL-15) by western blotting.
RESULTS: The exercise group (NDEx and HFDEx) of the HSP protein levels significantly ($p<0.005$) increased than non-exercise group (ND and HFD) in myocardium. Also, high-fat diet exercise (HFDEx) of the IL-15 protein levels significantly ($p<0.005$) increased than non-exercise group (ND) in myocardium. However, there was no significant difference in skeletal muscle.
CONCLUSION: Exercise training confers a myriad of physiological benefits in aging and cardiovascular diseases through its antioxidant and anti-inflammatory actions. Heat shock proteins are highly conserved chaperone proteins that regulate the folding and processing of damaged proteins and therefore exert significant anti-inflammatory action (Walsh et al., 2001). Exercise increases nutritive blood supply to and removes waste from skeletal muscles, while also upregulating the expression of the anabolic myokine IL-15 (Nielsen et al., 2007). Therefore, exercise training can contribute to the prevention of aging- and obesity-associated decrease in cardiac function as a increase anti-inflammation cytokines expression of cardiac muscle for improves cardiovascular function.
* This work was supported by the National Research Foundation of Korea Grant funded by the Korean Government (NRF-2017R1A2B1008644).

EFFECTS OF EXERCISE ON BONE METABOLISM MEDIATED BY BMP-SMAD1 SIGNALING PATHWAY

JUN, Z., LINGLI, Z.

DEVELOPMENT AND PLANNING OFFICE

INTRODUCTION: The study tends to reveal how bone morphogenetic protein signaling pathways affects bone metabolism in the process of exercise training, via checking bone mineral density (BMD), biomechanics characteristics and blood and urine indices after injecting mice with Smad1 activating enzyme inhibitor, running a treadmill exercise or both.
METHODS: 72 six-week-old C57BL/6 male mice were divided into 4 groups as follows (18 mice for each group): control group (C group), exercise group (E group), LDN group (LDN+C group), exercise in combined with LDN group (LDN+E group). The mice were trained on a treadmill. The starting speed was 12 m/min, for 20 min per day, with 0° slope. In the firstly two weeks, the speed was increased by 3 m/min every other day, and the duration was increased by 10 min every other day. After a period of adaptation, from the third week to the end, the speed was 18 m/min, on a 5° slope, with the training duration of 50 min per day. Training was continued for 6 weeks, 6 days per week. The speed of exercise group was equivalent to 85 % maximal oxygen uptake (VO2max). Mice in the LDN groups were injected with LDN (LDN-193189HCL, Selleck chem) on Wednesday from the third week to sixth week. LDN (3mg/kg body weight) was mixed with DMSO and slowly added this DMSO liquor into physiological saline. LDN powder was completely dissolved using water bath ultrasonic and dissolved by 0.22 μm filter. Each mouse was weighed before injecting and the doses of LDN were adjusted. After intervention, we check mineral density of femoral bone, biomechanics characteristics (maximum load, yield stress and elastic modulus), and blood and urine indices (serum calcium level, serum phosphate level, urinary DPD/Ucr).
RESULTS: Firstly, the BMD of E group was greatly higher than C group ($P<0.01$) and the BMD of LDN + E group was higher than LDN + C group ($P<0.05$), but it sharply lower than LDN + C group ($P<0.01$). The serum calcium level of LDN + E group was higher than LDN + C group ($P<0.05$). Moreover, the serum calcium level of LDN + C group was greatly higher than C group ($P<0.01$), and LDN + E group was greatly higher than E group ($P<0.01$). In addition, serum phosphate level of LDN + C group was higher than C group ($P<0.05$) and LDN + E group was higher than E group ($P<0.05$). DPD of LDN + C group was higher than C group ($P<0.05$) and LDN + E group was higher than E group ($P<0.05$).
CONCLUSION: Exercise could improve BMD of growing mice, but injecting LDN-1931189HCL greatly inhibits the effect of exercise, which represents that BMP-Smad1 signaling pathway induces effects of exercise on bone resorption but it has no significant effect on bone biomechanics characteristics.

EFFECT OF EXERCISE TRAINING ON SKIN-GAS NITRIC OXIDE CONCENTRATIONS AND ANTIOXIDATIVE CAPACITY IN RATS

ITOH, H.1, UTSU, Y.1, KATO, H.1, MINAGAWA, A.1, TSUDA, T.1, MATSUMOTO, T.2

1: NAGOYA INSTITUTE OF TECHNOLOGY, 2: NAGOYA UNIVERSITY

INTRODUCTION: Exercise training increases the plasma nitrite and nitrate (NO_2^- + NO_3^-; NOx) as an index endogenous formation of NO (Xiao and Qian 2000). However, no one has confirmed the effect of exercise training on skin-gas NO concentrations. We have previously reported that exercise training reduced basal level of reactive oxygen species (ROS) by increasing antioxidative capacity (glutathione

redox system) (Itoh 1998). On the other hand, oxidative stress reduces the bioavailability of vascular NO (Förstermann 2010), there is no data concerning the relationship between skin-gas NO concentrations and antioxidative capacity. Therefore, the purpose of the present study was to examine the effect of exercise training on skin-gas NO concentrations emanating from rat tails and to confirm relationships among skin-gas NO, plasma NOx concentrations, and antioxidative capacity in rats.
METHODS: Wister male rats (5 weeks of age) were divided into sedentary (S) and training (T) group. Exercise training was carried out on treadmill (12-20 m/min, 30min, 4 days/wk, 10-15 wk). The skin-gas samples were obtained by covering the tail with a polyethylene bag in which pure nitrogen gas was introduced, and collected in a sampling bag at rest. The skin-gas NO concentration was measured by a chemiluminescence analyzer (Pico-Device Co., Ltd., Nagoya, Japan). At 16 weeks of age, rats were anesthetized and blood and liver was taken. The plasma NOx (BioAssay Systems, USA), aorta NOS activity analyzed with a kit (Oxford Biomedical Research). Reduced (GSH) and oxidized (GSSG) glutathione (HPLC), MDA (UV) in plasma and liver, furthermore, systolic blood pressure (SBP) and heart rates (HR) were also measured from the tail (KN-210; Natsume Co., Ltd.).
RESULTS: Significantly higher skin-gas NO, plasma NOx concentrations ($p<0.05$), and lower SBP, HR ($p<0.05$) were observed in T compared to S. On the other hand, no significant difference was found in aorta NOS activity, MDA in plasma and liver between S and T. A higher GSH/GSSG tendency was observed in T compared to S, however, no significant difference was found between T and S.
CONCLUSION: These results suggest that exercise training increased skin-gas NO and plasma NOx concentrations of rats. Increased eNOS content in leg muscles and eNOS expression in cardiac muscle (McAllister 2008) of trained rats might be reasons of increased NO production in the vascular endothelial cells, nevertheless no significant difference was found in aorta NOS activity. Moreover, a higher GSH/GSSG tendency observed in T and decreased plasma endothelin-1 concentrations (Maeda 2003) which was potent vasoconstrictor peptide produced by vascular endothelial cells might be the reasons of increased NO bioavailability in the blood. Therefore, exercise training in this study decreased SBP and HR in trained rats.

EFFECT OF BLACK TEA DERIVED POLYPHENOL FRACTION ON MUSCLE ATROPHY AND RECOVERY IN MICE

AOKI, Y.
UNIVERSITY OF TSUKUBA

INTRODUCTION: Recently, there are some reports that polyphenols have some good effects on muscle. Our laboratory originally purified high-molecular-weight polyphenols extracted from black tea. We named it Mitochondria Activation Factor (hereafter, MAF), because MAF enhanced mitochondrial membrane potential of ciliated protista Tetrahymena pyriformis (Fujihara et al.). We found MAF raises AMPK (regulator of PGC-1 alpha, which stimulates mitochondria biogenesis) phosphorylation level and improves endurance performance in mice (Eguchi et al.). Recently, we extracted crude MAF fraction with 80% ethanol, and named this fraction E80. In this study, we examined whether E80 prevented skeletal muscle of mice during tail suspension or promoted recovery from muscle atrophy.
METHODS: Adult mice (8 weeks of age) were fed on food containing 0.5% E80 during 2 weeks of tail suspension and 5 days or 10 days of recovery after 2 weeks of tail suspension. After these process, mice were euthanized by cervical dislocation and excised soleus muscle.
RESULTS: We measured muscle wet weight and molecules regulating muscle mass and some molecules regulating hypertrophy. Then, we found E80 may have potential for promoting recovery of muscle mass from atrophy by tail suspension.
CONCLUSION: Previously, we reported E80 promote muscles hypertrophy during functional overload in mice. In this study, we demonstrated E80 has potential for promoting recovery of muscle mass from atrophy.

BODY FAT, REDOX BALANCE AND TELOMERE LENGTH OF MIDDLE AGED UNTRAINED AND MASTER ATHLETES

AGUIAR, S.S., SOUSA, C.V., SANTOS, P.A., BARBOSA, L.P., DEUS, L.A., ROSA, T.S., ANDRADE, R.V., SIMÕES, H.G.
CATHOLIC UNIVERSITY OF BRASÍLIA

INTRODUCTION: Several evidences suggest that low body fat is associated with a lower oxidative stress and a longer telomere length (TL), however, these parameters have not yet been investigated in track and field master athletes. We compared and associated the % body fat, redox balance and TL of master athlete runners (MA) and untrained middle aged controls (CON).
METHODS: Both MA (n=21; 51.6±8.1yrs) and CON (n=11; 45.4±10.3yrs) had anthropometrics and blood samples collected for biochemical and molecular analyzes. Pro and antioxidant measures as well as DNA extraction were performed using commercial kits following the fabricant protocols. TL was measured through quantitative PCR analyses for relative TL determination (T/S).
RESULTS: The TL of MA group ($T/S = 1.10 \pm 0.84$) was longer than CON ($T/S = 0.56 \pm 0.56$; $p = 0.038$). A large effect-size between MA and CON (Cohen's $d = 0.849$) was also observed. The comparison of antioxidant/pro- oxidant ratios indicated a better redox balance for the MA in comparison to the studied middle aged CON, which showed lower values for SOD/TBARS and CAT/TBARS ($p < 0.05$). Furthermore, MA had lower body fat (12.21±4.1%) than CON (26.02±4.3; $p = 0.001$), with a significant positive correlation between TL and CAT/TBARS ($r = 0.380$; $p = 0.032$) and a negative correlation between TL and body fat ($r = -0.471$; $p = 0.007$).
CONCLUSION: In conclusion, master athletes have longer TL than untrained peers, what in turn seems to be related to their better body composition and redox balance.

ASSOCIATIONS OF PPARG AND PGC-1A GENE POLYMORPHISMS WITH BODY STRUCTURE

BOSNYÁK, E., TRÁJER, E., PROTZNER, A., GYÖRE, I., MÓRA, Á., TÓTH, M., SZMODIS, M.
UNIVERSITY OF PHYSICAL EDUCATION

INTRODUCTION: The PPARG gene codes a nuclear hormone receptor, and is involved in the regulation of several genes, and metabolism pathways. The activitation of the gene results the decrease of insuline resistency and the increase of the adiponectin's level, which is one of the fat cells' hormones. Through these mechanisms the gene enhances the insuline sensitivity. The rs1801282 polymorphism was associated with body weight, body mass index and waist circumference.
The biogenesis of the mitochondria goes through the activation of the PGC-1α . The PGC-1α takes part in the induction of the enzymes that are neccessary for carbohydrate and fatty acid consumption as well. The rs8192673 polymorphism of the PGC-1α gene was associated with insulin resistance, obesity indices in women, lipid metabolism and insulin secretion. The aim was to describe the PPARG and PGC-1α genotype frequencies and the possible connetions to body dimensions and obesity indices.
METHODS: 324 participants were involved to the study, both athletes and controls . Genotype analysis was carried out via a DNA chip, anthropometric measurements were taken according to the International Biological Program. The level of significance was 5%.

RESULTS: The PPARG genotype frequencies in the total sample were: Pro12Pro=62.04%, Pro12Ala=21.91%, Ala12Ala=16.05%, while that of the PGC-1α were: CC=10.63%, CT=45.85%, TT=43.52%. There was significant difference in the athletes' group in the values of the upper arm circumferences , and in the values of the upper arm circumference minus the biceps skinfold between the Pro and Ala homozygote genotypes. The difference in the triceps skinfold was significant between the genotypes in control group . Grouping the participants according to the WHO BMI categories the genotype frequencies differed in control group. There were no relations between PGC-1α genotypes and obesity indices in this sample.
CONCLUSION: The AlaAla genotype was associated with higher mid upper arm circumference and mid upper arm circumference minus biceps skinfold values among athletes, while the same polymorphism was connected to higher triceps skinfold in controls. These results suggest no clear connection between the PPARG variants and body dimensions, confirming the international results. This study have not found any relation between the PGC-1α rs8192673 polymorphism and obesity indices.

NOVEL USE OF UNTARGETTED METABOLOMIC PROFILING OF TREADMILL ULTRAMARATHON RUNNING

MOIR, H.J.1, HOWE, C.C.F.1, ALSHEHRI, A.2, MUGGERIDGE, D.2, MULLEN, A.B.2, BOYD, M.2, SPENDIFF, O.1, WATSON, D.G.2
1: KINGSTON UNIVERSITY LONDON , 2: UNIVERSITY OF STRATHCLYDE

INTRODUCTION: The rising popularity of ultramarathon running over the past few years has seen non-professional runners striving for bigger and tougher extreme physical challenges. Understanding the effects of ultramarathon events and the ultramarathon runners profile provides a unique model to investigate the physiological responses to prolonged physical exertion. The current study determined the metabolic changes induced by extreme exercise through ultra-marathon running in order gain an insight into how metabolism is adapted for endurance performance. Plasma samples were analysed for their metabolomic profiles to determine the metabolic changes. The aim of the current study was to analyse the change in metabolic profile of trained ultramarathon runners in response to an 80.5km simulated treadmill ultramarathon.
METHODS: Metabolomic profiling of nine trained male ultramarathon runners was performed in response to an 80.5km self-paced treadmill-based time trial performed in a controlled laboratory environment. Plasma samples were obtained from venous whole blood, collected at rest, half-way (40.25km) and on completion of 80.5km (post-80.5km). Samples were analysed by high resolution mass spectrometry in combination with both hydrophilic interaction (HILIC) and reversed phase (RP) chromatography. The extracted putatively identified features were modelled using Simca P 14.1 software.
RESULTS: The runners completed the distance in 09:00:18±01:14:07 (hh:mm:ss), at a running velocity of 9.8±1.3 km.h-1. The exercise induced a large number of metabolic changes with multiple amino acids decreasing in abundance while there were increases in the levels of a number of acylcarnitines, fatty acids and oxidised fatty acids. There were no significant differences observed between the halfway (40.25km) and post-80.5km samples (p>0.05). A large number of amino acids decreased and fatty acid metabolism was affected with an increase in the formation of medium-chain unsaturated and partially oxidised fatty acids and conjugates of fatty acids with carnitines.
CONCLUSION: A marked elevation in acylcarnitine levels suggests a source of energy for export into the musculoskeletal mitochondria. The fall in the amino acids used in protein biosynthesis may be due to an increase in protein biosynthesis during exercise. Elevation of oxidised fatty acids may be associated with potent effects on blood vessels promoting either vasodilation or vasoconstriction or as markers of oxidative stress. The pattern of fatty acids and carnitines observed in the current study suggests a large increase in peroxisomal metabolism providing acetyl carnitine as a fuel source. This is the first study to provide evidence of the metabolic profile in response to prolonged ultramarathon running using an untargeted approach. The findings provide an insight into the effects of ultramarathon running on the metabolic specificities and alterations that may demonstrate cardio-protective effects.

Motor Learning and Motor control

EFFECTS OF DIFFERENT PROTOCOLS OF PHYSICAL EXERCISE IN AQUATIC MEDIUM ON MOTOR-COGNITIVE PERFORMANCE AND COGNITIVE FUNCTION ON PHYSICALLY ACTIVE ELDERLY: A CROSSED STUDY

FRANÇA BARROS, J., ANDRÉ GOMES DA SILVA, R., BEZERRA PADILHA, K., RAFAELLY DA SILVA PERES, I., RIBEIRO DA SILVA, A., ANSELMO SILVA DE LIMA, F., ALBERTO VIEIRA BROWNE, R.
UNIVERSIDADE DE BRASÍLIA / UNIVERSIDADE FEDERAL DO RIO GRANDE DO NORTE

INTRODUCTION: The aging process is inevitable, but it varies from individual to individual the effects caused by it, it is known that active aging slows down the degenerative effects caused by advancing age, thus being dependent on the program of activities practiced over time will contemplate modifications different substances on the motor and cognitive performances compared to the elderly who do not have an active lifestyle. Objective: To analyze the acute effects of different sessions (automatic, dual task, cognitive and moment control) on gait performance and executive function in physically active elderly women.
METHODS: This is a randomized controlled trial with a cross-over design, where each subject will undergo two sessions of scientifically-based physical exercises (dual task and automatic session), a session with cognitive stimulation and a control momentum, as described The dual task session occurred through exercises with stimuli based on motor learning with new movements in the aquatic environment, the automatic session occurred through exercises with standardized movement in the aquatic environment, and the cognitive session occurred through cognitive (audiovisual) stimuli by In the midst of a video demonstrating aquatic physical exercises, the moment of control there was no type of motor and cognitive stimulation, in which the subjects remained lying on a mat. To analyze the effect on gait performance, the gait and gait test was used in different situations and to analyze the executive function, we used the gait tests A and the stroop test. The normality of the data was verified by the Shapiro-Wilk test. The data were expressed in median and 25th and 75th percentiles. Friedman test was applied to compare the absolute change values (? = post - pre) of each dependent variable between the exercise sessions. Wilcoxons test was used in the intra-condition comparison of each dependent variable. The size of the effect was calculated by the following formula: [z / v n]. The level of statistical significance was set at p <0.05. Statistical procedures were performed using SPSS for Win / v.22.0 (Statistical Package for Social Sciences, Chicago, IL, USA)
RESULTS: Regarding gait performance and executive function, no statistically significant difference was found between the sessions (dual task, automatic, cognitive and moment control), but a better motor-motor gait was observed after the automatic session (p = 0.015) and double task (p = 0.001) and motor-cognitive torque only after the dual task session (p = 0.032). We also observed an improvement in the Stroop test after automatic sessions (p = 0.003) and double task (p <0.001) 0.001) and cognitive (p <0.001). There was no effect on the control session variable (p> 0.05).

CONCLUSION: The results of the study demonstrated that the dual task protocol presented a potential positive effect on the improvement of motor-cognitive performance and cognitive functions in physically active elderly women, related to the aspect of mobility and cog

WATCH OUT FOR THE HAZARD! BLURRING PERIPHERAL VISION FACILITATES HAZARD PERCEPTION IN DRIVING

RYU, D., COOKE, A., WOODMAN, T.

BANGOR UNIVERSITY

INTRODUCTION: In dynamic and time-constrained environments, such as those we encounter when playing sport or driving a car, the rapid acquisition and comprehension of a wide range of visual information is essential for successful performance. To locate the most pertinent information in these environments (e.g., the player best positioned to receive a pass in team sport, or road hazards that occur during driving), a continuous interaction between the central and peripheral parts of the visual field is thought to be crucial. However, research has yet to directly examine the comparative roles of central and peripheral vision in hazard detection; a critical component of driving performance. In the present study, we examine the role of central and peripheral vision in perceiving and detecting hazards in driving. We also compare the hazard perception ability of experienced and novice drivers.
METHODS: The gaze-contingent display paradigm was used to selectively present information to central and peripheral parts of the visual field. Twelve experienced and twelve novice drivers watched 2 sets of hazard perception test video clips (60 trials in total) in three different viewing conditions: full vision (unrestricted vision), moving window (clear central and blurred peripheral vision), moving mask (blurred central and clear peripheral vision). Participants were required to locate hazardous situations by making a mouse click on each hazard as soon as it was detected.
RESULTS: The experienced drivers were more accurate at detecting hazards than the novices. Both groups showed more accurate and faster responses to hazards in the full vision and moving window conditions than the moving mask condition. Most Interestingly, response accuracy was highest in the moving window condition, especially for experienced drivers. Gaze behaviour analyses revealed a narrower search strategy in the moving window condition compared to the full vision and moving mask conditions. Finally, if participants fixated on a hazard, they were more likely to correctly identify it as a hazard in the moving window condition than in the other two conditions.
CONCLUSION: The findings indicate that central vision is important in driving regardless of skill level. More importantly, blurring peripheral vision facilitates the processing of prominent information (i.e., hazards) by removing less relevant information from the visual field, and leads to more accurate performance especially for experienced drivers. Our finding paves the way for future research to use blurred peripheral vision as a training tool to enhance hazard perception in any domain where this is a crucial component of performance, including car driving and sport.

VISUAL SEARCH STRATEGIES IN EXPERIENCED FEMALE SOCCER PENALTY TAKERS: RESPONSES TO FIVE GOALKEEPER TACTICS

ELLISON, P.

EDGE HILL UNIVERSITY

Introduction: Visual search strategies are used to identify key performance cues and are used by penalty takers to establish shot placement to improve chance of success (Wilson, Wood and Jordet, 2013). Three main strategies employed are: keeper-independent (ignore keeper and pick a spot); keeper dependent (wait for keeper to move); and opposite-independent (look one way and shoot the other). However, goalkeepers can employ techniques to influence or distract the player in order to be able to save the shot (Wood and Wilson, 2010). The aim of this study was to investigate differences in visual search strategies in experienced female soccer players and their responses to five different goalkeeper techniques.
Method
This study used a within-subjects research design. Thirteen experienced (≥ 5 years' experience) female soccer players (Mean age = 20.12, SD = 2.23 years.) took part. In order to establish preferences, they were asked which penalty taking strategy they preferred prior to participating in the study. They viewed 20 video clips of a simulated penalty scenario, and were instructed to watch and finally fixate their gaze in the section of the goal that they would shoot the penalty. Five randomly presented goalkeeper movement categories were evenly presented: stationary (ST), jockeying (JK), off centre (OC), crouching (CR) and focused arm movement (AM). Total of eye fixations (TF), duration of fixations (DF), number of fixations in areas of interest (FA), and location of last fixation (LF) were measured using a Tobii Pro X2-30 eye-tracker. ANOVA investigated differences between categories and the statistical significance level was set at $p < 0.05$.
Results: Significant differences were found between all goalkeeper movement categories ($p=0.024$). Bonferroni adjustments post-hoc found significant differences for TF between ST and JK ($p = 0.003$) and ST and CR ($p=0.043$) and JK and AM ($p=0.009$); DF between ST and CR ($p = 0.003$); and for FA between ST and JK ($p = 0.013$), and ST and OC ($p = 0.037$). LF identified comparable outcomes for all conditions.
Conclusion
Despite similarities in final fixations, goalkeeper movement categories affected visual search strategies and distracted the player viewing the penalty. Moving goalkeeper scenarios resulted in a higher numbers of fixations than those with stationary positions supporting the results of previous literature (Wood and Wilson, 2010).
References: Wilson, MR. Wood, G. Jordet, G (2013). The SES, 38, 8-9.
Wood G, Wilson MR. (2010). J Sports Sci, 28(9):937-946

MOTOR EXPERTISE MODULATES RESPONSE VARIABILITY AND BRAIN SIGNAL COMPLEXITY OF COGNITIVE CONTROL

WANG, C.

NATIONAL CHENG KUNG UNIVERSITY

INTRODUCTION: Motor expertise has been associated with differences in domain-general cognitive function. However, the neural mechanisms for such effect are still unclear. Brain signal complexity, an index of information processing capacity, has recently shown to increases with training experience, taken as evidence of experience-driven neural adaptability. Accordingly, this study aimed to explore whether individual difference associated with motor expertise in cognitive control performance is linked to differential brain signal complexity.
METHODS: We employed multiscale entropy analysis of electroencephalographic , a measure of brain signal complexity that calculates sample entropy at multiple time scales, to reveal the relation of motor expertise to neural adaptability and information processing capaci-

ty. A between-subjects design that included 18 open skill sport players and 18 age- and gender-matched closed skill sport players was conducted to examine differences related to motor expertise in performance and MSE of EEG signal during a flanker task which has varying levels of cognitive demand.
RESULTS: Results revealed that open skill players made more stable responses than closed skill players, regardless of levels of cognitive demand. In terms of EEG data, we observed that open skill players showed significant conflict-related modulation on MSE values at more coarse-grained temporal scales over frontal midline areas, while such effect was not found for closed skill sport players .05 FDR corrected>.
CONCLUSION: Taken together, our findings suggest that players trained in open skill sports showed greater domain-general cognitive control than those from closed skill sports, as revealed by lower behavioral variability but higher brain variability during cognitive control processes. We thus concluded that greater complexity occurring in response to the task involving higher cognitive demands appears to reflect brain networks of adaptation to the cognitive effort and opportunity provided by specific sport training.

EFFECTS OF ACUTE MODERATE-INTENSITY INTERVAL EXERCISE INTERVENTION ON FITNESS AND ERP INDICES OF INHIBITORY CONTROL IN SEDENTARY FEMALE ADULTS

JI, W.T., CHEN, K.H., ANG, B.S., WEN, H.J.

TZU CHI UNIVERSITY

INTRODUCTION: Greater aerobic fitness is associated with superior cognitive function (Kamijo & Masaki, 2016). People with low fitness level had smaller amplitude of the P3 wave, which indicated poor attention. Physical activity and aerobic exercise in particular, promotes health and effective cognitive function. The electrophysiological (event-related potential, [ERP]) in inhibitory control performance at different fitness level still not known. Currently, moderate-intensity interval exercise (MIIE) is a popular exercise modes that combine aerobic exercise and resistance training, and was a good choice for sedentary female adults (Chen, Wen, & Ang, 2017). This study was to investigate the effects of acute MIIE intervention on inhibitory control in different fitness female adults.
METHODS: Twenty healthy sedentary female adults (aged 20-45 years) were recruited from a larger pool of potential participants and were placed into high-fit group (HF, n=10, estimated VO2max= 33.26±1.31 ml/kg/min) and low-fit group (LF, n=10, estimated VO2max= 21.84±1.34 ml/kg/min). All participants accept an acute MIIE 30 min which including 4 cycles in a session, 6 sets in one cycle, 1 minute per set, and 15 seconds break between each set. During training, the HR was monitored using telemetry HR monitor to ensure they reached target HR. The inhibitory control performance data (accuracy rate [ACC] and reaction time [RT]) and electrophysiological (ERP) indices were simultaneously to record the amplitude and latency of N2 wave when participants performed a go/ nogo task before and after the acute MIIE.
RESULTS: The results showed that at baseline, the percentage body fat in LF (40.4±4.8%) was significant higher than HF (31.8±3.1%, $p<0.001$). ACC at baseline in go condition significantly higher in HF (100.0±0%) than in LF (99.8±0.26%, p=.025). however, ACC significantly decreased in HF (pre 100.0±0%, post 99.3±0.89%; p=.026) after the acute MIIE, whereas no change in LF (pre: 99.8±0.26%, post 99.3±1.42%, p=.221). N2 amplitudes revealed significant main effects of condition [$F(1,18) = 7.2$, $P=0.015$, $\eta p1 = 0.286$] and electrode [$F(2,36) = 5.78$, $P=0.007$, $\eta p2 = 0.24$], with the go condition exhibiting smaller than the nogo condition, and the N2 amplitude at the FCz significantly larger than those at the Cz and Fz sites. There were significant interactions among time × group [$F(1,18)=5.82$, $P=0.027$, $\eta p2=0.24$], after post hoc revealed that at HF after acute MIIE the N2 amplitude in go condition at Cz was higher than that in LF (pre adjust -1.99, post HF adjust -1.367 vs. LF adjust -3.04, p=.016).
CONCLUSION: A single bout of 30-min MIIE showed an acute effect on inhibitory control, which significantly enhanced the N2 amplitude at Cz in high-fit sedentary female adults than that in low-fit. Further work could investigate the long-term effects of MIIE on inhibitory control performance and ERP indices in sedentary female adults.
(MOST 106-2410-H-320-004 & TCMMP 105-03-01 supported the study)

DOES COORDINATION PREDICT MAXIMAL STRENGTH AND STRENGTH GAINS IN YOUNG FEMALE ELITE BASKETBALL PLAYERS?

SEMPF, F., KÖNIG, B., GLAG, D., THIENES, G.

UNIVERSITY OF GÖTTINGEN

INTRODUCTION: Coordination is regarded as an important factor in the development of sport and condition skills (Meinel & Schnabel, 2015; Schnabel, 2014) and training of coordinative abilities such as balance can be linked to improvements in performance (Hrysomallis, 2011) and strength gains (Heitkamp, Horstmann, Mayer, Weller & Dickhuth, 2001). The purpose of this study was to examine if a basketball adjusted coordination level (CL) is related to maximal strength and predicts strength gains after a strength training intervention in young female elite basketball players.
METHODS: A convenience sample of 14 female elite basketball players (age = 15.21 ± 1.31 years, height = 174.89 ± 8.55 cm, weight = 60.07 ± 5.48 kg) was tested in four coordination tasks (dribbling course, free throw, jumping laterally, modified star excursion balance test) and subsequently for their maximal isometric upper body strength (MIUBS) using a Dr. Wolff Backcheck device (Dr. Wolff Sports & Prevention GmbH, Amsberg, Germany). After 8 strength training sessions consisting of lower and upper body movements MIUBS of the players was retested. A z-transformation was used to calculate CL from the four coordination tasks and the relationships were computed using Kendall's Tau. A paired t-test was conducted to assess differences between pre- and post-training MIUBS.
RESULTS: Significant changes in MIUBS were observed after the training intervention (+35.79 ± 18.02 kg; $p \leq .001$; $d = 1.99$), albeit no significant correlations ($p \geq .05$) could be found between CL and pre-/ post-test MIUBS or strength gains after the intervention.
CONCLUSION: While the importance of coordination is often presumed to be an important factor for physical abilities, coordination as evaluated in this study seems not to affect MIUBS or strength gains in young female elite basketball players. However, due to the small sample size the results should be regarded with caution. Further studies should include a dynamic strength test and investigate if these findings are similar in male athletes.
REFERENCES:
Heitkamp, H. C., Horstmann, T., Mayer, F., Weller, J. & Dickhuth, H. H. (2001). International journal of sports medicine, 22 (4), 285-290.
Hrysomallis, C. (2011). Sports medicine. 41 (3), 221-232.
Meinel, K. & Schnabel, G. (2015). Aachen: Meyer & Meyer.
Schnabel, G. (Hrsg.). (2014). Aachen: Meyer & Meyer.
Contact: felix.sempf@sport.uni-goettingen.de

THE INFLUENCE OF LIGHT FINGERTIP TOUCH ON FEED-FORWARD AND FEED-BACK CONTROL IN POSTURE STABILITY

EDAMATSU, C.

KURASHIKI UNIVERSITY OF SCIENCE AND THE ARTS

INTRODUCTION: We propose a new method "stabilogram fan-shaped analysis (SFA)", which representing the COP fluctuation with one variable by calculating the area of the circular sector defined by the COP sway vectors. This concept is both similar to "stabilogram diffusion analysis (SDA)" (Collins et al., 1993) and Nagano's analysis (Nagano et al., 2010). These methods can analyze the dynamic characteristics of postural control. Meanwhile, light touch to stable object with a fingertip stabilizes standing posture because of it generates extra somatosensory information. While the effect of light touch has been studied, less attention has been given to the dynamic characteristics of postural control, particularly for feed-forward and feed-back control. The purpose of this study was to investigate the influences of light fingertip touch on feed-forward and feed-back control in posture stability.
METHODS: Nine healthy young subjects participated. Stabilographic examinations were performed during the trials with (LT) and without (NT) lightly touching a stable object. The time-series data for the COP were acquired at 100 Hz with a 30-s sampling time.
Using the SFA method, the area of the circular sector was defined by the velocity vector after a certain time interval (ΔT) was calculated. The area was then averaged over the number of time intervals that made up the COP time series. This process was repeated for increasing values of ΔT. A plot of the mean area of the circular sector versus ΔT was called SFA plot. The FFratio was defined as the ratio of the integrated value of SFA plot up to 0.10 s to that up to 3.0 s. Additionally, the FBratio was defined as the ratio of the integrated value of SFA plot from 0.20 s to 0.70 s to that up to 3.0 s.
RESULTS: The FFratio and the directional change of COP sway in the feed-forward phase was significantly larger for the LT condition. This implies that the COP sway for the LT condition displayed a random-like nature as one would expect from predictive postural control in the feed-forward phase. Meanwhile, there was no significant difference for any conditions with regard to the FBratio and the directional change of the COP sway in the feed-back phase.
CONCLUSION: These results suggest that light fingertip touch alters feed-forward control, but doesnt alter feed-back control in posture stability.

THE RELATIONSHIP BETWEEN TACTICAL SKILLS AND SHOOTING SKILLS OF BASKETBALL AMONG COLLEGE STUDENTS

KONNO, R.

J. F. OBERLIN UNIVERSITY

The purpose of this study is to assess the relationship between tactical skills and shooting skills, as one of individual skills, among college students taking a basketball class, considering their experience of playing sports in a club team and whether or not they take a teaching profession class in college of health and physical education.The participants were 55 college students taking a basketball class. They completed the Tactical Skills Inventory (Elferink-Gemser et al., 2004) at the beginning of the basketball course. Regarding the shooting skills, the number of shooting attempts within a limited time and their successes were recorded. Students had two types of shooting (i.e., shooting close from the basket and layups after dribbling) at the beginning of the course. They practiced those two types of shooting throughout the course, and then those two types of shooting were measured at the end of the course to assess their improvement. Various experience of playing in club sports were classified into 3 groups: the group of students who has experience playing basketball in a club, the group of students who have experience playing any ball sports except for basketball, and the group of students who have experience playing the other sports. Students were also separated into 2 groups: the group of students who were taking a teaching profession class and the group of students who were not. The exploratory factor analysis on the Tactical Skills Inventory produced 2 factors; their reliabilities and validities were assessed. Correlational coefficients were calculated, and all correlations between these two tactical skills and all 4 shooting skills were found moderate. After classifying students based on their experience of playing in club sports and their choice of taking a teaching profession class, all of those correlations were recalculated, and the analyses produced different results. The group of students who were not taking a teaching profession class had significant relationships between their tactical skills and all 4 shooting skills. However, the group of students who were taking that class did not have significant relationships between those two types of skills, except for the relationship related to one of the shooting skills at the end of the course. The results of the two-way ANOVA showed that the group of students who were taking a teaching profession class had significantly greater tactical skills. It might be considered that students who were taking a teaching profession class tend to assume their own tactical skills as very great but their results of shooting skills at the beginning of the course were not as great as their tactical skills. Students who were taking a teaching profession class might had taken many sports classes and had a great confidence in general sports; therefore, they might assume that they had a great knowledge about tactical skills even specific to basketball.

EFFECTS OF THE TIME OF DAY ON SPRINT START PERFORMANCE

KESOGLOU, I., SMIRNIOTOU, A., PILIANIDIS, T., PARADISIS, G.

NATIONAL & KAPODISTRIAN UNIVERSITY OF ATHENS

INTRODUCTION: Time of day is considered to influence physiological and neurological functions of exercise performance via circadian rhythms. Sprint start is a complex motor action which critically affects the sprint performance. Chronobiological studies suggest that short-term performance and psychomotor performance are improved during the early afternoon when core temperature is at its highest level. The purpose of the present study is to determine the time day effect on sprint start performance.
METHODS: 16 healthy males (age:18-21yrs, BM: 68-75kg) participated in this study. Prior to the experimental study, an extensive number of sprint start trials were performed to familiarize the participants and to determine the most comfortable crouch position on the starting blocks. During the experimental design, the participants completed three sprint trials in each session, morning session at 09:00, evening session at 17:00 and night session at 21:00. The best out of the three trials was used for further analysis. Time of 3m (3M), Reaction-Time(RT)and pre-Motor-Time(PMT) of gastrocnemius muscle of the rear leg used to assess the sprint starting performance. The repeated-measures analysis used to determine if any significant differences existed within the day with Bonferroni confidence interval adjustments.
RESULTS: RT differentiated significantly within a day, $F(1.939, 29.079)=5.54$, $p=.010$. Post hoc tests revealed that RT reduced by 0.15sec between morning and evening ($P<.05$). RT decreased 0.12sec between morning and night($P<.05$). PMT is not significantly affected by the time of the day $F(1.683,25.239)=0.99$,$p>.05$, and 3M time also $F(1.579,23.685)=0.253$, $p>.05$.
CONCLUSION: Starting action requires advanced physiological and psychological abilities and could be influenced by several factors. The time of day has a positive influence on reaction time indicating a better sprint start performance in the evening and at night than in the

morning. PMT of gastrocnemius and time of 3M showed repeatable results within a day. More research is required to assess the sprint start performance and the muscles involved as well within a day as between days.
References: Kesoglou I, et al. (2016). J Bio Exe, 12(1), 55-68
Drust B, et al. (2005). Chron Inter, 22(1), 21-44
Chtourou H & Souissi N. (2012). J Str Cond Res, 26(7),1984-2005
Giacomoni, M., et al. (2006). Int J Sports Med, 27(6), 468-474
Contact: ikeso@phed.uoa.gr

Neuromuscular Physiology

ELECTROMECHANICAL RESPONSE TIMES IN THE KNEE MUSCLES IN YOUNG AND OLD WOMEN *

SZPALA, A., RUTKOWSKA-KUCHARSKA, A.

UNIVERSITY SCHOOL OF PHYSICAL EDUCATION IN WROCLAW

INTRODUCTION: The aim of the study was to compare electromechanical response times (total reaction time, TRT; pre-motor time, PMT; electromechanical delay) in the knee muscles in groups of young and older women during release of peak torque (PT), and to analyze the symmetry of the parameters measured. Muscles acting on the knee joint were selected for the study since the weaker stabilizing muscles of the joint increase the risk of falling among older people.
METHODS: Fifty women (one group approximately 20 years of age and the other approximately 60) participated in the study. PT and electromyographic activity were measured for flexors and extensors of the right and left knee in static conditions in response to a visual stimulus.
RESULTS: Significantly longer TRTs (p=0.05) and PMTs (p=0.05) were found in the group of older women compared to the younger participants. Asymmetry was found between the older and the younger group of women in PT of knee flexors.
CONCLUSION: Significantly longer TRT and PMT phases in the group of older women suggests a longer time for information processing in the central nervous system in older people. Electromechanical response parameters may be useful when assessing the risk of falls in older people.
REFERENCES: * Szpala A, Rutkowska-Kucharska A. (2017) Electromechanical response times in the knee muscles in young and old women, Muscle Nerve, 56(6), E147-E153.
CONTACT: agnieszka.szpala@awf.wroc.pl

EFFECT OF AGE ON MUSCLE STRENGTH OF LOWER LIMBS: A CROSS-SECTIONAL STUDY

IKEZOE, T., SATO, S., ICHIHASHI, N., TABARA, Y., NAKAYAMA, T., MATSUDA, F., TSUBOYAMA, T.

GRADUATE SCHOOL OF MEDICINE, KYOTO UNIVERSITY

INTRODUCTION: There have been many studies on age-related changes of muscle strength, and it is well known that age-related decline in the lower limbs strength such as knee extension strength is greater than that in the upper limbs strength such as hand grip strength. However, there have been few studies focusing on age-related changes in lower limbs strength, including those around the hip, knee and toe joint. We, therefore, investigated the effect of age on muscle strength constituting the lower limb muscles including those around the hip, knee and toe joint.
METHODS: The subjects comprised 2092 community-dwelling middle-aged and elderly people (744 men, 1348 women, aged 68.2±5.4 years) and 39 young people (19 men, 20 women, aged 22.6±2.7 years). Subjects with physical dysfunctions, which could potentially influence measurements such as acute neurological and severe musculoskeletal and cognitive impairments, were excluded. The subjects were divided into 5 groups according to age: young, 60-64, 65-69, 70-74, and 75 years and older.
Maximal isometric strength of the lower limbs were assessed including strength of hip flexion, hip extension, hip abduction, knee extension, quadriceps setting, and toe flexion. Muscle strength in the right leg was measured twice after a premeasurement trial, and the higher value of the two measurements was used for analysis.
We calculated the t-scores to take into account the variability in muscle strength between muscles in the young reference group. The t-score was calculated using the following equation: t-score = (muscle strength in the middle-aged and elderly − mean strength in the young) / (SD of strength in the young). Differences in the t-score between muscles were examined using a multiple comparison method (Tukey test).
RESULTS: For middle-aged and elderly men, the t-score in muscle strength was lowest for the toe flexion, followed by the quadriceps setting and hip abduction, whereas the t-score was highest for knee extension in all middle-aged and elderly groups. The multiple comparison test showed that the t-score of toe flexion has significantly smaller values than other muscles among the lower limb muscles.
For middle-aged and elderly women, the t-score in muscle strength was lowest for the quadriceps setting, followed by hip abduction and toe flexion, whereas the t-score was highest for hip extension in all middle-aged and elderly groups. The multiple comparison test showed that the t-score of quadriceps setting has significantly smaller values than other muscles.
CONCLUSION: We investigated the age-related change in muscle strength of lower limbs. Our findings showed that noticeable decreases of muscle strength were observed in the quadriceps setting, toe flexion and hip abduction in both middle-aged and elderly men and women. These results suggest that greater degree of age-related decline was seen in the quadriceps setting strength, which reflects both hip and knee extension strength, than in the knee extension strength alone.

THE RELATIONSHIPS OF SENSORY INTEGRATION TO MOTOR PERFORMANCE AND QUALITY OF LIFE IN CHILDREN WITH OBESITY

SU, C.T.1, FU, C.P.1, LU, C.I.2, YANG, A.L.3

1: FU JEN CATHOLIC UNIVERSITY, NEW TAIPEI CITY, TAIWAN 2: JIANG-TSUN UNITED CLINIC, TAIWAN 3: UNIVERSITY OF TAIPEI, TAIPEI, TAIWAN

INTRODUCTION: The global prevalence of childhood obesity has become around 30%, which is already one of the major issues of health. Previous studies have indicated inferior levels of motor performance and quality of life in children with obesity. Sensory integration is relevant of conducting many daily activities, including motor and psychosocial aspects. A few studies speculated that insufficient ability of processing sensory inputs may contribute to poorer motor skills in children with obesity , and a correlation may exist between sensory modulation ability and QOL . However, studies in children with obesity exploring either the relationships between motor performance and SI, or the relationships between QOL and SI remained limited. Thus, we examined these relationships.

METHODS: We recruited 12 children who were categorized as obesity based on the BMI norm of Taiwanese children. Their motor performance, QOL, and SI were measured by Bruininks-Oseretsky Test of Motor Proficiency , Kid-KINDL, and Sensory Profile , respectively.
RESULTS: Correlational analyses indicated that some significant relationships existed . Specifically, moderate correlations between better motor performance and more responses in SP were found in fine manual control and sensory seeking, and manual coordination and sensory avoidance. Less responses in sensory seeking were moderately correlated with better physical well-being scores. High correlations between less responses in SP and higher QOL scores were found in sensory sensitivity and family, sensory sensitivity and school, sensory avoidance and family, and low registration and school.
CONCLUSION: Some significant correlations were found between motor performance and SI, as well as QOL and SI. These results may support the influences of SI in motor performance and QOL in children with obesity. However, sample size was limited in this study. Recruiting a larger sample size were highly recommended in future studies.

EFFECT OF HEAT STIMULATION ON SKELETAL MUSCLE CONTRACTILE PROPERTIES.

HIRATSUKA, K.1, TSUNODA, N.1, SIMUNIC, B.2, DJORDJEVIC, S.2

1: KOKUSHIKAN UNIVERSITY , 2: UNIVERSITY OF PRIMORSKA

INTRODUCTION: It is many reported that skeletal muscle contractile properties by tensiomyography (TMG) method are informed to sports and rehabilitation fields (Simunic, 2012). For example, contractile properties of muscle effected by cooling with cold-water.However, effect of heat stimulation on skeletal muscle contractile properties by TMG method is not so reported. Therefore, this study was to clarify the effect of heat stimulation on muscle contractile properties.
METHODS: Recnosix-Red Coral was used for producing heat stimulation. Heat stimulation of 750KHz at 60W power output was generated in 15 minutes, after muscle contractile properties were measured. Skin temperature was monitored by a high-precision thermometer (LT-2). Muscle contractile properties on rectus femoris (RF) were assessed by a Tensiomyography (TMG method). A contraction time (Tc) and maximal displacement of the muscle belly (DM) were measured as parameters for the contractile properties (Dahmane et al., 2006). In addition, normalized velocity (Vrn) was also analyzed (Rodríguez-Ruiz et al., 2014). Muscle contractile properties and skin temperature were measured pre and post heat stimulation condition.
RESULTS: Skin temperature was significantly increased by heat stimulation. Dm showed significant higher values than pre, the values of Td and Tc were significant shorter than that of pre. And also the Vrn value showed significantly higher velocity than that of pre.
CONCLUSION: It was considered that heat stimulation may considerable alterations to muscle contractile properties. These alterations significantly affect the state of muscles and their response capacity, particularly in relation to muscle stiffness and muscle contraction velocity.
Reference
Dahmane R, Djordjevics S, Smerdu V. (2006). Med Bio Eng Comput, 44(11), 999-1006.
Rodríguez-Ruiz D, Diez-Vega I, Rodríguez-Matoso D, Fernandez-del-Valle M, Sagastume R4, Molina JJ. Biomed Res Int. 2014.1-8
Simunic B. J Electromyogr Kinesiol. 2012 Aug;22(4):527-30.
Contact: hiratsuk@kokushikan.ac.jp

EFFECT OF EXHAUSTED TREADMILL RUNNING IN RATS ON THE STAINING OF PARVALBUMIN-POSITIVE NEURONS IN THE CORTICOSTRIATAL PATHWAY

CUI, S.

BEIJING RESEARCH INSTITUTE OF SPORTS SCIENCE

INTRODUCTION: Central nervous system alteration contribute to the exercise-induced fatigue. Corticostriatal systems are known to mediate motor behavior,but the changes of the corticostriatal circuits after exercise are unclear.Owing to parvalbumin-positive interneurons vital for feedback and feedforward inhibition and are critically involved in the generation of network oscillations and GluN2B-Containing NMDA Receptors in the shift choice behavior.The purpose of this study was to determine the role of Corticostriatal PV+ intherneurons in the regulation of exercise induced fatigue.
METHODS: All the 16 Wista rats were randomly divided into exhausted group; and control group, incremental of treadmill exercise was employed. The initial treadmill speed was 8.2m/min, after 15min the speed increased to 15m/min, 15min later the speed improved upto 20m/min until fatigue. Record exercise time and movement distance. The immunofluorescence method was used to observe the expression of PV+ interneurons and GluN2B-NMDAR.
RESULTS: The PV+ interneuron expression more prevalently distributed in the primary motor cortex and dorsolateral striatum of EG group. Compared to the control group, It was observed a higher number of PV-positive neurons in the primary motor cortex and dorsolateral striatum < p<0.01>. Moreover, we found that the coexpression of PV+ interneuron and GluN2B-NMDAR in the dorsolateral striatum of EG group significantly increased. These regional distribution of PV+ interneuron indicate activity of M1-DLS loops was enhanced after exercised-induced fatigue.
CONCLUSION: It is revealed that the PV+ interneuron of the M1-DLS pathway play an important role in neural modulation for the exercise-induced fatigue. Our results indicated that GluN2B-NMDAR may contribute for the mechanism of central fatigue.The present study might provides morphological basis for the research of central mechanism of exercise-induced fatigue.

EFFECT OF FATIGUE GENERATED BY LONG INTENSIVE EFFORT ON KINESTHETIC SENSE.

JASTRZEBSKA, A.D., BAKONSKA-PACON, E., WIERZBICKA-DAMSKA, I.

UNIVERSITY OF PHYSICAL EDUCATION IN WROCLAW

INTRODUCTION: In majority cases we are able to provide a precise estimation of force and movements. However, in fatigue conditions having problems with execution of skilled movements is well-known experience. The aim of presented study was to estimate the changes of kinesthetic sense (KS) in fatigue condition induced by long intensive effort performed on treadmill.
METHODS: 15 participants performed incremental test to volitional exhaust for fitness level and VO2max estimation. The 40-min effort with intensity of 80% VO2max was performed for fatigue elicitation. Respiratory parameters were measured breath-by-breath (K4b2, Cosmed, Italy). KS was measured before (pre-test) and follows the 5 min of recovery (post-test) for incremental and 40-min effort. Blood was collected for estimation of lactate concentration (Dr Lange Küvettentest, LKM 140, Germany) and venous blood was collected to determine the concentration of selected neurotransmitters (ELISA Test Demeditec Diagnostics GmbH Germany).

RESULTS: Lactate concentration in blood reach 3.92 ± 1,0 [mmol]. Concentration of neurotransmitters in plasma increased significantly. The generated force was on similar level in both pre- and post-test conditions in both incremental and 40-min efforts. Parameters describing force regulation (SD – standard deviation of mean force and CV – coefficient of variation [%]) significantly improved for right arm pushes after the effort and stayed on similar level for other limbs. We noticed significant reduction of time of force development and exhibition for right arm pushes ($p<0.05$), reduction tendency for left arm pushes and no difference for legs.
CONCLUSION: We expected worsening of KS after the 40-min effort. The increase of neurotransmitters indicates the development of fatigue, although not converted into a decline of KS directly after the efforts. It may be that 5 min after the effort the excitation of nervous system allows better muscle sense and a biochemical changes resulted by effort occur before fatigue appears in nervous system function.

A COMPARISON OF HIGH VELOCITY RESISTANT LOADING AND TRADITIONAL STRENGTH LOADING METHODS ON POST-ACTIVATION POTENTIATION

RICHARDS, B.J., KASHETSKY, N., GIFFORD, M., SEAMAN, K.

UNIVERSITY OF NEW BRUNSWICK

INTRODUCTION: The effect that Post-activation potentiation has on an athlete's ability to produce maximal power outputs has been an area of interest in recent years. According to this theory, contractile history has the ability to elicit potentiation of activated muscle fibre, which can be utilized by athletes to increase power output if fatigue can be mitigated prior to subsequent force applications[2]. The underlying mechanisms that may contribute to PAP are: 1> Phosphorylation of myosin regulatory light chains; 2> Increased recruitment of higher order motor units; 3> Muscle fiber pennation angle[1,3]. The purpose of this study was to investigate the utility of high velocity resistance loading in comparison to traditional strength loading (TS) on the fulfilment of PAP.
METHODS: Thirteen <7 male and 6 female> university varsity athletes volunteered to participate in the study. Participants were 19±2.1 years old with an average 1-RM of 113±29.5 kg and an average strength to weight ratio of 1.5±0.5. Participants completed a standardized warmup protocol. Upon completion, baseline vertical jump was measured. Participants then performed two sets of five repetitions of either HVR <65% of 1-RM> or TS <90% of 1-RM> in a randomized order. Participants returned one week later to complete the remaining condition (HVR or TS). Following a rest period of four and eight minutes, vertical jump was performed. Vertical jump heights were converted to power via the Sayer equation[2].
RESULTS: Following the HVR and TS interventions, significant improvements were observed between the HVR baseline and eight minute rest ($p=0.009$, ES 0.736), and between HVR and Maximal power regardless of time . No other differences were observed.
CONCLUSION: The main findings include: 1> HVR loading provided significant improvement from baseline in maximal power output demonstrating the utility of this method for stimulating PAP, 2> Rest period timing results demonstrate that optimized rest durations are an important consideration related to achieving PAP and vary between participants as some achieved peak power output at eight minutes and others are four.
References: 1. Mitchell C., & Sale D., (2011) Enhancement of jump performance after a 5RM squat is associated with postactivation potentiation. European Journal of Applied Physiology 111(8): p.1957-1963.
2. Tillin, N. A., & Bishop, D. (2009). Factors Modulating Post-Activation Potentiation and its Effect on Performance of Subsequent Explosive Activities. Sports Medicine, 39(2), 147-166. Doi:10.2165/00007256-200939020-00004
3. Sayers, S. P., Harackiewicz, D. V., Harman, E. A., Frykman, P. N., & Rosenstein, M. T. (1999). Cross-validation of three jump power equations. Medicine & Science in Sports & Exercise, 31(4), 572-577. Doi: 10.1097/00005768-199904000-00013

OPEN VERSUS CLOSED KINETIC CHAIN EXERCISES FOR INDUCTION OF POST ACTIVATION POTENTIATION IN VERTICAL JUMP

DAL PUPO, J.1, GARCIA, T.1, KNIHS, D.1, RODRIGUES, O.A.F.1

1 - FEDERAL UNIVERSITY OF SANTA CATARINA

INTRODUCTION: Positive effects have been evidenced using strength exercises as post-activation potentiation (PAP) prior to the power activities such as vertical jump (Esformes and Bampouras, 2013; Fukutani et al., 2014). However, the influence of specificity regarding the type of kinetic chain in the conditioning exercises used in PAP induction has not been investigated yet. Thus, the objective of this study is to analyze the effects of PAP induced by isometric strength exercises of open and closed kinetic chain on squat jump (SJ) performance.
METHODS: Thirteen male weight training practitioners (age: 24.0±3.14 years; body mass: 80.72±3.14 kg) volunteered to participate in this study. Four experimental protocols were performed: P1 - SJ performed before and 3 min after performing the closed kinetic chain conditioning exercise (CKC); P2 - SJ performed before and 7 min after the CKC conditioning exercise; P3 - SJ performed before and 3 min after an open kinetic chain conditioning exercise (OKC); P4 - SJ performed before and 7 min after an OKC conditioning exercise. The protocols were performed on four days, in a randomized order. CKC consisted of a free squatting exercise performed with a barbell over the subject's shoulders attached to a chain on the ground and OKC was performed in a knee extensor chair. The squat jumps were performed on a force platform. Jump height (JH), mean power output (MPO), peak power output (PPO) and net impulse (NI) were obtained. Electromyographic (EMG) activity of vastus lateralis, vastus medialis, rectus femoris and biceps femoris muscles were analyzed in SJ pre and post-PAP. ANOVA was used for the comparison pre and post-potentiation, for all protocols.
RESULTS: Higher PPO was observed after PAP compared to the baseline condition for Protocol 1 ($p=0.04$). No effect was observed for the variables JH ($p=0.07$), MPO ($p=0.17$) and NI ($p=0.14$) in any of the protocols. No effect was also found for EMG activity when comparing pre vs. post-PAP, in any of the muscles analyzed ($p>0.05$).
CONCLUSION: The results of the present study indicate that CKC conditioning exercise, performed 3 minutes before the main task, is more effective than an OKC exercise to induce PAP in squat jump. These findings may be explained due to the greater specificity of CKC exercise with vertical jump task. A three minute interval seems to be more adequate to trigger the potentiation process and avoid the fatigue effects (Wilson et al., 2013).
References: Esformes, JI, and Bampouras, TM. (2013). J Strength Cond Res 27: 2997-3000.
Fukutani, A et al. (2014). J Strength Cond Res 28: 2236-2243.
Wilson, JM (2013). Meta-analysis of postactivation potentiation and power: Effects of conditioning activity, volume, gender, rest periods, and training status. J Strength Cond Res 27: 854-859.

MRCP INDUCED BY PUSHING BUTTON IN RESPOSE TO THE START SOUND OF ALPINE SKIING

SUDA, K.1, GOTO, A.1, FUMOTO, M.2, USUI, S.2, NISHIHIRA, Y.3

1:TOKYO INSTITUTE OF TECHNOLOGY 2:TOKYO INTERNATIONAL UNIVERSITY , 3: UNIVERSITY OF TSUKUBA

INTRODUCTION: The start of Alpine skiing is allowed within 10 seconds, and the start sound are consisted of 6 sounds from the first sound to the last sound. Fifth sound is highest and indicate the center of the start time. From the view point of neurophysiology, it is not clear whether skiers should start in response to the fifth sound or not. On the other hand, brain wave, especially event related potentials (ERPs) have been used for studying the activity of the brain at various human situations. MRCP (motor related cortical potentials) is one of the ERPs which can be recorded just before movement (Kornhuber, H. H., Deeke L., 1965). With this potential, readiness of movements can be compared. To compare start performance in Alpine skiing, reaction time is meaningless, so we compared the MRCP induced by pushing button in response to the fifth sound of Alpine skiing start, with the one at optional time.
METHODS: 12 persons participated in this study. They were asked to push button under three conditions. 1) in response to the fifth sound of Alpine skiing start sound as quickly as possible. 2) at optional time from the first sound to the last sound. 3) at optional time without start sound. MRCPs were analyzed from C3 and Cz electrodes according to the international 10-20 method. EMG was recorded from flexor pollicis brevis muscle of right hand. The EMG is used for analyzing MRCP. Data from 4 participant were rejected because of the artifact, ANOVA was used for the statistics.
RESULTS: We analyzed three components of MRCP, BP, NS' and MP. There were not significant differences in the amplitudes among the three conditions. On the other hand, the onset of BP was significantly early without sound compared to the with Alpine skiing start sound.
CONCLUSION: From the results following things are concluded. 1) We could not find clear difference in activation of motor related areas when the participant pushed button under the start sound and without start sound. This may imply that there are no clear differences in start timing from the view point of the activation of motor related areas. 2) Rhythmical sound like Alpine skiing start sound may shortens preparation time of the motor related area for an action.
Reference
Kornhuber, H. H., Deeke L. (1965) Pflugers Arch Gesamte Physiol Menschen Tiere. 10;284:1-17.
Contact: suda@ila.titech.ac.jp

MUSCLE ACTIVATION ON THE FLYWHEEL SQUAT ASSESSED BY FUNCTIONAL MAGNETIC RESONANCE IMAGING

ILLERA-DOMÍNGUEZ, V., NUELL, S., ALOMAR, X., CARMONA, G., PADULLÉS, J.M., PADULLÉS, X., LLORET, M., CUSSÓ, R., CADEFAU, J.A.

INEFC BARCELONA

INTRODUCTION: Resistance training results in a rapid activity-dependent influx of fluid and accumulation of osmolites (phosphate, lactate, sodium) in muscles. Based on this physiological phenomena, functional magnetic resonance imaging (MRI) is a non-invasive technique to assess increases on the transverse relaxation time (T2) of muscle water from pre-exercise to post-exercise as an index of muscle activation (1). The aim of this study was to examine thigh muscles activation on the squat exercise, performed on a flywheel device.
METHODS: 10 physically active students (age 23.4±4.1 years) performed 10 sets of 10 flywheel squats (Inertia 900 kg·cm-2). MRI scans were performed in basal conditions (Pre) and ≈ 5 min after finishing an acute bout of the exercise (Post), using a 3-T MRI scanner (Magnetom VERIO, Siemens, Germany). In each scan, twelve contiguous (each 31.5 mm) 3.5-mm cross-sectional images of the thigh of both limbs were obtained, starting at the iliac spine. A parametric image was generated from the T2 mapping sequence and T2 of muscles from both thighs were measured using OsiriX 8.5.2. (Pixmeo, Switzerland). A circular region of interest (ROI) was selected for the muscles gluteus maximus (GM), rectus femoris (RF), vastus intermedius (VI), vastus medialis (VM), vastus lateralis (VL), adductor magnus (AM), gracilis (GR), biceps femoris long head (BFL), biceps femoris short head (BFS), semitendinosus (ST) and semimembranosus (SM) using the similar size and anatomical location in each of the T2 mapping images where these muscles were visible. T2 values for each muscle were computed as the mean value of its different ROIs. T2 shift was then calculated by subtracting T2 basal values to T2 values post-exercise, expressed as a percentage of the basal value. Results are shown as the average T2 shift of right and left thighs.
RESULTS: There was a significant increase in GM (42.5±8.4%), AM (20.8±13.0%), RF (18.4±13%), VI (31.7±18.1%), VM (36.3±13.9%) and VL (45.9±18.4%) T2 signal. There was a significant decrease in GR (7.5±7.8%), BFL (4.2±4.8%), BFS (8.0±6.9%), ST (7.1±3.0%) and SM (6.5±5.9%) T2 signal.
CONCLUSION: The reported decrease in T2 signal of the hamstring muscles supports the results of previous electromyographic studies of the squat (2), which show a lower activation of hamstrings as compared to quadriceps. Given the significance of muscle activation and muscle swelling this study has potential implications for designing resistance training programs.
References: 1. Damon BM, et al. J Gravit Physiol. 2007;14(1):1-8.
2. Slater L V, et al. J Strength Cond Res. 2017;31(3):667-76.

EFFECT OF HIP, KNEE AND ANKLE JOINT ANGLES ON ELECTROMYOGRAPHIC ACTIVITY IN HIP THRUST

NISHIOKA, T.1, YAMAGUCHI, S.1, OKADA, J.1

WASEDA UNIVERSITY

INTRODUCTION: Hip thrust is known as a very effective exercise for strengthening hip extensors like gluteus maximus. However, few studies have considered more effective technique of hip thrust. We examined the influence of hip thrust performed by changing angles of hip joint, knee joint and ankle joint on the muscle activity of lower limbs, and clarify the technique with the highest muscle activity of each muscle. It was aimed to verify the pros and cons of technique that have been regarded as effective.
METHODS: 9 healthy male college students who did not regularly practice hip thrust participated. The hip thrust trial methods were conducted by the eight kinds of various joint angle (10° or 30° hip abduction/90° or 80° knee flexion/ankle plantar or dorsal flexion). all trials of hip thrust were performed 1 set of 3 repetitions using 70%1RM estimated from the result of 3RM testing. The intervals between the sets were set to 3 minutes, and the order of each trial was set at random. EMG of each test muscle was measured. The test muscles were all in the right vastus lateralis (VL), biceps femoris (BF), upper and lower gluteus maximus (UGM and LGM). The EMG signals were normalized, and the RMS value in the 2nd repetition phase out of 3 repetitions of hip thrust trials was calculated.
RESULTS: Regarding the total RMS values of posterior chain (BF+UGM+LGM), 10/90/D was significantly lower than 10/80/D, 30/90/P, 30/90/D and 30/80/P (10/80/D: $p<0.01$, 30/90/P, 30/90/D, 30/80/P: $p<0.05$). 30/80/P was significantly greater than 10/90/P and 10/80/P (10/80/P: $p<0.05$, 10/90/P: $p<0.01$). Additionally, significant simple・simple main effect was observed in the hip abduction angle

and the knee flexion angle ($p<0.05$). They significantly increased at 30° hip abduction position than 10° hip abduction position, and significantly increased at 80° knee flexion position than 90° knee flexion position. However, no significant second interaction and simple interaction were observed
CONCLUSION: Although 10/90/P and 10/90/D have been regarded as effective (Contreras et al.,2011;Eckert and Snarr, 2014), according to the results, the most effective technique of hip thrust seems to be 30/80/P. This seems to be due to the fact that the muscle activity of BF increased in 80° knee flexion position and the muscle activity of UGM and LGM increased in 30° hip abduction position. Therefore, the muscle activity of gluteus maximus and biceps femoris in hip thrust is thought to be largely influenced by hip abduction angle and knee flexion angle.
REFERENCES:
Contreras, B, Cronin, J, and Schoenfeld, B. Barbell hip thrust. Strength Cond J, 33, 58-61, 2011.
Eckert, RM, and Snarr, RL. Barbell hip thrust. J Sport Human Perf, 2, 2014.
CONTACT:
w-t.n.89@fuji.waseda.jp

EVALUATING REGIONAL DIFFERENCES OF METABOLIC RESPONSE BY 31P- CSI DURING INCREMENTAL ISOTONIC EXERCISE ON QUADRICEPS

KANEKO, Y.1,2, KIME, R.2, HONGO, Y.1, OHNO, Y.1, SAKAMOTO, A.1, KATSUMURA, T.2
KURETAKE COLLEGE OF MEDICAL ARTS & SCIENCES

INTRODUCTION: Imbalanced activity of vastus medialis and vastus lateralis has been found in patients with patellofemoral joint pain (PFP) by electromyography investigation and it is essential to facilitate these muscles adequately for rehabilitation and prevention (Souza and Gross 1991; Pal et al., 2011). Evaluating the activities of knee extensor muscles in various aspects can provide more information to confirm if appropriate intervention is provided for rehabilitation. The aim of this study was to detect the differences in muscle metabolic response of the quadriceps during incremental dynamic knee exercise by using regional 31Phosphorus Chemical Shift imaging (31P-CSI).
METHODS: Sixteen healthy male participated in this study. The experiments were carried out with a 1.5-T superconducting magnet with a 5-inch diameter circular surface coil. The subjects performed isometric unilateral knee extension for their maximum voluntary contraction (MVC) in the prone position. Then they performed dynamic unilateral knee extension of right leg at 10% to 30% of their MVC. The subjects pulled down a rope with the adjusted weight attached to the ankle at a frequency of 0.5 Hz for 380 sec for a one-pulse 31P-CSI acquisition. The peak areas of inorganic phosphate (Pi) and phosphocreatine (PCr), and the intracellular pH (pHi) were calculated in post processing. The changes in Pi/PCr and pHi of medial and lateral side of quadriceps were analyzed.
RESULTS: There was no significant difference in Pi/PCr between the medial and the lateral side of the quadriceps during the exercise at rest, 10%, 20%MVC (medial side: 0.16±0.03, 0.20±0.05, 0.23±0.05, lateral side: 0.16±0.05, 0.16±0.05, 0.22±0.06, respectively) . There was significant difference in Pi/PCr at 30%MVC (medial side: 0.34±0.12, lateral side: 0.27±0.09, $p < 0.05$). The pHi showed no significant difference.
CONCLUSION: These results suggest that there is a regional difference in metabolic responses on quadriceps during incremental isotonic exercise in healthy subjects. Present study supports previous study reported heterogenic muscle metabolism (Cannon DT et al., 2013) and another study showed the spatial heterogeneity of muscle blood flow, which revealed the greatest increase in vastus medialis compared to the other muscles during isometric exercise (Kalliokoski et al., 2000). Further study is required in PFP subjects with the same protocol.

ANGULAR VELOCITY-DEPENDENT POTENTIATION OF MAXIMAL CONCENTRIC PEAK TORQUE OF KNEE EXTENSION

MIYAMOTO, N.
NATIONAL INSTITUTE OF FITNESS AND SPORTS

INTRODUCTION: One bout of 5–6 s of maximal voluntary isometric contraction (MVIC) is known to enhance subsequent dynamic joint performance such as concentric peak torque and power with maximal voluntary effort (Baudry 2010; Miyamoto 2011, 2012, 2013). The presence of such potentiation is angular velocity-dependent (Fukutani et al. 2013). However, it remains unclear (1) what is the threshold of angular velocity for the potentiation of concentric peak torque is, and (2) whether the extent of potentiation increases with the increase in the angular velocity of concentric contractions. The present study aimed to clarify these questions.
METHODS: Thirteen healthy male subjects performed maximal voluntary concentric (isokinetic) contractions of knee extension at 30, 60, 120, 240, and 360 degrees/second before and 1-min after a 5-s conditioning MVIC of knee extension. Immediately before the measurements of concentric knee extension, measurements of evoked isometric twitch of knee extension were performed. Electromyographic (EMG) signals were obtained from the vastus medialis, vastus lateralis, rectus femoris, and biceps femoris. Measurements of each angular velocity condition were separately performed in a randomized order.
RESULTS: The twitch peak torque significantly increased after the conditioning MVIC in all velocity conditions ($P < 0.05$) whereas the extent of potentiation in isometric twitch torque was similar between the five conditions. EMG amplitudes (i.e., M-wave peak-to-peak value in twitch and root-mean-square value in concentric contraction) were unchanged before and after the conditioning MVIC in all conditions. The maximal voluntary concentric peak torque significantly increased in 240 and 360 degrees/second conditions (+3.6% and +8.6%, respectively; $P < 0.05$), but not in 30, 60, and 120 degrees/second conditions. Additionally, the extent of the increase in concentric peak torque was significantly higher in 360 degrees/second condition than in 240 degrees/second condition ($P < 0.05$).
CONCLUSION: These results indicate that the maximal voluntary concentric torque can be potentiated by the conditioning contraction when the concentric contraction is performed at an angular velocity higher than 240 degrees/second. Furthermore, the extent of the potentiation of concentric torque can increase with the increase in angular velocity of concentric contractions.

EXCITABILITY AND FIRING PROPERTIES OF MOTONEURONS ARE MODIFIED BY TRANS-SPINAL DIRECT CURRENT STIMULATION

KRUTKI, P., DRZYMALA-CELICHOWSKA, H., MROWCZYNSKI, W., BACZYK, M.
POZNAN UNIVERSITY OF PHYSICAL EDUCATION

INTRODUCTION: Polarization of neurons induced by externally applied constant current stimulation is a new neuromodulatory technique which has recently been introduced in rehabilitation of patients after neurological injuries to decrease spasticity (Lefaucheur et al. 2017) or as an addition to physical training in sport (Angius et al. 2017). However, physiological mechanisms and neuronal interactions within

spinal networks are poorly known. The aim of this study was to reveal changes in motoneuron membrane and firing properties in response to trans-spinal direct current stimulation (tsDCS).
METHODS: The study was performed in vivo on adult male rats under general anesthesia. The intracellular recordings of electrical potentials were made from motoneurons located in L4-L5 segments of the spinal cord, innervating hind limb muscles. Anodal or cathodal tsDCS was applied through a stainless steel electrode, located on the dorsal surface of the lumbar vertebra above the recording site. A current intensity varied from 0.1 mA to 0.4 mA. Electrophysiological parameters of motoneurons were measured before, during and after an application of tsDCS, lasting from 5 to 15 minutes.
RESULTS: Changes in electrophysiological parameters of motoneurons could be observed in all tested motoneurons immediately after the onset of polarization, the effects lasted throughout the whole session and were sustained after the end of polarization (measured up to 30 min.). Anodal tsDCS resulted in an elevation of the resting membrane potential, a decrease in the rheobase current and the threshold of rhythmic firing, and an increase of the maximum firing frequency. Reverse effects were observed after cathodal tsDCS: the hyperpolarized resting potential,an increase in the rheobase, an increase in the threshold of rhythmic firing (or its complete blocking).
CONCLUSION: tsDCS mimics the physiological polarization processes which occur within the spinal networks: it does not evoke action potentials in neurons, but puts them in a state of subthreshold depolarization or hyperpolarization, depending on a polarity of applied current (Weiss and Faber, 2010). The results of this study indicate that tsDCS immediately facilitates (anodal) or inhibits (cathodal) generation of action potentials in motoneurons, and these effects last longer than duration of polarization. This partly explains how tsDCS influences on the recruitment of motor units and the generated muscle force.
Supported by the National Science Center grant No 2017/25/B/NZ7/00373
References: Angius L, et al. (2017). Front Physiol 4/8 90.
Lefaucheur JP et al. (2017). ClinNeurophysiol 128: 56-92.
Weiss SA, Faber DS. (2010). Front Neural Circuits 4: 15.
Contact: krutki@awf.poznan.pl

SPECIFIC DISTRIBUTION OF HAMSTRING MUSCLES FOR SPRINT RUNNERS AND ITS FUNCTIONAL IMPLICATION FOR PERFORMANCE IMPROVEMENT

KAMINO, K., KUNIMASA, Y., MAKINO, A., SANO, K., KIJIMA, K., KOMI, P.V., ISHIKAWA, M.
OSAKA UNIVERSITY OF HEALTH AND SPORT SCIENCES

INTRODUCTION: Bi-articular muscles show the spatial distribution of neural activation at different regions from proximal to distal parts. If bi-articular muscle function was different by region, the muscle longitudinal shape, such as CSA size at different regions, may be different by region. The purpose of the present study is to examine the characteristics of muscle anatomical cross sectional area (CSA) at different regions from proximal to distal parts of each muscle of the hamstring muscles in high level sprinters, and to examine the relationship with those and the sprint performance.
METHODS: The CSA of the semitendinosus muscle (ST), semimembranosus muscle (SM), biceps femoris long head (BFL) and biceps femoris short head (BFS) at the four different region of hamstring muscles for sprinters (SPRINT: n = 20, age: 21.5±1.5 yr, 100m season best record: 10.8±0.2 sec) and healthy male control subjects (CTRL: n = 20, age: 20.8±1.3 yr) were measured by using B-mode ultrasonography. The CSA of each region of each muscle was calculated by cross sectional musculoskeletal ultrasonographic images.
RESULTS: The measured regions were divided into four parts from proximal to distal parts (PRO1, POR2, DIS2, DIS1). The results clearly showed that the shaves of CSA from proximal to distal parts were similar across the four muscles between both groups but the size of the CSA for SPRINT was significantly greater at PRO2, DIS2 and DIS1 in ST, DIS2 and DIS1 in SM, DIS2 and DIS1 in BFL, DIS1 in BFS as compared with CTRL. In the relationships with sprint performance, the CSA of PRO1 and PRO2 in ST and PRO1 in SM was negatively related.
CONCLUSION: These results suggest that distal parts of hamstring muscles for SPRINT may be characteristics of movement specific. However, the proximal parts of ST and SM muscles may play important roles of the improvement of their sprint performance.

THE EFFECT OF KINESIO TAPING IN LEG RECOVERY AFTER DELAYED ONSET MUSCLE SORENESS

LIN, Y.J., LENG, Y.R., LIN, H.T.
KAOHSIUNG MEDICAL UNIVERSITY

INTRODUCTION: Delayed onset muscle soreness (DOMS) is usually occurred in two to seven days after high-intensity exercise. DOMS may lead to swelling and painful muscles, decrease joint ROM and muscle strength, increase muscle stiffness and resting tension. In recent years, an increasing number of athletes had been using Kinesio taping® for better performance in many sports competition. Until now, the effect of Kinesio taping in DOMS and its possible mechanism was still unclear. Therefore, the purpose of this study was to investigate the effect of Kinesio taping in recovery of leg after DOMS.
METHODS: Fifteen healthy college students attained two different testing conditions, attached Kinesio taping and without Kinesio taping after DOMS, the testing order was randomized, and at least one month apart between testing conditions. Before test, the subject was asked to warm up five minutes by using a stationary bike first, and then went on the calf muscle eccentric exercise (Yanagisawa et al., 2011). The timing of evaluation were before eccentric exercise (T0), immediately after eccentric exercise (T1), 24 hours (T2), 48 hours (T3) and 72 hours (T4) after eccentric exercise. The participants attached Kinesio taping just after eccentric exercise. The evaluated parameters include ankle range of motion, muscle soreness, calf muscle tenderness, sarcous character measurement, muscle strength, and ankle proprioception. The repeated measure two-way ANOVA was used to test the effect of Kinesio taping and five evaluation times in analysis parameters.
RESULTS: When applied Kinesio taping, significant decreased in muscle stiffness, passive muscle tension, muscle soreness, leg circumference, and increased ankle range of motion, muscle elasticity, and ankle dorsiflexion maximum torque in subjects ($p < 0.05$). There were significantly differences between evaluated time in CK, lactate, sarcous character, muscle soreness, muscle tenderness, ankle proprioception, and ankle plantarflexion maximum torque ($p < 0.05$).
CONCLUSION: The occurrence of delayed onset muscle soreness depends on multiple potential physiological mechanisms and neuromuscular system. Results from this study found that the Kinesio taping has some positive improvement in some syndromes after DOMS that are similar to the previous study tested in Biceps (Lee et al., 2015). However, no significant difference results especially in blood biochemistry need further investigated. For the athletic trainer, the Kinesio taping may be helpful as an complimentary therapy for delayed onset muscle soreness.
REFERENCES: Yanagisawa O, Kurihara T, Kobayashi N, Fukubayashi T (2011), J Magn Reson Imaging, 34(4), 887-894.
Lee YS, Bae SH, Hwang JA, Kim KY (2015), J. Phys. Ther. Sci., 27(2), 457-459.

CONTACT: E-mail: whiting@kmu.edu.tw

Nutrition

NEW ZEALAND BLACKCURRANT EXTRACT ENHANCES FAT OXIDATION DURING PROLONGED CYCLING IN ENDURANCE-TRAINED FEMALES

STRAUSS, J.A.1, WILLEMS, M.E.T.2, SHEPHERD, S.O.1

1: LIVERPOOL JOHN MOORES UNIVERSITY, 2: INSTITUTE OF SPORT, UNIVERSITY OF CHICHESTER

INTRODUCTION: New Zealand blackcurrant (NZBC) extract has previously been shown to increase fat oxidation during prolonged exercise, but this observation is limited to males. We examined whether NZBC intake also increases fat oxidation during prolonged exercise in females, and whether this was related to greater concentrations of circulating fatty acids.
METHODS: In a randomised, crossover, double-blind design, 16 recreationally active females (age: 28±8 years, BMI: 21.3±2.1 kg·m-2, VO2max: 43.7±1.1 ml·kg-1·min-1) ingested 600 mg·day-1 NZBC extract (CurraNZ™) or placebo (600 mg·day-1 microcrystalline cellulose) for 7 days. On day 7, participants performed 120 min cycling at 65% VO2max, using on-line expired air sampling with blood samples collected at baseline and at 15 min intervals throughout exercise for analysis of glucose, NEFA and glycerol.
RESULTS: NZBC extract increased mean fat oxidation by 27% during 120 min moderate-intensity cycling compared to placebo (P=0.042), and mean carbohydrate oxidation tended to be lower (P=0.063). Pre-exercise, plasma NEFA (P=0.034) and glycerol (P=0.051) concentrations were greater following NZBC intake, although there was no difference between conditions in the exercise-induced increase in plasma NEFA and glycerol concentrations (P>0.05). Mean fat oxidation during exercise was moderately associated with pre-exercise plasma NEFA concentrations (r=0.45, P=0.016).
CONCLUSION: Intake of NZBC extract for 7 days elevated resting concentrations of plasma NEFA and glycerol, indicative of higher lipolytic rates, and this may underpin the observed increase in fat oxidation during prolonged cycling in endurance-trained females.

SPRINT, STRENGTH AND BODY MASS CHANGES FOLLOWING INGESTION OF A COMBINED SUPPLEMENT BY COMPETITIVE GAMES PLAYERS

ELLMORE, M.

UNIVERSITY OF LINCOLN

INTRODUCTION: From survey findings (Airstone et al. 2005), a significant proportion of players chose this supplement to improve muscle mass and performance. The purpose of this investigation is to determine whether the reasons for supplement choice were justified as the evidence available to support supplementation of this combination of ingredients is not sufficient.
METHODS: Fifteen trained male games players (mean body mass 80.4kg±7.7) ingested 1.2g/kg/day of a combined supplement or placebo for a period of 8 weeks, through randomised, double-blind, crossover administration. The effects of the powdered supplement (SUPPL) containing whey protein, carbohydrate, creatine monohydrate and glutamine or lactose placebo (PLA) were determined in ten, 6s cycle ergometer sprints with 24s active recovery in terms of peak power output (PPO), mean power output (MPO), fatigue index (FI) and peak pedal frequency (PPF). Measures of maximal strength during 1 repetition (1RM) of bench press (Max B) and squat (MaxS) exercises and changes in total body mass (TBM) and lean body mass (LBM) were also recorded. Differences between treatment, trial and performance data were established using repeated measures ANOVAs (F1,15) and interactions were determined using the Bonferroni correction (P≤0.0125).
RESULTS: After determining that activity (P=0.912) and dietary intake of protein (P=0.260) were consistent during placebo and supplement phases of the investigation and there were no crossover effects, significant interactions (P≤0.0125) between treatments (Placebo, Supplement) and trials (Pre, Post) were determined in terms of PPO (PLA:892W SUPPL:937W F(1,15)=27.000), FI (PLA:43% SUPPL:39% F(1,15)=47.221), PPF (PLA:83rpm SUPPL:90rpm F(1,15)=36.347), TBM (PLA:82kg SUPPL:83kg F(1,15)=54.255) and MaxS (PLA:86kg SUPPL:98kg F(1,15)=88.872).
CONCLUSION: These findings demonstrate that, to some extent, participants' reasons for choosing this supplement were justified. The mechanisms of effect can be attributed to participants' meeting daily requirements for calorie and protein intake, established for these athletes in a previous study (Ellmore, 2017) and a number of previously reported factors including enhanced pre-exercise phosphocreatine storage, adenosine triphosphate availability, a reduction in muscle relaxation time and muscle growth, which may alter protein turnover and enhance training capability. Further research incorporating appropriate dietary control and analysis of supplement content would highlight the impact of such supplement intake more effectively.
References: Airstone, M.R., Fagbemi, S.O. and Morris, A.E.J. (2005). J Sports Sci 23 (2), 118-119
Ellmore, M.R. (2017). 22nd Annual congress of the ECSS. Book of Abstracts, 189.

CARNOSINE IN MULTIPLE SCLEROSIS AND EXPERIMENTAL AUTOIMMUNE ENCEPHALOMYELITIS

SPAAS, J.

HASSELT UNIVERSITY

INTRODUCTION: Carnosine, a dipeptide composed of β-alanine and histidine, is present in many tissues throughout the body and ~99% of carnosine is found in skeletal muscle tissue. Here, it has several physiological functions (e.g. Ca2+ handling, intramyocellular buffering) that correspond with multiple sclerosis (MS)-related (muscular) dysfunctions. Due to its antioxidant properties, carnosine is also considered a neuroprotective and antisenescent compound. We present a series of three consecutive studies investigating the role of carnosine in MS and Experimental Autoimmune Encephalomyelitis (EAE), an animal MS model.
METHODS: Study 1 compared muscle carnosine content between MS patients (n=24) & healthy individuals (n=22, m. vastus lateralis), and between EAE & control animals (both n=40, m. tibialis anterior). Study 2 evaluated the effects of carnosine and β-alanine intake (24d) on muscle carnosine content and clinical disease course in a monophasic EAE rat model (n=39). Study 3 evaluated the effects of carnosine intake (35d) on clinical disease course in a chronic EAE mouse model (n=20).
RESULTS: Muscle carnosine content was reduced in EAE (-46 to -60%, p<0.001) and MS (-25%, p=0.03) (study 1). Carnosine and β-alanine intake restored muscle carnosine levels in EAE (p<0.01, study 2). Finally, carnosine appears to affect the disease course (delayed hind quarter paralysis onset, reduced peak and cumulative disease score) in monophasic and chronic EAE models (study 2 & 3).

CONCLUSION: Muscle carnosine is reduced in MS and EAE, and carnosine intake restores this in EAE. Carnosine intake appears to improve hind quarter paralysis in EAE. Future studies will further investigate the effects of carnosine (loading) in MS and EAE.

EFFECTS OF NITRATE SUPPLEMENTATION ON THE WINGATE TEST IN RUNNERS.

SANTANA, J., MADUREIRA, D., FRANÇA, E., CAPERUTO, E.C.

SÃO JUDAS UNIVERSITY

INTRODUCTION: During a 10km race, runners perform sprints (anaerobic exercise) in the beginning and the end of the event and keep continuous running (aerobic exercise) between these sprints. The literature shows that the improvement in the anaerobic phase of the runner increases running performance. Nitrate is a supplement that increases performance reducing O2 cost improving nutrients delivery to the muscles. Therefore, the aim of this study was to evaluate the effect of nitrate supplementation in the anaerobic phase of runners.
METHODS: Sixteen runners (age 30.2 ± 5.7 years old) received nitrate supplementation in a double-blind, randomized trial and were divided in two groups: Nitrate (N03) (750mg of Nitrate per day for thirty days) and Control (CON) (750mg of Resistant Starch per day for thirty days). All groups trained three times/week during four weeks. Anaerobic phases were evaluated through a 60sec Wingate test and blood lactate concentration before the test (BAS), fifteen days (DUR) and thirty days after (POS) the tests. After the normality test (Shapiro-Wilk), two way Anova test was made with Tukey Post-test with $p<0.05$.
RESULTS: There was no significant differences in the 60sec Wingate Test in both the groups (Nitrate: BAS 370.1±64.4; DUR 409.2±79.6; POS 421.2±71.5) (Control: BAS: 460.2±117.3; DUR 480.9±119.7; POS 500±123.9). Blood lactate showed significance decreases in Nitrate group and the Control group, but the nitrate group showed a significant decrease in the moment DUR and POS moment, when compared with BAS moment (Nitrate: BAS 13.4±1.7; DUR 9.7±2.7; 8.1±1.2). The Control group showed significant decrease only in the POS moment, when compared with BAS moment (Control: BAS 12.4±1.8; DUR 11±2; POS 9.5±2.8). The runners of both groups did not show significant improvement in the Wingate test due to their training being predominantly aerobic. The nitrate group showed significant decrease in blood lactate in 15 days due to the effect of nitrate supplementation, through vasodilation, reducing work during the test, thus producing less blood lactate.
CONCLUSION: We can conclude that in two weeks of supplementation, nitrate decreases the blood lactate concentration in anaerobic tests of runners.

EFFECTS OF OMEGA-3 FATTY ACIDS SUPPLEMENTATION ON VO2MAX, BLOOD LIPOPROTEINS AND HORMONE CONCENTRATION IN CYCLISTS

POPRZECKI, S.1, ZEBROWSKA, A.1, STANULA, A.1, MIKOLAJEC, K.1, BARON-KACZMAREK, D.1

ACADEMY OF PHYSICAL EDUCATION

INTRODUCTION: Several studies have demonstrated potential sport and health benefits from consumption fish oil derived omega-3 FA supplementation (Boss et al.2010, Peoples et al. 2008). Hence there is clear evidence that n-3 FA ingestion has the potential to modulate a wide range of physiological (VO2max) and biochemical (lipids, lipoproteins, hormone) processes that could, theoretically, enhance adaptation to exercise training (Ooi 2015). The aim of this research was to analyzed effects of cyclists supplementation with n-3 FA, combined with aerobic training on blood lipoproteins, hormone and VO2max.
METHODS: The 15 cyclists, aged 23,1±5,4 y were assigned to two groups: experimental (n=8) (E), supplementing the diet with n-3 FA (1,2 g/d for 3 weeks- 660 mg EPA and 440 mg DHA) and control group (C) (n=7) without changing of the diet. The mean individual training volume was 655±53 km/week. Before and after 3 weeks cyclists performed VO2 max test using cycloergometer Lode Excalibur Sport. Blood samples were taken before VO2max cycling test and after 3 weeks.
RESULTS: No significant effect was observed on VO2max (p=0,300) in response to n-3 PUFA supplementation. But it was significantly differentiated the value of Peak Power (PP) (p=0,000). We observed significant increase PP only in supplemented group (p=0,002). Modified diet not significantly differentiated PPLT (p=0,086), HRmax (p=0,117), HRLT (p=0,946), as well as Ve (p=0,976). Supplementation with omega-3 FA didn't significantly influenced on cortisol (p=0,234), hGH (p=0,561) and insulin (p=0,396) concentration. Serum glucose was significant differentiated (p=0,021). Then supplementation did not effect on TAS (p=0,323) and FRAP (p=0,312) concentration. Supplementing the diet with omega-3 FA did not affect significantly on FFA concentration (p=0,860) and TC (p=0,44), HDL-C (p=0,84), LDL-C (p=0,72), TG (p=0,74), also on atherogenic index, e.g. Castelli (p=0,98), LDL/HDL (p=0,47), and HOMA IR index (p= 0,154) and Quicki index (p=0,14).
CONCLUSION: The supplementation of cyclists diet with 1,2 g/d omega -3 PUFA during 3 weeks, combined with aerobic training, did not significant effect on respiratory parameters, as well as, serum hormone concentration, antioxidant status then lipids and lipoproteins profile. Only PP value was significantly differentiated by modified diet. In generally, the human data are inconclusive as to whether omega-3 PUFA diet supplementation at this dosage is effective, the potential synergism between n-3 supplementation and exercise provides an area for future research.
References: Boss A., Lecoultre V., Ruffieux C.,et al. (2010). Br J Nutr, 103: 1151-1159.
Ooi E., Watts G.F., Wai Ng T. et al. (2015) Nutrients, 7(6), 4416-4425.
Peoples G.E.; McLennan P.L. ,et al. (2008) J Cardiovasc Pharm. 52(6):540-547.
Contact: e-mail: s.poprzecki@awf.katowice.pl

EFFECTS OF PHYSICAL FITNESS LEVEL AND NUTRIENT INTAKE ON VENOUS COMPLIANCE IN YOUNG HUMANS

OUE, A., SAITO, M., IIMURA, Y.

TOYO UNIVERSITY

INTRODUCTION: Ageing and/or the lower physical activity associate with the increased stiffness of veins (Hernandez et al. 2004, Monahan et al. 2001), causing the cardiovascular disease (e.g. hypertension) (Olsen and Lanne 1998, Safar and London 1987). In order to reduce the risk for cardiovascular disease, it is important to enhance the venous compliance at an early age. Some physical fitness (e.g. aerobic capacity) and nutrients (e.g. vitamin C and vitamin E) could offer health benefit to the arterial function, although it is not understood whether these factors influence venous compliance. Thus, the purpose of this study was to reveal the relationship between physical fitness and venous compliance, and between nutrients and venous compliance in young humans.
METHODS: In 81 health young subjects (male: n = 46, female: n = 35) who had no a habitual physical activity, fitness levels, diet survey and venous compliance were investigated. As fitness levels, muscle strength (grip strength), high power (standing broad jump), agility (jumping side to side), muscular endurance (sit-up), flexibility (long seat body anteflexion), and whole body endurance (multi-stage fitness

test) were measured. In addition, total fitness score was calculated from all fitness levels. BDHQ (brief-type self-administered diet history questionnaire) was used to assess diet survey. Venous compliance in the forearm was determined using the first derivation of the cuff pressure–venous volume relation obtained by venous occlusion plethysmography during cuff deflation protocol.
RESULTS: In both males and females, total fitness score had a significant positive relation with the venous compliance ($P < 0.05$). In each fitness level, venous compliance in males correlated with grip strength and standing broad jump ($P < 0.05$), and venous compliance in females correlated with grip strength, sit-up, long seat body anteflexion, and multi-stage fitness test ($P < 0.05$). There was a positive correlation between vitamin D or vitamin B12 and venous compliance in females ($P < 0.05$), although α- and β- carotene and vitamin K had significant negative correlation with venous compliance ($P < 0.05$).
CONCLUSION: Compared with females, venous compliance in males had a positive relation with fitness levels which depended on muscle mass, which might be due to the difference of body composition between sexes. In addition, the relationship between nutrition intake and venous compliance had also a sex difference, which might be attributed to the difference of dietary habit and eating behavior between females and males. In conclusion, these results suggest that some physical fitness and vitamins might be related to the venous compliance in young humans, which have a sex difference.
References: Hernandez and Franke. J Appl Physiol 97: 925-929, 2004.
Monahan et al. Am J Physiol 281: 1267-1273, 2001.
Olsen and Lanne. Am J Physiol 275: 878-886, 1998.
Safar and London. Hypertension 10: 133-139, 1987.
Contact: oue@toyo.jp

THE EFFECTS OF 10 WEEKS OF CHOCOLATE MILK CONSUMPTION AFTER BODY-WEIGHT RESISTANCE TRAINING ON BODY COMPOSITION IN FEMALE UNIVERSITY STUDENTS

CHEN, T.T., QIU, Y.H., LUO, P.F.
NATIONAL ILAN UNIVERSITY

INTRODUCTION: Adequate post-exercise nutrition regimen is essential for optimizing recovery and adaptations. Chocolate milk has become a favored recovery aid for exercise participants due to its desired carbohydrate: protein ratio (about 4:1) and its great accessibility. The purpose of this study was to investigate the effects of 10 weeks of body-weight resistance training combined with post-exercise chocolate milk consumption on body composition in female university students.
METHODS: Thirteen college-aged, sedentary females were recruited for this study. Subjects were randomly assigned to either control group (CON) or body-weight training group (BWT).The subjects (n=7) in BWT trained 3 days per week for 10 weeks and ingested 290 mL of chocolate milk immediately after body-weigh exercise training for whole major muscle groups while the subjects (n=6) in CON maintained the similar lifestyle without any intervention. The chocolate milk (180 kcal) contained 5.8 g of protein (23.2 kcal), 23.78 g of carbohydrate (95.1 kcal), and 6.96 g of fat (62.6 kcal). Body composition (lean body mass, fat mass, and total mass, and other measures) was assessed by bioelectrical impedance analysis (BIA) methods before and after intervention.
RESULTS: No significant differences existed between groups at baseline and after 10 weeks for any measure. The muscle mass (18.98 ± 3.68 kg vs. 19.58 ± 3.83) and lean body mass (35.48 ± 6.03 vs. 36.46 ± 6.33) of BWT increased significantly ($p < 0.05$). The body weight increased and fat mass tend to decreased in BWT, however, no significant differences were observed ($p > 0.05$).
CONCLUSION: Body-weight resistance training in combination with post-exercise chocolate milk ingestion could evoke favored changes in body composition in female university students.

COMBINED EFFECTS OF LACTOTRIPEPTIDE AND AEROBIC EXERCISE ON COGNITIVE FUNCTION AND ARTERIAL STIFFNESS IN MIDDLE-AGED AND OLDER ADULTS

HAMASAKI, A., AKAZAWA, N., YOSHIKAWA, T., MYOENZONO, K., TAKAHASHI, K., SAWANO, Y., NISHIMURA, M., MAEDA, S.
UNIVERSITY OF TSUKUBA

Background: Age-related declines in vascular function increase the risk of cognitive impairment and dementia (Waldstein et al. 2008; Tarumi et al. 2015). The aim of this study was to investigate the effects of lactotripeptide (LTP) ingestion and exercise training on cognitive function and arterial stiffness in middle-aged and older adults.
Methods: In a randomized, placebo-controlled, double-blind design, 64 healthy older adults were assigned to four groups: placebo without exercise (Placebo, n = 18), placebo with exercise (Exercise, n = 15), LTP without exercise (LTP; n = 15), and LTP with exercise (Combined; n = 16) groups. The participants ingested placebo or LTP every day and performed aerobic exercises 0 or 4–6 days/week for 8 weeks. Before and after the 8-week intervention, Stroop interference time and carotid artery β-stiffness were measured.
Results: After the intervention, the Stroop interference time was significantly shorter in the Combined group and β-stiffness was significantly decreased in the LTP and Combined groups. The changes in Stroop interference time and β-stiffness were significantly greater in the Combined group than in the Placebo group. In addition, there were significant correlations between changes in Stroop interference time and β-stiffness.
Conclusions: The 8-week intervention that involved both LTP ingestion and exercise combined training improved executive function and arterial stiffness in middle-aged and older adults. These results suggested that the intervention-induced improvements in cognitive function was mediated by vascular function.
References: Waldstein SR, Rice SC, Thayer JF, Najjar SS, Scuteri A, Zonderman AB. (2008) Hypertension. 51, 99-104
Tarumi T, de Jong DLK, Zhu DC, Tseng BY, Liu J, Hill Candace, Riley J, Womack KB, Kerwin DR, Lu H, Cullum CM, Zhang R. (2015) Neuroimage. 110, 162-170

SURVEY ON FLUID INTAKE HISTORY OF COLLEGE STUDENTS MAJORING IN SPORT AND WELLNESS

SUGIURA, K.
RIKKYO UNIVERSITY

INTRODUCTION: Proper hydration is very important both for improving sports performance and for promoting health by sports. However, there are few research studies on age at which proper hydration is started in Japan.
METHODS: In this study, a questionnaire survey on fluid intake history was conducted for 204 students (136 males and 68 females) majoring in sport and wellness. The contents of the survey were (1) according to the time of elementary school, junior high school, high school,

and college, what kind of drinks were prepared during sports, and who prepared drinks and taught the importance of hydration to subjects, (2) when subjects understood the significance of hydration.
RESULTS: In elementary school, parents instructed hydration and prepared drinks (mainly water and barley tea). In both junior high school and high school, coaches instructed the need for hydration and ordered team members to prepare drinks (mainly water and sports drinks). In college, team managers prepared drinks (mainly water and sports drinks), however, there was no guidance. The time when the students understood the significance of hydration was the highest in high school days.
CONCLUSION: Although it was a good thing to prepare drinks during sports even at elementary school, teaching hydration was still left to parents. In the education curriculum that trains childrens sports coaches, it will be a future task to focus on hydration.

THE CHANGE OF DIETARY HABITS INFLUENCING DEGREE OF SATISFACTION WITH DIETING IN CHILDHOOD AND YOUNG ADULTHOOD.

SAKAGUCHI, S.1, AOYAGI, O.2, SAKAGUCHI, H.3

1> FUKUOKA SEISHU-KAI HOSPITAL, 2> FUKUOKA UNIVERSITY, 3> JAPAN UNIVERSITY OF ECONOMICS

INTRODUCTION: It is thought that in order to be satisfied with one's dieting, various factors such as with whom, what foods, how much, and when people eat have an effect. Again, it is easily expected that the extent to which these factors cause an effect is different between children who have no choice about how to eat and young adults who are able to form their own dietary habits by themselves. Thus, this study aimed to compare the degree of satisfaction with dieting between children and young adults.
METHODS: A 13-item questionnaire survey concerning dietary habits in elementary school years and at the present day was conducted with 1204 N-university students in September 2017. In addition, respondents were questioned about their degree of satisfaction with dieting in elementary school years and the present day, using a 5-level scale from "very satisfied" to "not satisfied at all." Cross tables were tabulated between the degree of satisfaction and 13 dietary habit items in childhood and young adulthood respectively, and a chi-square test was conducted. When a significant difference was found, adjusted residuals were successively computed and tendencies found between childhood and young adulthood were examined.
RESULTS: In response to the question about with whom they ate breakfast or dinner, whereas children who ate breakfast alone felt quite a low degree of satisfaction, young adults responded with "neither" for eating alone. However, young adults felt a low degree of satisfaction eating dinner alone, as opposed to breakfast.
Concerning the time of day for eating breakfast or dinner, in both of childhood and young adulthood, those who were satisfied with their dieting ate early in the day, indicating that the range of eating times was wider in young adulthood than childhood. Although no remarkable tendency was detected in childhood, there was a tendency that those who were satisfied with their dieting ate dinner early in the evening.
As far as the contents of breakfast were concerned, although no relationship between the degree of satisfaction with dieting and the contents of breakfast was found, satisfied young adults ate only rice (e.g. a rice ball).
Although the frequency with which satisfied respondents bought pre-cooked food from a supermarket or a packed lunch from a convenient store was at the most in "once a week," children had a tendency to be equal to or less than equal to this and a tendency to be equal to or more than this was found in young adults.
CONCLUSION: It can be concluded that eating alone, a dependence on pre-cooked food from a supermarket or a packed lunch and eating breakfast regularly affect the degree of satisfaction with children's and young adults' dieting.

THE CONTINUITY OF DIETARY HABITS BETWEEN CHILDHOOD AND YOUNG ADULTHOOD

SAKAGUCHI, H.1, AOYAGI, O.2, SAKAGUCHI, S.3

1> JAPAN UNIVERSITY OF ECONOMICS, 2> FUKUOKA UNIVERSITY, 3> FUKUOKA SEISHU-KAI HOSPITAL

INTRODUCTION: If dietary habits acquired while young strongly affect those in adulthood or later and they are hard to change, then dietary education, e.g. in university, is limited in its ability to change this and the childhood dietary habits are concluded to be already important. On the contrary, if it is sufficiently possible to change this even after young adulthood, then effective dietary education in higher education institutes can be expected. Thus, this study aimed to investigate the continuity of dietary habits between childhood and young adulthood.
METHODS: A questionnaire survey consisting of 13 items concerning dietary habits during elementary school years and the present day was conducted with 1204 N-university students in September 2017. Cross tables were tabulated between elementary school years and the present day and then ratios choosing the same option ordinal correlation coefficient in the case of ordinal-scaled data and contingency coefficient in the case of nominal-scaled data were computed. At the same time, a chi-square test was conducted and when significant differences were found, adjusted residuals were computed, and their tendency was examined in terms of what cells in the cross table were significant.
RESULTS: "How many times did you adjust the amount of food you ate?" "Where was the most seasoning used, at home or other dining locations?" "How frequently did you eat your favorite food repeatedly?" "How frequently did you go on a diet?" "What did you eat for dinner?" and "How much did you eat?" in the order of the degree of continuity with higher than 50% of the degree of continuity and higher ordinal correlation coefficient of more than 0.5. However, others did not show a high degree of continuity and correlation coefficient. Except for "What did you eat for dinner?" the items showing a high degree of continuity and correlation coefficient were common to individual tastes and attitudes toward dietary habits. This is to say, it can be said that although it is hard to change individual tastes and attitudes toward dietary habits, there is a sufficient possibility to change other dietary habits.
CONCLUSION: Although it is hard for the effect of dietary education in university or other educational institutions to change individual dietary tastes and attitudes toward dietary habits, there is a possibility to correct improper dietary habits in other areas in young adulthood.

THE CHANGING POSSIBILITY OF DIETARY HABITS FROM CHILDHOOD TO YOUNG ADULTHOOD

AOYAGI, O.1, SAKAGUCHI, S.2, SAKAGUCHI, H.3

1> FUKUOKA UNIVERSITY,2> FUKUOKA SEISHU-KAI HOSPITAL, 3> JAPAN UNIVERSITY OF ECONOMICS

INTRODUCTION: Dietary habits in childhood are basically determined by parents. However, after becoming young adults, they are able to determine all their dietary habits. Yet, not all their dietary habits that they were familiar with during their childhood change although their options increase. Thus, this study investigated the discontinuity of dietary habits between childhood and young adulthood.
METHODS: A questionnaire survey consisting of 13 items concerning dietary habits in elementary school years and the present day was conducted with 1204 N-university students in September 2017. Cross tables were tabulated between elementary school years and the present day and a chi-square test was conducted. When a significant difference was found, adjusted residuals were computed and the tendency was investigated from what cells except for the same options in the cross table is significant.
RESULTS: Significant differences in the chi-square test and significant adjusted residuals, except for the same options between elementary school days and university years , were found in only the following 6 items: "With whom did you eat breakfast?" "What time did you eat breakfast?" "With whom did you eat dinner?" "What time did you eat dinner?" "How frequently did you go to a convenient store or supermarket for food?" and "How frequently did family members eat food different from the other members?" Those who responded that they ate with not all family members but with their parents at breakfast and dinner in elementary school years responded that they eat with people other than family members . Concerning the question of what time they ate breakfast and dinner, those who ate breakfast from 8 am to 9 am responded "10 am or later" in young adulthood and those who ate dinner from 8 pm to 9 pm during childhood responded "10 pm or later" during young adulthood. In response to the question of "How frequently did you go to a convenient store or supermarket for food?" those who bought pre-cooked food or packed lunches in supermarkets or convenience stores two to three times per week responded "four to six times a week" during young adulthood. Finally, also regarding the question of the frequency of family members eating food different from other members, significantly many people who responded "four to six times" during childhood responded "everyday" during young adulthood.
CONCLUSION: This fact that only 6 items showed significant differences indicated that basically dietary habits in childhood are retained in young adulthood, so desirable dietary habits would have already been formed in childhood.

EFFECTS OF PHYSICAL EXERCISE AND IRON SUPPLEMENTATION ON THE LOCOMOTOR ACTIVITY OF PREGNANT RATS.

DAUBIAN-NOSÉ, P., FRANCO, B., FORTE, L.D.M., DE FANTE, T., MANCHADO-GOBATTO, F.B., TORSONI, A.S., BEZERRA, R.M., ESTEVES, A.M.

UNIVERSIDADE ESTADUAL DE CAMPINAS

INTRODUCTION: Restless Legs Syndrome (RLS) is a sleep disorder characterized by an uncomfortable feeling and the desire to move the legs. Studies have shown this syndrome in several populations, including pregnant women, suggesting investigation of iron deficiency. Both intravenous and oral iron supplementation have been shown to be beneficial in treatment of the syndrome. Physical exercise in turn presents several benefits and has also been observed in the treatment of RLS. The present study aimed to evaluate the influence of physical exercise and iron supplementation on a sleep-related movement disorder (RLS) in pregnant (P) rats.
METHODS: The animals (60 days) were distributed into4 groups: Control diet standard (CTRL/NP - CTRL/P); Diet with iron supplementation (Sfe/P); Physical exercise+standard diet (EF/P); Exercise + diet with iron supplementation (Sfe+EF/P). A vaginal smear was performed to establish the estrus cycle of the rats and for subsequent use in the data collection. Locomotor activity was evaluated through the Open Field test. The animals were submitted to an aerobic exercise program (swimming) during the pregnancy period, 6 days per week, until the 20th day of pregnancy. For the iron supplementation groups, a 100ppm Fe diet was maintained during pregnancy. For the standard diet group, a diet of 52-57ppm Fe was maintained. At the end of the experiment, the animals were euthanized individually for extraction of the striatum for analysis of D2, dopamine transporter (DAT), and tyrosine hydroxylase (TH) receptor expression. To evaluate the proteins of interest, the Immunoblot technique was used.
RESULTS: The results regarding locomotor activity suggest that iron supplementation did not differ in relation to the control group in any variable. Physical exercise induced a reduction in the variables total ambulation and rearing, and an increase in the variable grooming. The combined treatment of iron supplementation and physical exercise precipitated a reduction in the variables total ambulation, rearing, and grooming, and an increase in total freezing time. Through the Imunoblot method we observed reductions in dopamine D2 receptor expression for the Sfe+EF/P group compared to the CTR/P group, the DAT did not demonstrate a second major statistic for any of the groups, while the TH was reduced in the Sfe+EF/P group in relation to the CTR/P.
CONCLUSION: Therefore, we can conclude that non-pharmacological treatments (supplementation of iron and physical exercise) in combination demonstrated a relation with the expression of proteins related to RLS and was effective in combating the syndrome in this animal model.

THE USE OF NUTRITIONAL SUPPLEMENTS IN JAPANESE TOP-LEVEL TRACK AND FIELD ATHLETES

TABATA, S.1,2, TAGUCHI, M.2, TAHARA, K.2, MANABE, T.2, MATSUMOTO, H.1, YAMASAWA, F.2

1: INSTITUTE FOR INTEGRATED SPORTS MEDICINE, KEIO UNIVERSITY, TOKYO, JAPAN 2: MEDICAL COMMITTEE, JAPAN ASSOCIATION OF ATHLETICS FEDERATIONS (JAAF), TOKYO, JAPAN

INTRODUCTION: The high use of nutritional supplements in professional athletes has become an important issue in sports medicine. The use of nutritional supplements increases not only the risk of having positive doping test because of contaminated prohibited substances but also serious health problems in athletes. Therefore, it is necessary to have a correct understanding of the use of nutritional supplements in athletes. The aim of this study was to elucidate the use of nutritional supplements in Japanese top-level track and field athletes.
METHODS: Subjects were 183 junior <101 males and 82 females> and 266 senior <144 males and 122 females> Japanese TF athletes who had participated in international competitions from 2013 to 2017. The discipline was divided to seven categories as follows: sprinting <≦400m>, middle-distance <800-1500m>, long-distance <≧3000m>, hurdle, jumping, throwing, and combined events. Medical questionnaire was performed to all entrants by Japan Association of Athletics Federations before participating in international competitions. The athletes were requested to report for any nutritional supplements that they were taking. Nutritional supplements were classified as follows: protein, carbohydrate, vitamins, minerals, amino acids, creatine, caffeine, fish oil , ubiquinone , herbal supplements, and others.
RESULTS: 292 athletes showed a total consumption of 666 nutritional supplements. The prevalence of supplements use in athletes was 65.0% and 2.3 products were reported per supplements user. One female athlete reported to have used 12 supplements. Amino acid

and vitamins, followed by minerals and protein were found most popular supplements. The prevalence of use of females <69.6%> was higher than in males <61.2%> but was not statistically significant. The senior athletes showed higher prevalence <69.2%> than junior athletes <59.0%> . The prevalence of use by discipline varied from 47.7% for jumping to 78.3% for long-distance. The long-distance athletes particularly reported higher use of vitamins, amino acid, and minerals than that in other disciplines.
CONCLUSION: 65% of Japanese top-level TF athletes reported the use of nutritional supplements. The prevalence of use was great in female, senior and long-distance athletes.

THE PERFORMANCE EFFECT OF SCHEDULED CARBOHYDRATE AND CAFFEINE INTAKE DURING HURLING MATCH-PLAY

KEANE, J.1, SHOVLIN, A.1, MANGAN, S.1, MALONE, S.1, COLLINS, K.1, SHORTALL, M.1
INSTITUTE OF TECHNOLOGY TALLAGHT

INTRODUCTION: Hurling is a stick and ball high intensity intermittent field sport. Hurling players can complete up to 14.8% of match-play at high intensity (>17 km·h-1) with high intensity work rates decreasing throughout match-play (Collins et al., 2017). Given that nutritional intervention studies completed in other intermittent field sports have shown performance benefits from co-ingestion of CHO+CAF, the current study investigated the effects of scheduled caffeine (CAF) and carbohydrate (CHO) supplementation on simulated hurling match-play performance.
METHODS: Eight (n=8) male hurling players completed three hurling match-play simulation protocols performed 7 days apart in a double-blind, randomized design. Treatments included PLA, CHO and CAF + CHO. Participants ingested in randomised order, either a 6% CHO solution (CHO), a placebo solution of similar taste (PLA) or a combined intake of 6% CHO solution + 200mg CAF capsule. At specific time points (Pre, HT, FT) participants completed a repeated sprint protocol (RAST; 12 x 20-m). Several physiological (%VO2max, %VO2mean, %HRmax, %HRmean, RER, and blood lactate; BLa) and performance (RSAbest, RSAmean and RPE) variables were monitored at multiple time points throughout each match simulation.
RESULTS: There was a non-significant difference reported between supplement trials (CHO, PLA & CHO + CAF) regarding BLa (ES: 0.030, small), %VO2max (ES: 0.018, small), %VO2mean (ES: 0.008, small), %HRmax (ES: 0.037, small), %HRmean (ES: 0.019, small), RER (ES: 0.018, small), RPE (ES: 0.027, small) and RSAbest (ES: 0.070, small). RSAmean performance significantly increased in CHO + CAF trials compared to PLA and was significantly different based on time condition (Pre, HT & FT) (ES: 0.124, small). A significant difference was observed in BLa between time points (Pre, HT & FT) (ES: 0.820, large), in %HRmean (ES: 0.477, large) and RER (ES: 0.553, large) across halves and in RPE from S1-S10 (ES: 0.614, large).
CONCLUSION: This study is the first to provide normative data regarding effects of CHO and CAF supplementation on simulated hurling match-play performance. Similar to previous research, performance benefits were observed following co-ingestion of CHO and CAF (Gant et al., 2010). Significant improvements in RSAmean performance at FT during the CHO + CAF treatment suggest that repeated running performance decrements may be limited as a result of nutritional supplementation during match-play.
REFERENCES:
Collins K, McRobert A, Morton J.P, O'Sullivan D, Doran D.A. (2017) The Work-Rate of Elite Hurling Match-Play. J Strength Cond Res.
Gant N, Ali A, Foskett A. (2010) Int J Sport Nut Exe Met 20(3): 191-197.
CONTACT:
j.keane94@gmail.com

EFFECTS OF CREATINE SUPPLEMENTATION ON MUSCULAR STRENGTH, POWER, AND ANAEROBIC CAPACITY AFTER UPPER-BODY COMPLEX TRAINING WITH OPTIMAL INDIVIDUAL POST-ACTIVATION POTENTIATION TIME IN KAYAKERS

YANG, M.T., LEE, Y.H., LIN, S.C., LEE, M.M., CHAN, K.H.
TAIPEI MEDICAL UNIVERSITY

INTRODUCTION: To investigate the effects of creatine supplementation on muscular strength, power, and anaerobic capacity after upper-body complex training with optimal individual post-activation potentiation time in canoeists.
METHODS: Sixteen male high school canoeist volunteers were recruited to participate in this study. The tests of prone row for one repetition maximum, distance of overhead medicine ball throw, 30 s Wingate power, and the individual postactivation potentiation (PAP) period were determined before the study. Subjects were divided into groups of creatine (CR) and control (CON) according to their maximal strength. In the initial 6 days of loading phase, subjects in CR group consumed 20 g creatine and 20 g glucose per day, and CON group consumed 20 g methylcellulose. Thereafter, subjects in CR group consumed 2 g creatine, 2 g glucose and CON group consumed 5 g methylcellulose and 2 g glucose per day until the end of study. Subjects then perform the complex training 3 times per week for 4 weeks after 2 days of loading phase. The training protocol consists 6 sets (2 min between sets) of 3-RM bench press/ 8 repetition medicine ball chest press and 3-RM bench pull/ 8 repetition medicine ball over head throw with the rest time of individual PAP period. After 4 weeks training, the same testing protocol with pre-training will also be proceed. Data was analyzed by two-way mixed-design ANOVA.
RESULTS: After supplementation and complex training with the rest time of optimal individual PAP time, the prone row for one repetition maximum, distance of overhead medicine ball throw, and 30 s Wingate power in both group were significantly higher than pre-test values. However, there were no significant differences between CR and CON.
CONCLUSION: Four weeks of upper-body complex training with optimal individual post-activation potentiation time can effectively enhance muscular strength, power, and anaerobic capacity. However, creatine supplementation had no additional benefits on muscular strength, power, and anaerobic capacity.

EFFECT OF CHRONIC DIETARY NITRATE SUPPLEMENTATION ON 100-M SWIM PERFORMANCE.

MARSTON, M., VARNHAM, R., RAMSBOTTOM, R.
OXFORD BROOKES UNIVERSITY

INTRODUCTION: Dietary inorganic nitrate (NO3-) has been shown to improve human leg extensor power (Coggan et al., 2014), time trial performance using the upper body (Peeling et al., 2015) and extend exercise capacity during cycle ergometry (Bailey et al., 2009). However, little is known with respect to swimming. The aim of the present study was to investigate the effect of NO3- supplementation, in the form of concentrated beetroot juice (BRJ), on 100-m swim performance.
METHODS: Ten University level swimmers, eight men, two women (age, 21.0±2.1 years; height, 1.80±0.06 m; body mass, 69.6±9.2 kg) (mean±SD) participated; and were treated in accordance with principles laid down in the Declaration of Helskinki. Volunteers attended

three time trials in a 25-m swimming pool (temperature 27±0.5 0C). A standardized warmup preceded each trial and trials were repeated at similar times of day (±1 hour). After familiarization volunteers (in random order) consumed either 70 mL 'Beet it' (0.04 mmol NO3- per 70 mL) twice a day for three days or the equivalent volume of orange juice (OJ) as placebo. The true nature of the study was disguised as volunteers were advised both beverages were isocaloric and high in antioxidants (Bond et al., 2014). Consumption of beverages was interspersed by a 7-10 day 'wash out' period. Differences between conditions were determined using Student's t-test (SPSS v.23).
RESULTS: There was a significant difference in systolic and diastolic blood pressure supplementing with NO3- compared with OJ, 128±8/72±6 vs.133±9/75±6 mmHg respectively, which was associated with a lower pre-exercise heart rate 71±11 (NO3-) vs. 75±14 b min-1 (OJ) (P<0.01). Volunteers recorded significantly faster 100-m swim times 67.3±7.8 BRJ vs. 69.1±6.7 s OJ (P<0.05), Cohen's ES = 0.27.
CONCLUSION: Swim performance was significantly improved in University level swimmers using BRJ supplementation, possibly due to increased oxygen availability.
References: Bailey et al. (2009) Dietary nitrate supplementation reduces the O2 cost of low-intensity exercise and enhances tolerance to high-intensity exercise in humans J Appl. Physiol. 107: 1144-1155.
Bond et al. (2014) Effects of nitrate supplementation on cardiovascular and autonomic reactivity in African-American females ISRN Physiol. Feb. 23 pii 676235.
Coggan et al. (2014) Effect of acute dietary nitrate intake on maximal knee extensor speed and power in healthy men and women Nitric Oxide 48: 16-21.
Peeling et al. (2015) Beetroot juice improves on-water 500 m time trial performance, and laboratory-based paddling economy in National and International-level kayak athletes International Journal of Sport Nutrition and Exercise Metabolism 25: 278-284.

DOES L-CARNITINE SUPPLEMENTATION IMPROVE PERFORMANCE OF DISTANCE ATHLETES?

GRIVAS, G.V., VAVRITSAS, S.

PHYSICAL EDUCATION AND SPORT SCIENCE

INTRODUCTION: Carnitine (L-3-hydroxytrimethylamminobutanoate) is an endogenous compound that can be synthesized in the liver and kidney from the essential amino acids lysine and methionine or ingested through diet (Bremer, 1983; Clarkson, 1992; Kraemer, 2005). L Carnitine plays a critical role in energy production and in fat metabolism through its function as a transporter of long-chain fatty acids into mitochondria for β-oxidation (Fritz, 1963). In cells, it helps transport fatty acids into the mitochondria, where they can be burned for energy. There is a debate about the effects of L-Carnitine supplementation on performance in endurance runners (Panjwani et al., 2007; Broad et al., 2005). Therefore, the aim of the present study is to investigate the effects of L-Carnitine on performance of distance athletes.
METHODS: The following databases were searched: Pubmed, SPORTDiscus, Medline and CINAHL (Cumulative Index to Nursing and Allied Health Literature). In each database the title, abstract and keywords search fields were searched. The following keywords, combined with Boolean operators (AND, OR), were used: "L-Carnitine", athletic performance", "distance runners", "sports performance", and "endurance runners".
RESULTS: There are only three studies in the literature showing beneficial effects of L-Carnitine on performance of distance athletes (Arenas et al., 1994; Gorostiaga et al., 1989; Marconi et al., 1985). On the contrary, four studies have shown no effects of L-Carnitine supplementation on performance of distance runners (Cooper et al., 1986; Colombani et al., 1996; Greg et al., 1987; Wachter et al., 2002).
CONCLUSION: These results indicate that there is uncertainty in regards to how L-Carnitine helps athletic performance. However, it is clear that L-Carnitine plays an important role on recovery from strenuous exercise (Ho et al., 2010; Kraemer et al., 2003; Spiering et al., 2007; Volek et al., 2002). The majority of studies suggested a dose of 2 g/d of L-Carnitine. Perhaps should be examined higher dose than 2 g/d of this supplementation to improve performance of distance runners.

Philosophy and Ethics
Physical Education and Pedagogics

AN INTERVENTION TO PROMOTE WALKING IN UNIVERSITY CAMPUS SETTING

LEUNG, E.F.L.1, SUM, R.K.W.2, YUEN, B.P.K.1

THE CHINESE UNIVERSITY OF HONG KONG

Purpose: Physical activity (PA) habits during young adult years may have long-term health influences on adult life. University campuses possess unrealized opportunities for PA promotion among young adults. The current study aimed to evaluate the effectiveness of an 8-week campus walking programme among university students.
Methods: A total of 1308 students from a university were recruited and participated in the current study. They were group-randomized by class and placed into two groups, i.e. the intervention group (I) and the control group (C). Participants of the I group were encouraged to walk on the campus trails instead of using campus shuttle bus for transportation. Participants were requested to record their walking frequency by using the reading devices installed along the trails. The "Green Walker" prize for students walked more than 40 times in the campaign period would be awarded. Participants of group C did not receive any intervention treatment. They were requested to maintain their present lifestyle for 2 months. The assessments of walking scores were conducted at baseline and two months after the commencement of the intervention.
Results: Increased in walking score was found in the I group, but they were not statistically significant ($p > 0.05$). Although the increase in walking was not significant, the significance level was close to 0.05 ($F [1, 1306] = 2.853$, $p < 0.091$). The walking score for C group was more or less the same after 2 months.
Conclusion: The results showed that the 8-week campus walking programme was not effective in promoting walking on campus. The lack of intervention effects might be attributed to the short intervention period and lack of reminding messages for intervention participants. The current study collected self-reported data, which could create a response bias. Objective PA could be assessed by using accelerometers which might also help to remind and motivate participants to exercise.

THE EXPERIENCES OF DAILY PHYSICAL EDUCATION IN HUNGARY

HAMAR, P.1, KARSAI, I.2, CSORDÁS-MAKSZIN, Á.1, SOÓS, I.3

1UNIVERSITY OF PHYSICAL EDUCATION, BUDAPEST, 2UNIVERSITY OF PÉCS, HU, 3UNIVERSITY OF SUNDERLAND, UK

Introduction: In Hungary, the regulation of public education requires delivering 5 PE lessons a week. The weakest link in daily PE is the insufficient availability of sports facilities and equipment. In order to teaching physical education to meet the challenges of the 21st centu-

ry's standards, effective education, teaching and training, one school - one gym - one swimming pool primary objectives are required. Creative and highly experienced physical education teachers can temporarily overcome the difficulties caused by incomplete material conditions, but this cannot be sustained in the long run. In our study, we investigated the opinion of physical educators regarding to whether or not the quality and quantity of material conditions (facilities/equipment) provided to physical education are adequate. Are the unacceptable conditions of existing sports facilities used in classrooms generic? We assumed that the answers would differ depending on the type of settlements and schools, ultimately the location where the respondent PE teachers teach physical education.
Methods: A cross-sectional questionnaire-based survey method was taken place in Hungary. The original version of the questionnaire translated into Hungarian was used by K. Hardman and J. Marshall in an international investigation (Hardman & Marshall, 2009). In the interest of the representativeness of the data, the stratified sampling procedure for groups was used (N=1161). In addition to descriptive statistics (frequencies) performed, chi-square test was employed to reveal the relationships between the dependent and independent variables.
Results and Discussion: 45.1% of the respondents consider the sports facilities used for teaching are unacceptable. However, 71.4% of the quality of the facilities and 77.3% of the quality of the equipment are judged good-adequate. In contrast, 52.1% of respondents reported the amount (quantity) of facilities, while 40.8% the quantity of equipment as average-inappropriate, The results of the chi-square test show significant differences between the quantitative and qualitative indicators for sports facilities and equipment according to the type of settlements and schools ($p < 0.05$). As for the question of Where, in what kind of settlement do you teach?, The least negative (34.5%) responses are manifested by the teachers from Budapest. Thus, the "capital centering" is also reflected in other areas, as in the financial situation of schools, such as related to school sports facilities and sports equipment. From the whole sample, vocational schools teaching staff agreed in the highest percentage (62%) with the unacceptable situation of sports infrastructure. This may be due to the fact of the content features of vocational training, as well as the maintainers of vocational training vary considerably from other school types.
References: Hardman, K. & Marshall, J. (2009) Second World-wide Survey of School Physical Education. Final Report. H & P Druck, ICSSPE, Berlin

THE EFFECTS OF CHARACTER PERFORMANCE IN TEACHING GAMES FOR UNDERSTANDING WITH TEACHING PERSONAL AND SOCIAL RESPONSIBILITY

YA-TZU, K., HUNG-SHIH, C., SHYH-CHING, C.
NATIONAL TAIWAN SPORT UNIVERSITY

Introduction: Teaching Games for Understanding has a lot of research in physical education teaching to prove its effectiveness. However, the method doesn't have any research results on the students' character performance. Therefore, the Teaching Personal and Social Responsibility might be an effective mode and it can enhance the performance of character under the Teaching Game for Understanding method.
Aim
The purpose of this study was to explore the influence of character performance in Teaching Games for Understanding with Teaching Personal and Social Responsibility.
Sample
Two of the classes including 49 ninth graders received the instruction lasted 8 weeks. The students were randomly assigned to one experimental condition. One group (N=24) worked on the Teaching Game for Understanding, and another (N=25) worked on the Teaching Game for Understanding with Teaching Personal and Social Responsibility.
Method
It takes "Measuring student responsibility in physical education" designed by Hsu, Pan, Chou, Lee and Lu (2014) for teenager students from 13 to 18 years old in Taiwan. The instrument is the measurement of students responsibility in PE classes. In order to examine the leaning effects between two groups, a t-test analysis was performed. Then, an ANCOVA was performed to examine the comparison of the character performance in the two groups.
Result
They showed that the students had a better performance in their character performance after they were received Teaching Game for Understanding with Teaching Personal and Social Responsibility.
Conclusion
It can be a reference for the study based on the Teaching Personal and Social Responsibility and Teaching Game for Understanding. Besides, it also may be beneficial for PE teachers and scholars to future study. The study suggests that researchers manipulate different the variables likes ages or athletic events. Teaching Games for Understanding can combine with other different teaching methods. Researchers implement the study in longitudinally or qualitatively study.
Key word
Teaching Games for Understanding, TGfU ; Teaching Personal and Social Responsibility, TPSR ; Character Performance ; Teaching Method of Physical Education
Contact: 1050404@ntsu.edu.tw

EFFECTS OF PERCEIVED PHYSICAL LITERACY ON PHYSICAL ACTIVITY ENJOYMENT AND SITUATIONAL INTRINSIC MOTIVATION IN PE CLASSES

SUM, K., WALLHEAD, T., HA, S.C.A., SIT, H.P.C.
THE CHINESE UNIVERSITY OF HONG KONG

INTRODUCTION: This study aims to examine the influence of student-athletes' perceived physical literacy in predicting physical activity enjoyment and situational intrinsic motivation in physical education classes among Hong Kong primary and secondary school students.
METHODS: A total of 2446 primary and secondary school students in Hong Kong were recruited into this cross-sectional study. Self-report scores from perceived physical literacy instrument , physical activity enjoyment scale and situational intrinsic motivational scale were recorded.
RESULTS: Three instruments were significantly correlated with the r between physical activity enjoyment and perceived physical literacy being highest . Regressions further revealed that students perceived physical literacy was the best predictor for physical activity enjoyment . While physical activity enjoyment was used to predict perceived literacy, physical activity enjoyment was the best predictor for

perceived physical literacy . In addition, knowledge and understanding , intrinsic motivation and amotivation were significant for predicting physical activity enjoyment in PE classes.
CONCLUSION: The results were useful in intervening in the perception of physical literacy and participation in physical education classes for primary and secondary school students in Hong Kong and other countries. Findings also provide a new perspective for teaching education institutions and professional development programmes by emphasizing the concept of physical literacy.

TEACHERS' ROLE MODEL IN PHYSICAL ACTIVITY: ARE PRE-SCHOOL CHILDREN MORE ACTIVE WHEN TEACHERS ARE ACTIVE?

CHEUNG, P.

THE EDUCATION UNIVERSITY OF HONG KONG

Introduction: In early childhood, children spend a large amount of time in pre-school. Teachers, with the opportunity to interact with children in every school day, are in a unique position to influence childrens behavior. The purposes of this study are: 1) to compare the activity level of pre-school children in a structured PE class led by an active or a less active teacher, and 2) to examine the interaction effect of school size, gender, and teacher activity level on the activity level of children.
Methods: Participants were 248 pre-school children (134 boys, 114 girls; mean age = 5.5) and teachers from twelve pre-schools. A 30-minutes structured PE class was conducted by trained teachers and the participants' physical activity level was measured by pedometers. Teachers' recorded steps counts were derived to classify if the children were led by active or less active teacher. Factorial analysis of variance (ANOVA) was used to determine if there was a significant difference in the pedometer-determined activity on gender and school size between the different classes.
Results: In the 30-minute PE class, significant difference between groups was observed as determined by ANOVA [F(1,246) = 149.81, p = .00], which revealed that the activity level of children was higher in the active teacher class (1,712 ± 501 steps) than that of the less active teacher class (951 ± 437steps). The main effects of gender on the PA level of children [F(1,247) = 6.20, p = .01] and of the teacher group [F(1,247) = 148.35, p = .00] were significant. The main effect of school size on children PA level was insignificant [F(1,247) = 3.44, p = .07].
Conclusion
The findings of this study confirmed that pre-school children were more physically active when the class was led by an active teacher. The understanding of this association would provide implication for pre-school teacher education training. Future study can explore different pedagogical approach for teachers to involve pre-school children to be more active during school hours.
Contact: cheungpy@eduhk.hk

EFFECT OF DRINKING WATER DURING SIMULATED HEAT WAVE CONDITIONS ON COGNITIVE PERFORMANCE IN CHILDREN

MEKJAVIC, V., MEKJAVIC, I.B.

JOZEF STEFAN INSTITUTE

INTRODUCTION: Due to global warming, summer heat waves have increased in frequency, magnitude and duration. Such heat waves place a burden on all individuals, increasing the risk of heat strain, and impairing performance. We evaluated the effect of children's hydration status during conditions simulating a heat wave on their cognitive performance.
METHODS: Nine girls (age: 14 yrs, body mass = 52.1 ± 9.7 kg, height = 149.5 ± 31.4 cm) participated in two trials, during which they sat for 90 minutes (two school hours) in a climatic chamber maintained at a temperature of 35°C and 50% relative humidity. The temperature and humidity were chosen to mimic the conditions during heat waves in June, which is the last month of school. On one occasion (Hydration trial), the subjects were requested to drink 500 ml of water (approximately 0.125 L every 20 minutes) during the 90 min exposure, and on the other occasion (Control trial) they refrained from drinking water. Before, and upon completion of the exposure in the climatic chamber, we measured their mass, tympanic temperature, heart rate, ratings of thermal comfort and temperature sensation, and also recorded their simple and choice reaction times, and their performance on two trail tracking tests; one tracking numbers only (Tracking Test A), and the other alternating tracking numbers and letters (Tracking Test B).
RESULTS: In the Control trial there was a significant ($p<0.05$) loss of body mass, and a significantly ($p<0.05$) greater increase in tympanic temperature and concomitantly heart rate than in the Hydration trial. The increase in thermal discomfort was similar in both trials, with subjects reporting a lower sensation of temperature during the Hydration trial. There was no effect of temperature or hydration on simple and choice reaction times. Lack of hydration (Control trial) significantly ($p<0.05$) increased the time required to complete the tracking tests.
CONCLUSION: During the heat waves that are anticipated to occur with greater frequency and intensity during the last month of the academic year (June), inappropriate hydration will cause a decrement in cognitive performance in children.
Acknowledgements: This study emanated from a dissemination action associated with the European Commission Horizon 2020 project Heat Shield (Project number 668786).

OXYGEN UPTAKE KINETICS DURING TREADMILL WALKING IN PRESCHOOL CHILDREN

STASIULIS, A., STASIULE, L., CAPKAUSKIENE, S.

LITHUANIAN SPORTS UNIVERSITY

INTRODUCTION: The pulmonary oxygen uptake (pVO2) kinetic response at the onset of exercise provides a non invasive method of evaluating aerobic metabolism in muscles during growth and maturation. However, to date only limited research has been devoted to investigating the pVO2 kinetics during exercise in children (Armstrong, 2017). Therefore, the aim of this study was to compare the pVO2 kinetics during six minutes walking on treadmill in preschool children of different gender.
METHODS: Preschool children (19 girls and 15 boys) participated in two consecutive treadmill exercises sessions separated be one hour. The mean age, height and body weight was 6.70 ± 0.38 and 6.79 ± 0.66 years, 1.23 ± 0.41 and 1.23 ± 0.50 m and 24.4 ± 3.6 and 24.3 ± 3.1 kg in girls and boys, respectively ($p>0.05$). During each session pVO2 data were collected at subjects rest and during walking (at 6 km/h and a 4% grade treadmill) for 6 minutes. The kinetics of pVO2 during exercise was analysed by applying mono exponential function.
RESULTS: Slow component of pVO2 was not observed in any group of children during this mode of exercise. For the girls and boys the pVO2 baseline value was 0.260 ± 0.042 and 0.274 ± 0.042 L/min, amplitude of pVO2 response was 0.564 ± 0.063 and 0.604 ± 0.053 L/min., time constant of pVO2 kinetics was 15.4 ± 2.2 and 15.9 ± 2.8 s, respectively (in all cases $p>0.05$). Absolute mean VO2 during third

minute of exercise was significantly higher in boys group (0.818 ± 0.081 and 0.881 ± 0.092 L/min in girls and boys, respectively; p=0.04). However, there was no significant difference of this measure between groups at fourth min of exercise (0,875 ± 0,076 and 0,824 ± 0,076 L/min; in boys and girls respectively, p=0.06). Absolute mean VO2 at fifth min of exercise was significantly higher in boys group than in girls (0,890 ± 0,075; 0,830 ± 0,070 L/min in girls and boys, respectively, p=0.02). However, there no significant difference between groups of that measure at sixth minute of exercise (0.843 ± 0.072 and 0.889 ± 0.078 L/min; girls and boys, respectively, p=0.09).
CONCLUSION: pVO2 kinetics estimated during two treadmill walking sessions is similar in preschool girls and boys but girls tend to demonstrate better walking economy during steady state of exercise.

IMPROVEMENT IN EXECUTIVE FUNCTION OF CHILDREN DURING A MONTH-LONG CAMPING TRIP

SHIMANO, A., NOI, S., TANAKA, R.

NIPPON SPORT SCIENCE UNIVERSITY

INTRODUCTION: In Japan, there is concern about poor development and performance of execution function in children. Therefore, we examined the influence of a long-duration camping trip on executive function. Results confirmed that long-duration camping activities may include elements that encourage the development of childrens executive function. However, the report was based only on the camp implementation group where control data had not yet been collected. Therefore, the aim of the present study is to reexamine the influence of a long-duration camping trip (31 nights and 30 days) on the executive function of children through comparison with a control group.
METHODS: Participants of this study were 203 children attending a long-duration camping trip (camp group: 9-14 years old) conducted in July and August from 2008 to 2017; 25 children formed the control group (control group: 9-12 years old) conducted in July and August 2017. Measurement of the camp group was carried out only in the morning, either on the 2nd day or the 3rd day (early stage) of the camp, 12th to 14th day (middle stage), or 30th day of the camp (final stage). Measurement of the control group was carried out according to the same schedule as the camping group. A go/no-go task was used to measure executive function. In the analysis, the number of commission errors (no-go errors) in the no-go trials, omission errors (go errors) in the go trials, and incorrect responses between stimuli (no-task errors) were calculated in both a differentiation experiment and a reverse differentiation experiment for the go/no-go task. Task results and their changes for both the camp and control groups were observed throughout the duration of the camping trip.
RESULTS: Results of a two-way analysis of variance examining group factors and period factors, no task errors in the differentiation experiment and no-go errors in the reverse differentiation experiment confirmed a significant interaction, and a significant difference was detected in the main effect of the time-period. As a result of subsequent multiple comparisons, it was confirmed that the no task errors in the differentiation experiment were significantly fewer in the final stage of the camp group than in the early stage. In addition, in the camp group, it was confirmed that the no-go errors in the reverse differentiation experiment decreased significantly from the early stage to the middle stage, and from the middle stage to the final stage. In recent years, several study findings suggesting that physical activity has a positive influence on executive function. It has been confirmed that during the long-duration camping trip examined in this study, the amount of physical activity is increased compared to before and afterward. Therefore, it can be inferred that physical activity contributed positively to executive function.
CONCLUSION: Long-duration camping trips may improve childrens executive function.
NOTE: This study was supported by commissioned research from Base Brain Work, Inc.

AN 8 WEEK STUDY ON YOGA STRETCHING AND CORE MUSCLES TRAINING AT A HIGH SCHOOL IN HONG KONG: TEACHER'S PERSPECTIVE

HON, S.

THE CHINESE UNIVERSITY OF HONG KONG

Introduction: The benefits of yoga stretching and core muscles exercises have been known, however, not too many school includes them in physical education classes. In addition, research in the area usually was done from the perspective of students and not from teacher. Therefore, the aim of this study was to explore the learning motivation and responses of a female high school teacher aged 40 when learning and implementing the new design exercise program for 40 female students aged between 12-14.
Methods: An in-service physical education teacher attended a 4-hour training by one certified yoga instructor and one certified fitness trainer on a new design exercise program including 32 yoga stretching postures and 18 core muscles exercises. After the training, the teacher implemented the new design program during physical education classes for 8 weeks at a chosen high school. The chosen class attended a 90 minutes physical education class once a week. In order to reflect the teaching and learning experience of the teacher, she completed a questionnaire after each class and attended interviews before and after the 8 week program. At the end, the teacher completed eight questionnaires and attended two 1-hour interviews. The questionnaires and interviews data were used for analysis in this study. Video recording was done in each physical class for analysis.
Results: The major reflections from the teacher were as follows: 1) an increase in teaching motivation in teaching new program and confidence in putting new elements in traditional physical education classes; 2) to combine the new program with other physical activities like ball games will make the class more fun; 3) the yoga elements in the new program improved the balance and stability of students; 4) students showed increased exercise intensity and motivation for the physical education classes while learning the new program. 5) the core training exercises can be used as warm up in every lesson and the yoga stretching exercises can be used as cool down in every lesson.
Conclusions
This study suggests that the new design program increased the teaching motivation and enhanced the teaching experiences of the teacher. In addition, the 8 week yoga stretching and core muscles exercises increased the exercise intensity of the students and increased the participation motivation of the students in the class.

Physiology

INFLUENCE OF LONG EXERCISE EFFORT ON ANTHROPOLOGICAL PARAMETERS.

WIERZBICKA-DAMSKA, I., BAKONSKA-PACON, E., JASTRZEBSKA, A.

UNIVERSITY OF PHYSICAL EDUCATION

INTRODUCTION: Every effort requires energy supply and causes fatigue. Symptoms of fatigue are evident in changes on inside body parameters (at all levels), but they can also easily be seen in the area of changes in muscle circumference and body composition.
The aim of the study was to show changes in anthropological parameters: circuits and body composition against changes of other internal markers resulting from fatigue caused by progressive and continuous running test.
METHODS: The study included a group of 30 people aged 27.9 ± 5.6, subjected to a progressive and continuous laboratory treadmill test. Arterialized blood parameters of acid-base balance (RapidLab 348 Siemens Germany), colorimetric lactate (Dr. Lange Küvettentest, LKM 140 Germany) were studied. Plasma concentrations were determined by immunoassay (ELISA Test Demeditec Diagnostics GmbH Germany): catecholamines (dopamine, noradrenaline adrenaline) and serotonin and tryptophan. Before and after exercise, body circumferences were measured: chest, waist, right and left forearm and arm, right and left leg and thigh and body composition (Biometrix, USA). The results were analyzed by Students t-test using Statistica 13.1.
The study was supported by a research grant from the National Science Centre in Poland (0022/RS4/2016/54).
RESULTS: Significant (statistically significant) changes in circumferences of the body and body composition were also observed in the background of statistically significant changes ($p \leq 0.001$) of biochemical fatigue markers.
The current circuit changes are always caused by a forced displacement. Their distribution is due to the nature and distinctness of the specific test, is determined by the size of the blood flow and thermoregulation and muscle micro-injury within the muscle cells. After the test attempts, the thigh and leg circumference increase while the waist circumference decreases. The composition of the body is visible changes in percentage of water content. These changes are particularly visible after 40 minutes continuous testing
CONCLUSION: Anthropological changes (changes in circumferences of the body and body composition) observed after exercise can be indicators of fatigue along with biochemical markers, especially since the direction of change is characteristic of the type of exercise stimulus.

CHRONIC TENDINOPATHIES AND PLATELET-RICH PLASMA TREATMENT: HOW TI IMPROVE THE EFFICENCY ?

KAUX, J.F., EMONDS-ALT, T.

UNIVERSITY OF LIÈGE

INTRODUCTION: Platelet-rich plasma is blood plasma with a high concentration of autologous platelets which constitute an immense reservoir of growth factors. Although highly popular with athletes, the use of PRP for the treatment of tendinopathies remains scientifically controversial, particularly due to the diversity of products that go by the name of "PRP".
METHODS: In a literature review, we take a closer look at eight parameters which may influence the quality of PRP: 1> anticoagulants used to preserve the best platelet function, 2> the speed of centrifugation used to extract the platelets, 3> the platelet concentrations obtained, 4> the impact of the concentration of red and while blood cells on PRP actions, 5> platelet activators encouraging platelet degranulation and, hence, the release of growth factors, and 6> the use or nonuse of local anesthetics when carrying out infiltration. In addition to these parameters, it may be interesting to analyze other variables such as 7> the use of ultrasound guidance during the injection with a view to determining the influence they have on potential recovery.
RESULTS: Analysis of the 59 studies shows that a majority use ACD-A as an anticoagulant during sampling. A platelet activator is only used in a few studies. However, the best results have been obtained in studies which use no platelet activator. In terms of the speed of centrifugation, analysis of all these studies appears to confirm the existence of a great number of protocols in the literature. It is difficult to draw any conclusions when these different variables are unknown . Currently, no studies have been carried out neither on the use of a "buffer" product to neutralize the acidity caused by the anticoagulant nor on the optimal volume of PRP to be injected. Although it would appear inadvisable to administer a local anesthetic because the anesthetic may reduce the local pH and lead to the inhibition, reduction, or absence of platelet degranulation, the literature shows that the majority use a local anesthetic. They do not, however, obtain better results than those not using a local anesthetic. Finally, it appears to be advisable to carry out infiltration under ultrasound guidance, even if PRP diffusion is observed after injection. This all aims to show that there is still a need for high quality studies, with standardized collection protocols and the use of PRP in the context of tendinopathies, in order to better scientifically understand the real effectiveness.
CONCLUSION: There is a lack of standardization in PRP preparation technique for chronic tendinopathies. However, our study helped identify features of PRP recommended a platelet concentration lower than 5 times the baseline , and avoiding leukocytes and erythrocytes. We recommend leveraging this information about PRP for future studies.

EVALUATION OF ION PROCESS AND QUALIFICATION IN VOLLEYBALL

BIRÓNÉ ILICS, K., MÁTRAI, ZS.

EÖTVÖS LORAND UNIVERSITY

Introduction: The purpose of the present research was to verify the results of our 2012-2013 research on the methods of selecting talented volleyball players. The scope of the initial research, based on measurements, covered the age group of children <12-13 years> and adolescents <14-15 years> . During our study, we applied selection methods – aimed at evaluating predictive validity – which best predicted the anticipated performance.
Methods: During the study, 7 types of data have been collected from the participating 141 children. To test the anthropometric parameters, we took 24 different body sizes of the players. The data also provided the expected adult height, the difference between the biological and calendar age, the athletes body type. We selected 6 motor tests: 18m running, 3kg medicine ball forward throw, long distance jump, 3kg two-handed medicine ball back throw, sit-up, jumping, flying sprint>. Ball control and performance were evaluated by coaches. They had to evaluate the players ball control skills on a scale of 1 to 5 during 50 individual training sessions. To analyze the environmental and personality factors, we compiled questionnaires for athletes and parents. Volleyball performance was evaluated by analyzing 3 matches for each player. We considered the best performers in the tests to be talented <5 girls and 8 boys>. We have tracked the career of the selected players so that we can verify their competence and qualification after 5 years.

Results: Of the 13 selected players <5 girls and 8 boys>, we considered qualified those who are currently at the forefront of Hungarian volleyball and whose performance is outstanding in Hungary. According to the study, 5 of the 13 talented players have met the expectations. It can be concluded that the selection process and the consequent qualification was successful for these 5 players.
Discussion: Our test results prove that our selection methods were correct. There is no doubt, however, that the research would only have been complete, if we had – besides sports sciences literature – included sports psychology literature too, as part of our selection procedures. The sport psychological aspect can determine the direction of possible research continuation.
References: Bíróné Ilics K. <2009>: Selection in playing volleyball. In: Hughes M, Dancs H, Nagyváradi K : Research in Sport Science. DataWin2, Cardiff, 236-244.
Harsányi L. <2000>: Edzéstudomány I. Dialóg Campus Kiadó, Budapest-Pécs
Mészáros J., Mohácsi J., Szabó T., Szmodis I. <2000>: Anthropometry and competitive sport in Hungary. Acta Biologica Szegediensis. 44<1-4>. 189-192.
Contact: birone.ilics.katalin@ppk.elte.hu

EFFECTS OF INTERMITTENT COLD EXPOSURE ON MUSCLE STRUCTURE AND FUNCTION: IMPLICATIONS TO IMPROVE RECOVERY AFTER INJURIES

TORRELLA, J.R., LARA, S., SANTOCILDES, G., CABRERA-AGUILERA, I., RIZO-ROCA, D., PAGÈS, T., VISCOR, G.

UNIVERSITAT DE BARCELONA

INTRODUCTION: Cold acclimatization induces changes in resting metabolic rate and different biochemical markers. The increase in metabolic rate is reflected as an increase of oxygen consumption that could reflect the remodelling of structural tissues. The aim of this study was to investigate the effects of whole-body intermittent cold exposure on rat gastrocnemius muscle and its usefulness to improve recovery after muscle injury.
METHODS: After inducing injury in the rat gastrocnemius, two groups of animals (n=6) were considered: COLD, submitted to intermittent cold exposure at 4ºC for 21 days; and CTRL, maintained at 27°C. Histological slides were stained for demonstrating the oxidative and contractile properties of the fibres, classified as slow oxidative (SO), fast oxidative glycolytic (FOG), fast intermediate glycolytic (FIG) and fast glycolytic (FG). Capillary density (CD), fibre capillarization (CCA) and fibre cross-sectional area (FCSA) were measured after ATPase staining. Force properties of contralateral injured and healthy gastrocnemius were registered by electrical stimulation of sciatic nerve. Peak (PF in mN/g) and tetanic force (TF in mN/g), contraction (CT) and half relaxation times (HRT), and fatigue properties at low frequency (30 Hz) were measured.
RESULTS: Intermittently exposed animals to cold evidenced a significant shift from FOG fibres to a more anaerobic phenotype (FIG and FG), together with an increase in capillary supply (CD and CCA) and smaller FCSA. Injured leg from the CTRL group registered significant lower values than the healthy leg in PF (37±9 vs 44±5, p=0.048), TF (110±40 vs 148±22, p=0.016), and showed lower resistance to fatigue. Intermittent cold exposure recovered PF and TF (but with lower values for injured leg: 39±5 vs 44±4, p=0.082 and 156±21 vs 167±26, p=0.309) and resistance to fatigue. No alterations were registered neither for CT nor HRT in any group.
CONCLUSION: Intermittent cold exposure resulted in a significant decrease of FCSA and an increase of CD reducing diffusion distance and facilitating oxygen supply to the tissue. This would counteract the effects of peripheral vasoconstriction induced by cold exposure. Moreover, a shift from an oxidative phenotype of the muscle fibres to a more anaerobic one, would give a faster thermogenic response against cold. Although without reaching the same values that its contralateral healthy leg, the injured leg was partially recovered after intermittent cold exposure. As has been described for therapies applying local cold to injured muscles, recovery was probably favoured by increased capillarization, reducing the infiltration of macrophages, oedema and accelerating the recovery from fibrosis.

DIFFERENCES IN MUSCLE OXYGENATION BETWEEN YOUNG AND MIDDLE-AGED RECREATIONALLY ACTIVE MEN DURING HIGH-VOLUME RESISTANCE EXERCISE

GEPNER, Y., WELLS, A.J., GORDON, J.A., ARROYO, E., VARANOSKE, A.N., COKER, N.A., FUKUDA, D.H., STOUT, J.R., HOFFMAN, J.R.

UNIVERSITY OF CENTRAL FLORIDA

INTRODUCTION: Near-infrared spectroscopy (NIRS) is a noninvasive technique that provides information regarding changes in tissue oxygenation based on oxygen-dependent absorption characteristics of infrared light in the range of 600–900 nm. The benefit of NIRS is in its ability to measure the instantaneous oxygenation response in a less restricted environment, which is suitable for evaluating exercise tasks involving both static and dynamic exercise. Previous research has demonstrated no differences in muscle deoxygenation between high intensity versus high volume resistance training programs. However, the greater duration of high volume resistance training (15 repetitions at 60% of the participants' maximal strength) has been shown to result in a significant delay in muscle reoxygenation. Investigations examining differences in muscle oxygenation between younger and middle-aged adults performing resistance training are limited. Thus, the purpose of this study was to compare muscle oxygenation of the vastus lateralis during a high volume, isokinetic resistance exercise protocol (HVP) between young adult (YA) and middle-aged adult (MA) men
METHODS: Twenty recreationally trained men were assigned to either the YA (21.8±2.0 y, 90.7±11.6 kg, 179±4.7 cm) or MA (47.0±4.4 y, 96.1±21.6 kg, 177±7.7 cm) group. The HVP consisted of eight sets of 10 repetitions of unilateral isokinetic concentric knee extension and eccentric knee flexion at 60°·sec-1. Changes in tissue hemoglobin saturation index (TSI), tissue oxygenated hemoglobin concentration (O2Hb), deoxygenated hemoglobin (HHb), and muscle oxidation index (O2Hb-HHb) were measured during the exercise session using near-infrared spectroscopy (NIRS). Data were analyzed using two-way mix factorial analyses of variance.
RESULTS: Prior to exercise, TSI was significantly greater for YA compared to MA (73.2±3.4% vs. 68.6±4.8%, p=0.024). For both groups, significant decreases in O2Hb and O2Hb-HHb, and increases in HHb were observed during each of the eight sets relative to the rest periods (p<0.05). However, the average change during the eight sets of the HVP revealed a significantly higher (p=0.036) level of HHb (7.8 ± 0.5μM vs. 5.3 ± 3.1μM) and a lower (p=0.029) level of O2Hb-HHb (-11.3 ± 1.4μM vs. -7.1 ± 5.5μM) for MA compared to YA.
CONCLUSION: During a high volume, resistance exercise protocol, middle-aged adults experienced reduced muscle oxygen saturation levels compared to younger, recreationally active adults. These results suggest that age-related changes in muscle oxygenation appear to occur in middle-aged adults, regardless of recreational exercise training experience.

ISCHEMIC PRE-CONDITIONING FOR HUMAN PERFORMANCE IS NOT EXPLAINED BY PLACEBO EFFECTS DURING CYCLE ERGOMETRY

BURR, J.F., CHEUNG, C., SLYSZ, J.T.

UNIVERSITY OF GUELPH

INTRODUCTION: The efficacy of ischemic pre-conditioning (IPC) for the augmentation of human aerobic exercise performance remains debated. In particular, it is suggested that previously observed effects of IPC may be influenced by insufficient placebo/nocebo shams and inappropriate aerobic exercise performance tests (1). Thus, the purpose of this investigation was to compare the effects of IPC versus both a non-treatment and sham placebo control, for altering measures of exercise performance and efficiency during a staged test to exhaustion.
METHODS: Twelve recreationally active participants (6M/6F, 66.7±15 kg, 169±9 cm, 43±8 ml.kg.-1min-1) underwent three 40 min pre-exercise conditions on different days in a random order: 1) wakeful supine rest, 2) sham therapeutic ultrasound or 3)IPC. The exercise challenge consisted of 3 min submaximal cycling stages commencing 5W below measured lactate threshold, and increasing 5W/stage to failure. Following a short 2 min break a supramaximal test (5W above power at VO2max) was conducted to failure. Cycling performance, lactate production, and metabolic demand were measured, and subjects were asked about their perceptions of treatment efficacy using a visual analogue scale.
RESULTS: 72% of participants reported a pre-exercise expectation of the sham being more effective than IPC, confirming efficacy of the deception. Comparing the IPC and Sham treatments to the baseline performance observed following 40min of quiet rest, an improvement was observed in the IPC group for max power output (IPC: +2.5±4W, Sham: 0±3.5W) and thus incremental stages completed (IPC: +0.5±0.9, Sham: 0±0.3 stages), both $p \leq 0.05$. Alterations were also observed only for the IPC group comparing time to failure during the supramaximal bout (control: 1378±288s, sham: 1380±256s, and IPC 1493±299s). No meaningful differences were observed for submaximal oxygen consumption, maximal oxygen consumption or lactate across the varying exercise intensities.
CONCLUSION: The present study refutes the suggestion that the observed effects of IPC do not exceed the performance benefits of an effective sham control. Differences between this study, and those after which it was modelled may be explained by the use of cycle ergometry, which is dynamic and adjustable in comparison to treadmill exercise.
Reference: 1) Sabino-Carvalho et al. (2017) Effect of Ischemic Preconditioning on Endurance Performance Does Not Surpass Placebo. MSSE 49(1) 124-132

EFFECTS OF EXERCISE TRAINING INTERVENTION ON INTRINSIC HIGH- OR LOW-AEROBIC EXERCISE CAPACITY IN MICE

HSU, Y.J., HUANG, W.C., LEE, M.C., HUANG, C.C.

NATIONAL TAIWAN SPORT UNIVERSITY

INTRODUCTION: Current exercise research is focusing on the physical fitness, physical activity, health promotion, disease prevention and performance improvement for individuals and communities around the world. Response to exercise intervention is often highly variable among individuals, however, the researchers have indicated that response to exercise may be affected mainly by genetic variations. We aimed to investigate different type exercise training and relationship affecting congenital exercise performance in an animal model with physical activity challenge from physiological and biochemical perspectives.
METHODS: In this study, we selected high- and low- intrinsic exercise capacity mice by using exhaustive swimming test. We investigated the differential effects of aerobic exercise or isometric strength training on physiological performance and biochemical profiles in high aerobic swimming exercise capacity mice (HAEC) and low exercise capacity mice (LAEC) mice, a total of 24 HAEC and 24 LAEC male mice 6 weeks old were randomly divided into 6 groups: (1) HAEC with sedentary control (HAEC-SC), (2) HAEC with aerobic exercise training (HAEC-AE), (3) HAEC with isometric strength training (HAEC-ST), (4) LAEC with sedentary control (LAEC-SC), (5) LAEC with aerobic exercise training (LAEC-AE), (6) LAEC with isometric strength training (LAEC-ST). After 4 weeks, mice underwent exhaustive swimming test, forelimb grip strength test and maximum holding time, respectively. The blood biochemical markers and tissue damage markers were determined.
RESULTS: The exhaustive swimming time of the HAEC-AE group were significantly 7.01-, 6.64 -and 4.37- fold (all $P < 0.0001$) higher than those of the LAEC-SC, LAEC-AE and LAEC-ST groups, respectively. The forelimb grip strength test of HAEC-ST group were significantly higher, by 1.18- ($P = 0.0003$), 1.14- ($P = 0.0022$) and 1.11- ($P = 0.0169$) fold, respectively, as compared with LAEC-SC, LAEC-AE and LAEC-ST groups. The maximum holding time of the HAEC-ST group were significantly 9.97-, 4.01 -, 6.94-, 6.70- and 3.27- fold (all $P < 0.0001$) higher than those of the LAEC-SC, LAEC-AE and LAEC-ST groups, respectively. LAEC-AE group were significantly increase serum ammonia, BUN (blood urea nitrogen) and creatine kinase (CK) concentration after the 15-min swimming test. Liver glycogen of the HAEC-AE group were significantly 3.00- ($P = 0.0027$), 2.18- ($P = 0.0228$) and 8.09- ($P < 0.0001$) fold higher than those of the LAEC-SC, LAEC-AE and LAEC-ST groups, respectively.
CONCLUSION: Acquired training could elevate the exercise performance in both lines mice, especially the improvement of HAEC mice is better than LAEC group. Intrinsic aerobic capacity is associated with the effectiveness of exercise training.

ACUTE EFFECTS OF HIIT IN HYPEROXIA ON RED BLOOD CELL DEFORMABILITY AND DEEP TISSUE OXYGENATION

SCHUMANN, M., FREITAG, N., BÖTTRICH, T., MANFERDELLI, G., BIZJAK, D.A., GRAU, M., BLOCH, W.

GERMAN SPORT UNIVERSITY

INTRODUCTION: Increased inspired fractions of oxygen (hyperoxia; FiO2) are known to enhance exercise performance and recovery, while simultaneously reducing perceived exertion. It is suggested that this may be attributed to improved cellular oxygen kinetics (1) but research underlying these assumptions is sparse. Red blood cell deformability is considered as an important determinant of tissue oxygen supply and, therefore, associated with sports performance. Thus, this study aims to examine the effects of hyperoxia during high-intensity interval training (HIIT) on red blood cell deformability and deep tissue oxygenation.
METHODS: Thirteen recreationally endurance trained men (age, 24 ± 3 years; weight, 79 ± 9 kg) performed a HIIT session (5 x 3 minutes at 80% of Wmax, separated by 2 minutes at 40% Wmax) on a cycle ergometer, both in hyperoxia (FiO2 0.3, HYP) or ambient conditions (NORM) in a randomized and counterbalanced order. Red blood cell deformability (maximal deformability [EImax] and shear stress needed for 1/2 of EImax [SS1/2]) was assessed from capillary blood before and after both loadings by ektacytometry. Tissue oxygen saturation (SO2) as well as oxygenized (OxyHb) and deoxygenized (deOxyHb) hemoglobin of the m. rectus femoris were assessed

throughout both loadings by near-infrared spectroscopy. Blood lactate concentrations were assessed after each high- and low-intensity bout, respectively.
RESULTS: EImax and SS1/2 remained statistically unaltered in both HYP (EImax: -0.4 ± 1.2%, ES 0.3; SS1/2: -4.7 ± 8.8%, ES 0.6) and NORM (EImax: -1.2 ± 1.8%, ES 0.7; SS1/2: -6.8 ± 5.8%, ES 1.2). Similarly, SO2, OxyHb and deOxyHb remained statistically unchanged in both conditions during high- (ES: all ≤ 0.3) and low-intensity bouts (ES: all ≤ 0.3), respectively. No significant between-condition differences were observed for changes in blood lactate concentrations. Blood lactate significantly increased in both HYP and NORM during high- (both $p<0.01$, HYP: 72.9 ± 41.1%, ES 1.5; NORM: 76.6 ± 50.4%, ES 1.7) and low-intensity bouts (both $p<0.01$, HYP: 42.7 ± 30.3%, ES 1.3; NORM: 47.3 ± 24.0%, ES 1.9), respectively.
CONCLUSION: Our data did not show statistically significant differences in red blood cell deformability and deep tissue oxygenation when HIIT was performed in hyperoxia and normoxia, respectively. This might be at least partially related to the rather low FiO2 of 30%. Whether the somewhat lower effect sizes in red blood cell deformability and blood lactate concentrations during HIIT in hyperoxia are physiological meaningful, should be addressed in future investigations.

FEASIBILITY AND EFFICACY OF HIGH-INTENSITY INTERVAL TRAINING (HIIT) IN CANCER PATIENTS: A SYSTEMATIC REVIEW AND META-ANALYSIS

RELJIC, D., ZOPF, Y.

UNIVERSITY HOSPITAL ERLANGEN

INTRODUCTION: Many cancer patients decrease physical activity after their diagnosis, mainly due to fatigue and physical discomfort. However, it is well established that physical exercise during/after cancer treatment can positively influence fatigue and other disease outcomes. Moreover, higher levels in cardiorespiratory fitness (CRF) are associated with a lower risk of post-operative complications and mortality in cancer patients. Thus, regular exercise plays an important supportive role in cancer therapy. High-intensity interval training (HIIT) has emerged as a promising exercise strategy allowing significantly shorter training times for achieving relevant increases in CRF in chronic disease populations. However, data on the application of HIIT in cancer patients are sparse. The aim of this systematic review was, therefore, to provide first insights into the feasibility and efficacy of HIIT for improving CRF in cancer patients.
METHODS: Pubmed/MEDLINE was searched systematically for relevant articles published in peer-reviewed journals through January 2018. Studies included were required to (1)apply a structured HIIT-intervention in cancer patients, (2)report data on compliance and adverse events (AEs), (3)report changes in maximal oxygen uptake (VO2max).
RESULTS: The database search yielded 292 potentially relevant articles. After removal of duplicates and studies not meeting inclusion criteria, 7 studies (n=197 subjects with different cancer types, 57.2±6.9 yrs) were finally analyzed. Mean study duration was 8 weeks and on average, 3 sessions/week were implemented. Participants exercised with a mean intensity of 91±2.9% of maximal heart rate. Exercise sessions lasted on average 32±5 min. Overall, studies reported high compliance (92%) and low dropout rates (4%). No serious AEs were reported. In total, only 3 minor AEs were observed, including sciatica (n=1) and knee pain (n=2). After data pooling, VO2max increased by 3.5 ml/kg/min following HIIT.
CONCLUSION: The results indicate that HIIT can effectively improve VO2max within only a few weeks in cancer patients. An increase in VO2max by 3.5 ml/kg/min (=1 MET) can be considered highly clinically relevant, given that an each 1 MET increase in CRF is associated with a 12% reduction in mortality. HIIT was generally well tolerated and the risk of AEs was low even though exercise intensities were higher compared to traditional exercise programs commonly implemented in cancer patients. Thus, HIIT may be a promising exercise modality to improve CRF in a time-efficient manner during cancer treatment. However, given the limited number of available studies, further research is necessary to substantiate these initial data.
Contact: dejan.reljic@uk-erlangen

DISSIMILAR INFLAMMATORY AND BDNF RESPONSES TO A HIGH-FAT MEAL AFTER HIGH INTENSITY INTERVAL EXERCISE AND CONTINUOUS EXERCISE

LEE, C.L.1, CHENG, C.F.2

NATIONAL SUN YAT-SEN UNIVERSITY

INTRODUCTION: The continuous exercise (CE) is aiming to decrease the risks of atherosclerosis and cardiovascular disease. Recently, low-volume high-intensity interval exercise (HIIE) has been considered as a time-efficient approach to prevent these chronic diseases in adults. Postprandial lipemia is an established independent risk factor for cardiovascular disease; however, the effects of CE and HIIE on inflammatory and brain derived neurotrophic factor (BDNF) after postprandial lipemia is unclear. This study examines the effects of CE and HIIE on interleukin-6 (IL-6) and BDNF followed a high-fat meal (HFM).
METHODS: Thirty-six active males were randomly assigned to three exercise trials in the evening: HIIE (10 × 1-min sprints at 85% of maximal oxygen uptake with 2-min rest interval), CE (65% of maximal oxygen uptake for 50-min), and control group (CON). The next morning after exercise, participants consumed a HFM of 13 kcal/kg body mass [1] after a 12 hr overnight fast. Blood samples were drawn before and after exercise on day 1, before HFM and then hourly until 4 hr on day 2.
RESULTS: There were no differences among groups for IL-6 and BDNF levels ($P > 0.05$) before exercise. The IL-6 concentrations in HIIE ($P = 0.02$) and CE ($P = 0.00$) were significantly higher than that in CON after exercise, but no significant differences were observed at other time points among groups ($P > 0.05$). The area under curve (AUC) of IL-6 from pre- to post-exercise was significantly higher in CE than those in HIIE and CON ($P < 0.05$), and CE and HIIE had higher IL-6 AUC compared with CON from post-exercise to pre-meal ($P < 0.05$). BDNF after exercise in HIIE and CE were significantly higher than that in CON ($P = 0.01$), but no difference between HIIE and CE. No significant difference was revealed in BDNF after HFM among groups ($P > 0.05$). BDNF AUC from post-exercise to pre-meal in HIIE (+23%, $P < 0.05$) was significantly higher than that in CON, and the CE had a particular trend toward significance (+21%, $P = 0.08$).
CONCLUSION: The IL-6 and BDNF were significantly increased after 1.5 and 2.5 km run, but no significant difference between exercise regimes [2]. Our results, different IL-6 AUC and BDNF AUC responses to CE and HIIE, might provide support for that the duration and intensity of exercise should be the essential factors [3] to the increases in IL-6 AUC and BDNF AUC. HFM resulted in a decrease by 27% in BDNF [4], however, HIIE and CE did not attenuate BDNF levels after HFM in this study which was in line with previous research [5]. Overall, despite significant increases in IL-6 and BDNF following an acute exercise, HIIE and CE did not alter the inflammatory and BDNF responses to HFM.

References: [1] Freese EC, et al. (2011). J Appl Physiol 111: 1584-9 [2] Cabral-Santos C, et al. (2016). Front Physiol 7: 509 [3] Pedersen BK (2000). Immunol Cell Biol 78: 532-5 [4] Karczewska-Kupczewska M, et al. (2012). Diabetes Care 35: 358-62 [5] Teeman CS, et al. (2016). Nutr J 15: 24.
Contact: karenlee1129@gmail.com

EFFECTS OF INTERACTIVE VIDEO GAMES ON BRAIN FUNCTIONS BETWEEN YOUNG AND ELDERLY PEOPLE

WIDJAJA, W.1, THITIPHONGTAKAN, S.1, AJJIMAPORN, A.1, KHERDKARN, P.2, SIRIPORNPANICH, V.3

1: CSST ,2: IPE ,3: IMB

INTRODUCTION: With developments of computer and software technologies, interactive video games become one of popular physical activities among adults and adolescents. It is a virtual-reality based game in which body movement is used to control the game. This game can be developed to promote health, fitness and happiness. However, its effects on the brain functions has not been rigorously studied. The aim of this study was to investigate the effect of interactive video game on the brain functions between young and elderly people.
METHODS: Participants were divided into two groups; Groups I (YG), aged 18-25 years old (n = 10) and Group II (EG), aged 55-70 years old (n=10). They had a normal physical activity less than 150 min/week. Physical activity readiness questionnaire and the Edinburgh handedness inventory were used for screening subject prior to the experiment. On the experimental day, their brain wave activities were measured by EEG with closed-eye condition for 5 minutes at pre and post exercises. The participants played Wii games (Nintendo) at 50-70% of the maximum heart rate by warming up for 10 minutes and exercise for 20 minutes. All parameters data were analyzed by using two-way repeated measures ANOVA in SPSS.
RESULTS: The results showed that the amplitudes of theta, alpha, and beta waves before exercise in YG were 12.96, 17.52, 7.93 μV, respectively. In EG, the amplitudes of the three waves were 11.70, 14.24, 9.28 μV, respectively. After exercise, all three waves increased. In comparison between groups they were not significantly different. However, the alpha waves before and after exercise in YG were significantly different ($p<0.01$). The beta wave in EG was not significantly higher than those in YG.
CONCLUSION: The higher alpha wave in YG may be caused by cortical inhibition and brain-stem activation during exercise (Koriath et al.,1987). The effects of exercise on cortical activity in cerebral cortex caused the increase of the beta wave in EG more than that in YG after exercise. This is correlated with the arousal and increase in blood flows to the brain. Moreover, the increase of the beta wave amplitude was also related with the level of exercise intensity (Timinkul et al.,2010). Therefore, the interactive video game is useful for sedentary people who want to relax after work or as a program to cool down after intense exercises.
REFERENCES:
Koriath JJ, Lindholm E, Landers DM. (1987). Inter J Psychophysiol 5(4),289-299.
Timinkul A, Omori T,Wanpen S, Yamada Y, Soya H (2010). J Med Techno Phys Ther, 22 (1), 82-91.
ACKNOWLEDGEMENT:
This project was funded by College of Sports Science and Technology and Graduate Studies of Mahidol University, Thailand.
CONTACT:
waree.widjaja@yahoo.com

DEHYDROEPIANDROSTERONE SUPPLEMENTATION COMBINED WITH WEIGHT-LOADING WHOLE-BODY VIBRATION TRAINING (WWBV) AFFECTS EXERCISE PERFORMANCE AND MUSCLE GLYCOGEN STORAGE IN MIDDLE-AGED C57BL/6 MICE

CHEN, W.C., LEE, M.C., LI, H.Y., TSAI, B.H., HUANG, C.C.

CHANG GUNG UNIVERSITY OF SCIENCE AND TECHNOLOGY

INTRODUCTION: Dehydroepiandrosterone (DHEA), one of the most abundant circulating steroids in humans and a precursor hormone, is primarily secreted by the adrenal gland and used by athletes for performance enhancement. Resistance training is known to be a strong stimulus for inducing muscle hypertrophy and preventing sarcopenia in the middle-aged or elderly. Towards this end, we investigate the effects of DHEA supplementation combined with WWBV training on exercise performance, physical fatigue-related biochemical responses and testosterone content in middle-aged 9 months old C57BL/6 mice.
METHODS: Male middle-aged C57BL/6 mice were divided into 3 groups (n = 8 per group) and treated for 4 weeks with the following: 1) Sedentary control (SC) with vehicle, 2) DHEA supplementation (DHEA, 10.2 mg/kg) and 3) DHEA supplementation with WWBV training (DHEA: 10.2 mg/kg; WBV: 5.6 Hz, 2 mm, 0.13 g). Exercise performance was evaluated by forelimb grip strength, time to exhaustion and anti-fatigue levels after a 15-min swimming exercise. In addition, the biochemical parameters and the testosterone levels were measured at the end of the experiment.
RESULTS: DHEA supplementation combined with WWBV training for 4 weeks significantly improved the grip strength was significantly higher by 1.15-fold ($p = 0.0006$) and 1.16-fold ($p = 0.0003$) in the DHEA group and WWBV + DHEA group. The swim time to exhaustion in the DHEA and WWBV+DHEA groups were significantly higher1.47-fold ($p = 0.0458$) and1.83-fold ($p = 0.0013$) than the SC group. The lactate level was lowered by 14.72% ($p = 0.0261$) for the DHEA treatment group and 32.31% ($p < 0.0001$) for the WWBV+DHEA treatment group when compared with the SC group. The BUN levels of the DHEA and WWBV + DHEA groups were significantly lower by 7.54% ($p = 0.0370$) and 29.20% ($p<0.0001$) than the SC group. In the DHEA and WWBV+ DHEA group, the testosterone levels were both significantly increased by 1.25-fold ($p = 0.0173$ and $p=0.0174$) compared with the SC group. The liver glycogen content of the WWBV + DHEA group was 1.4-fold higher ($p = 0.0307$) than the group with DHEA supplementation alone. SC group and DHEA group showed no significant difference in liver glycogen levels.
CONCLUSION: WWBV + DHEA group had increase anti-fatigue activity after acute exercise. Lactate and BUN levels decreased, all of which contribute to enhancing exercise performance in middle-aged mice. Taken together, our results suggest that combining the WWBV training program with DHEA supplementation could provide an anti-fatigue pharmacological effect in middle-aged males mice.

EFFECTS OF AGE ON DIVING BRADYCARDIA AND HEART RATE RECOVERY IN PEOPLE OLDER THAN 40 YEARS

KONISHI, M.1, TABATA, H.1,2, HIGUCHI, M.1, SAKAMOTO, S.1

1: WASEDA UNIVERSITY, 2: RESEARCH FELLOW OF THE JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE

INTRODUCTION: The autonomic nervous system plays an important role in the maintenance of cardiovascular homeostasis. The attenuation of parasympathetic regulation increases the risk of cardiovascular disease and mortality (Thayer and Lane 2007). Heart rate recovery immediately after exercise is an established measure of the parasympathetic regulation. The reduction in heart rate recovery is associated with elevated all-cause mortality (Cole et al., 1999). However, the measurement of heart rate recovery imposes a physical load on participants because of the strenuous exercise involved. The diving reflex test is short, simple, and relatively safe to perform and can be used to assess parasympathetic regulation (Heath and Downey 1990). Diving bradycardia has been observed to occur due to facial cooling and breath-holding. Although heart rate recovery declines with age, the effects of age on diving bradycardia have not been determined, especially in people aged over 40 years. Therefore, the purpose of this study was to examine the effects of age on diving bradycardia and heart rate recovery in people older than 40 years.
METHODS: The participants of the present study were 115 men and 58 women (age: 40-69 years) recruited from "Waseda Alumni's Sports, Exercise, Daily Activity, Sedentariness Health Study" from 2015 to 2018. The diving reflex test was performed for all participants in the sitting position, with their faces immersed in cold water (3-5 degrees centigrade) and with breath-holding for 30 seconds, before a graded exercise test. R-R intervals were recorded before and during the cold face test to determine maximal bradycardia. Heart rate recovery was determined by a graded exercise test on a cycle ergometer. After achieving the peak exercise level, all participants spent 3 minutes in the sitting position. Heart rate recovery was defined as the reduction in the heart rate from the rate at peak exercise to the rates 1, 2, and 3 minutes after the cessation of exercise.
RESULTS: Diving bradycardia was negatively correlated with age ($r = -0.235$, $P < 0.01$). Heart rate recovery at 1, 2, and 3 minutes after peak exercise was also negatively correlated with age ($r = -0.196$, $P < 0.01$; $r = -0.304$, $P < 0.01$; and $r = -0.327$, $P < 0.01$, respectively). Diving bradycardia was longer at the age of 40-49 years than at the age of 50-59 and 60-69 years ($P < 0.01$, all). Heart rate recovery at 2 and 3 minutes was slower at the age of 60-69 years than at the ages of 40-49 and 50-59 years ($P < 0.01$, all).
CONCLUSION: The present study suggests that diving bradycardia and heart rate recovery both deceased with increasing age. Aging appears to be related to an attenuation of diving bradycardia as an index of parasympathetic regulation in people aged over 40 years.
References:
Cole CR, Blackstone EH, Pashkow FJ, Snader CE, Lauer MS. (1999). N Engl J Med 341, 1351-1357.
Heath ME and Downey JA. (1990). Clin Sci 78, 139–147.
Thayer JF and Lane RD. (2007). Biol Psychol 74:224–242.
Contact: m.konishi@aoni.waseda.jp

CHANGES OF BODY TEMPERATURE AFTER EXERCISE IN SPINAL CORD INJURY PERSON

HAYASHI, S.

FUKUYAMA CITY UNIVERSITY

INTRODUCTION: In spinal cord injured persons, in the dominant area below the injured level, the superior central command is not transmitted or incompletely transmitted, so that movement disorder not only occurs but also the thermoregulatory responses are slowed or inhibited. It is divided into a complete type in which the spinal cord is transected and an incomplete type which has some function but remaining function but the paralyzed part extends to the nerve and muscles which are dominated below the injury level. The SCI that damaged the spinal cord, the central nervous system, became sympathetic dysregulation dysfunction, and the thermoregulatory function below the injured area was paralyzed. The lack of thermoregulatory functions such as sweating and skin vasodilation, which is a mechanism of heat dissipation, causes excessive rise in core temperature in heat environment. The aim of this study was to clarify the changes of body temperature during exercise and post exercise in heat environment with SCI man.
METHODS: Six healthy Japanese males, as control group, and three spinal cord injury persons, as SCI group, volunteered to take part in this study. The present study was approved by the Ethics Committee of Fukuyama City University (Japan). The subjects remained seated in a chair for at least 10 min before the resting measurement in the sitting position was conducted for 5 minutes. After that the subjects performed the arm cranking exercise at an exercise intensity of 60 % VO2 peak using arm cranking ergometer (881E MONARK) for 30 minutes. The tests were conducted during last autumn when the subjects should have been naturally heat acclimated. HR, RPE and core temperature were monitored each 5 minutes. Measurement after exercise was followed up for 30 minutes per 5 minutes.
RESULTS: The core temperature of SCI during exercise was significantly higher than control group ($p<0.05$). In SCI group, core temperature kept higher until the post exercise phase, and showed that the reduction rate of the body temperature was significantly lower than control group for 30 min ($p<0.05$). There was reported that persons who had damage higher than T11 or T12 lacked the function of skin vasomotor in the sympathetic nervous system, the skin blood flow of the femoral area became invariable, and affected the rise of core temperature. The injury level of this subjects was T10. Therefore, it was suggested that the core temperature kept higher value compared to control group due to lack of thermoregulation.
CONCLUSION: It is necessary to implement cool body for the SCI during exercise and after excise, because of these lacks of thermoregulation in the SCI cause not only heat injury but also impaired exercise performance.

A STUDY ON THE PREVENTION OF HEAT STROKE AT SPORT SPECTATORS UNDER HEAT ENVIRONMENT

IIDA, T., SEKI, K., TAKAGI, Y., NISHIMURA, K., MIYASAKA, Y.

SHUJITSU UNIVERSITY

INTRODUCTION: Spectators of sport games as well as athletes are at the risk of heat stroke. However, a survey on thermophysiological response of the spectators, which are risk factors for heat stroke, has not been reported.
The National High School Baseball Championship in the summer is one of the most popular sport games in the education at schools. Heat stroke in the spectators of high school baseball has recently been recognized. We clarified that the spectators at the baseball game in summer lacked water intake depending on their thirst rating. Therefore, this study aims to clarify the influence of watching a high school baseball game under a hot environment on weight loss amount and urine component.
METHODS: Eight healthy young men (21±1 yrs, 173.0±8.3 cm, 70.0±13.1 kg) volunteered as subjects for this study. Subjects watched DVD of high school baseball game in the climate chamber. The drink condition was that subjects can freely drink the barley tea which is a com-

mon drink in Japan, during watching about 2 hour game. Water intake, weight loss, sweat loss and urinary electrolyte concentration in the subjects were measured.
RESULTS: Air temperatures of the climate chamber during watching games were 33.1±0.2 °C, the humidity were 57.6±1.3% and the WBGT (Wet-Bulb Glove Temperature) were 29.4±0.2 °C. The weight before the game was 70.3±13.1 kg, that of after the game was 69.8±12.9 kg. No significant differences were observed in the body weight between the before and after the game. Additionaly, the subjects drank 453.6±510.3 ml of barley tea and the amount of perspiration was 559.9±248.3 ml, which were almost equivalent values. In contrast, the Na of urinary electrolyte was 1.002±0.681 mEq/gCr before the game, 0.675±0.371 mEq/gCr after the game. Moreover, the Cl was 1.211±0.657 mEq/gCr before the game, 0.788±0.353 mEq/gCr after the game. Futhermore, the Ca was 0.090±0.044 mEq/gCr before the game, 0.048±0.025 mEq/gCr after the game. Three urine components after the game were significantly lower than the one before the game ($P < 0.05$). These results indicates that water intake of spectators drinking barley tea in heat environment are enough, but the electrolyte is insufficiency.
CONCLUSION: We concluded that spectators watching sport events in summer needs to drink sports-drinks to prevention heat stroke.

STRESS-RECOVERY DYNAMICS DURING MOUNT KILIMANJARO CLIMB

PEREIRA, S.1, TAMULEVICIUS, N.2, WADHI, T.2, TIEN, J.J.3, MOSS, S.J.4

1. R.G. SPORTS CENTER, KSA.; 2. THE UNIVERSITY OF TAMPA, U.S.A.; 3. RAHIMA MOOSA HOSPITAL, S. AFRICA; 4. NORTH-WEST UNIVERSITY, S. AFRICA

INTRODUCTION: It can be argued that an athlete's experience has a profound effect on their self-efficacy in physiologically and emotionally stressful situations. The probability of injury in any given situation is influenced by the perception of stress as demonstrated by Anderson and Williams' Stress-injury Model (1988). Stressors within the mountain climbing population include both physiological and emotional aspects; physiological stress is caused primarily by altitude and emotional stress is caused by lack of experience, failure to attain goals, etc. The greater the stress, the greater the vulnerability to injury via attentional or physiological changes (Andersen & Williams, 1988). The aim of this study was to evaluate perception of stress-recovery during a climb of Mt. Kilimanjaro.
METHODS: 84 trekkers (age 42.98 ± 11.62) participated in a cross-sectional survey while climbing Mt. Kilimanjaro (altitude 5895m). The instrument was a Recovery – Stress Questionnaire (RESTQ-76); a close ended questionnaire composed of questions to identify physical recovery, self-efficacy, general stress, emotional exhaustion among other self-reported parameters. Resting Heart rate (RHR) and Oxygen Saturation (SO2) was measured the same time as participants were completing the survey. The survey was administered during seven days of climbing, at rest camps (altitudes ranging from 835m to 4600m).
RESULTS: Experience had a significant impact on RHR ($r=-0.539$, $p<0.001$). Physical Recovery was significantly related to the participants perception of physical fitness and vitality ($r=0.7$, $p<0.001$) as well as their perception of being burnt-out and/or wanting to quit ($r=-0.535$, $p<0.001$). Unpleasant thoughts or actions and/or not achieving goals were related to over-fatigue and lack of proper sleep ($r=0.629$, $p<0.001$). Self-perception of optimal training and preparation was related to the participant's perception of physical fitness ($r=0.696$, $p<0.001$) and also personal accomplishment and enjoyment ($r=0.617$, $p<0.001$). Higher injury rates were related to participants burning out and wanting to quit ($r=0.641$, $p<0.001$). Interrupted breaks or under-recovery showed an increase in general stress levels. ($r=0.588$, $p<0.001$).
CONCLUSION: The survey showed correlations between stress and recovery factors for trekkers in high altitudes. While altitude is known to have impact on RHR (O'Connor et al., 2004), trekkers with experience in higher altitudes had a lower RHR. Interestingly, physically active participants (as per ACSM) did not show any significant relationship with vulnerability to injury or perception of being in shape. As per our knowledge, this was the first study to record self-perceived recovery and stress factors among trekkers in mountains, and while the data is limited to a cross-sectional self-reported survey with a small sample group, it gives us insight into what factors to consider for future research.

THE IMMUNE, INFLAMMATION AND AEROBIC CAPACITY RESPONSE TO LIVING HIGH-TRAINING HIGH-TRAINING LOW UNDER SIMULATED 3200M NORMOBARIC HYPOXIA

GAO, H.

SHANGHAI RESEARCH INSTITUTE OF SPORTS SCIENCE

INTRODUCTION: Altitide training has been used by lots of endurance athletes to improve exercise performance. It success belongs to the erythropoietic effect of chronic hypoxia initiated by continuously residing at natural or simulated altitude. Hypoxic dose was an important factor and could influence the altitude training effects. However, several researches reported that the immune system was sensitive to hypoxia. This study was to explore the characteristics of immune response to living high-training high-training low (HiHiLo) during 3-week simulated 3200m hypoxia.
METHODS: Twelve female rowers slept in simulated 3200m normbaric hypoxia at least eight hours a day and trained under 3200m hypoxia two times per week for three weeks. The target heart rate of hypoxic training was 140-160bpm. After 1 day rest every week, blood was taken from cubital veins to measure different kinds of variables. Repeated measures analysis of variance was used to test differences in different time point. Paired T test was employed to compare the difference between two weeks.
RESULTS: (1) During HiHiLo period, WBC count show a significant time effect($P=0.01$). Compared with pre-HiHiLo, WBC count decreased significantly in the 1st week of HiHiLo. GR%, LY% and MO% had no obvious change. (2) There were a significant time effect both in T% and NK%（$P=0.046$、0.048）. In the 1st week of HiHiLo, T% elevated and NK% decreased significantly compared with pre-HiHiLo. (3) No significant time effect was observed in the count and percentage of CD4+ and CD8+. But the ratio of CD4+ to CD8+ decreased obviously in the 1st week after 3-week HiHiLo. (4) No significant time effects were observed in B%, IgA, IgM and IgG during HiHiLo period. (5) Plasma CRP kept in a normal range and show an obvious time effect. Compared with the 1st , 2nd and post-1st week of HiHiLo , plasma CRP of the 3rd week was obviously lower. No significant time effect of plasma IL-6 and TNF-α existed. (6) After 3-week HiHiLo, the blood lactate reduced significantly in 120W and 160W （$P=0.001$, 0.047）and the heart rate decreased significantly in all three steps（all $P<0.01$）.
CONCLUSION: 3-week living high-training high-training low under simulated 3200m normobaric hypoxia in low to middle aerobic intensity training period could improve aerobic capacity of female rowers. But it may lead to immunological stress in the first week. This stress will be alleviated gradually in the next two weeks. During HiHiLo, the inflammation response didn't show significant change. In the first week after HiHiLo completed, the immune function may shift toward suppression.

HEART RATE VARIABILITY CHANGES DURING PACED BREATHING MANEUVER PRE- AND POST-CONCUSSION

NEARY, J.P.1, SINGH, J.1, PISKORSKI, J.2, SIRANT, L.W.1, DECH, R.T.1, GUZIK, P.3

1:UNIVERSITY OF REGINA ; 2:INSTITUTE OF PHYSICS, UNIVERSITY OF ZIELONA GORA ; 3:CARDIOLOGY-INTENSIVE THERAPY, POZNAN UNIVERSITY OF MEDICAL SCIENCES

INTRODUCTION: Slow paced breathing at a rate of 6 breaths per minute (6-bpm) may force different cardiovascular oscillations to subdue to its rhythm, and it also modifies the autonomic function. The 6-bpm breathing augments the heart rate variability (HRV), i.e., an indirect and non-invasive marker of the autonomic control of the duration of cardiac cycles (RR intervals). Each pair of consecutive RR intervals is represented as one point in the Poincare plot of RR intervals, and all points in this plot contribute to both short- (SD1) and long-term (SD2) HRV (Guzik et al., 2007). Consecutive RR intervals generate monotonic (i.e., changing in the same direction) runs of the length of 1, 2, 3, 4 or more beats in a row. The acceleration runs are composed of such neighbouring RR intervals which only shorten one after another, the deceleration runs represent trains of RR intervals which consecutively prolong. This method describes the asymmetric structure of heart rate (Piskorski & Guzik, 2007). It is known that concussion leads to autonomic dysfunction, but research analyzing the effects of the 6-bpm breathing on HRV recorded pre- and post-concussion is non-existent.
METHODS: We aimed to compare the parameters of Poincare plots and monotonic runs of RR intervals recorded during the 6-bpm breathing protocol before and after head injury leading to concussion in otherwise healthy athletes. During the prospective observation, we collected data from 14 athletes (n=6 female) who underwent pre-season baseline HRV recording and came back within 72 hours post-head injury to complete the same protocol. All recordings for HRV were acquired at seated rest during the 5-minute spontaneous and the 5-minute paced 6-bpm breathing (guided breathing with equal 5-second duration of inspiration and expiration). Raw ECG tracings were exported at 250 Hz and analyzed beat-to-beat using an RR interval reader to adjust for any artifacts and premature beats. Data were analysed with the non-parametric paired Wilcoxon test and logistic regression models for the differentiation between pre- and post-concussion.
RESULTS: Despite a mean reduction of 5.7 ms in SD1 and 14.6 ms in SD2, there were no significant differences pre- to post-concussion. However, visual representations of the Poincare plots showed clear differences between both conditions. Furthermore, when analysed using a multivariate logistic regression predictive model consisting of decelerating runs of lengths 6 (0.4755, p=0.1290), 7 (-2.4465, p=0.0893), and 9 (-10.2061, p=0.9932), and accelerating runs of lengths 5 (-0.7183, p=0.0319), 7 (-0.3532, p=0.0803) and 10 (-0.6214, p= 0.0579), statistical significant was observed.
CONCLUSION: Our preliminary results suggest that the slow paced breathing at a rate of 6-bpm may reveal different patterns of the mutual relations between the consecutive RR intervals and the asymmetric features of the structure of heart rate. Further prospective research with an increased number of athletes at risk of concussion is required.

INFLUENCE OF ACUTE MODERATE-INTENSITY ENDURANCE EXERCISE ON ENDOTHELIAL FUNCTION IN OLDER HYPERTENSIVE RATS

WU, T.H.1, YANG, A.L.1, SU, C.T.2

1: UNIVERSITY OF TAIPEI ; 2: FU JEN CATHOLIC UNIVERSITY

INTRODUCTION: As the society is gradually entering the trend of aging, the prevalence of hypertension has been parallel increased. Advancing age has revealed the impairments of endothelial function and antioxidant activity which may induce more severity of pathology when combining with the influence of hypertension (Higashi et al., 2012). Moreover, exercise is well known in regulating blood pressure and cardiovascular function (Heckman et al., 2008). However, the effects of a single endurance exercise on endothelial function (i.e. vasorelaxation) in aging hypertension have not yet been clarified.
METHODS: Twelve-month-old spontaneously hypertensive rats (SHR) were randomly divided into two groups: the acute exercise (SHR-AEX) and sedentary control (SHR-CON) groups. The age-matched Wistar-Kyoto rats (WKY) were served as the normotensive control group. The SHR-AEX group was completed by a single bout of treadmill running at the moderate intensity (21 m/min) for 60 min. At the end of experiments, the endothelium-dependent vascular responses of aortic rings were evaluated by the organ bath system. Moreover, serum antioxidant activities, including superoxide dismutase (SOD) and catalase (CAT), were measured and compared among three groups.
RESULTS: After a single bout of treadmill running, the SHR-AEX group showed significantly ($p < 0.05$) higher acetylcholine (ACh)-induced vasorelaxation compared with the SHR-CON group, while that was significantly ($p < 0.05$) lower than the WKY group. Similarly, the serum SOD and CAT activities were significantly ($p < 0.05$) increased in the SHR-AEX group compared with the SHR-CON group.
CONCLUSION: The results of this study suggested that a single bout of moderate-intensity endurance exercise could reverse the endothelial function in terms of vasorelaxation in older hypertensive rats in part via the increase in antioxidant activities. The non-pharmacological modification, such as the moderate-intensity treadmill exercise, could be considered as the prevention and treatment of cardiovascular disorders in aging population with hypertension.
References: Heckman GA, McKelvie RS. (2008). Clin J Sport Med, 18(6), 479-485.
Higashi, Y., Kihara, Y., Noma, K. (2012). Hypertens Res, 35(11), 1039-1047.
Contact: cl2s15i46@gmail.com; yangailun@gmail.com

THE METABOLIC CHANGES IN THE HIPPOCAMPUS OF AN ATHEROSCLEROTIC RAT MODEL

LOU, S., LIU, B., LI, J.

SHANGHAI UNIVERSITY OF SPORT

INTRODUCTION: Atherosclerosis has been associated with the progression of cognitive impairment and dementia [1]. Several features, such as high oxygen consumption, a large content of peroxidation-sensitive polyunsaturated fatty acids and a strong dependency on the supply of glucose are features that make the brain vulnerable to metabolic changes even very small [2-3]. The hippocampus is closely related to memory and learning function, and prone to ischemic injury. However, applying Metabolomics technology to explore metabolites of hippocampus from atherosclerosis animals is rarely reported. We aim to reveal the metabolic changes in the hippocampus during atherosclerosis.
METHODS: We established a rat model of atherosclerosis by 10 weeks high-fat diet combined with intraperitoneal injection of vitamin D3 along with control group . Feeding all rats with basal diet for another 4 weeks, a Y maze test was performed to evaluate initial memory and the Metabolomics was applied to detect small moleculer metabolites in hippocampus.

RESULTS: After 4 weeks of diet intervention, The M group entered less frequently into and spent less time in the novel arm than rats from C group . Compared to the control group, metabolites including xylulose 5-phosphate, ribose 5-phosphate, glycerate 3- phosphate, succinate, nonanoic acid, and desmosterol were markedly elevated in the M groups, whereas methyl arachidonic acid and methyl stearate decreased.
CONCLUSION: Atherosclerosis induced by high-fat diet and intraperitoneal injection of vitamin D3 could cause cognitive impairment in rats. A series of metabolic changes implicated in the hippocampus of atherosclerotic rats, including a decrease in anaerobic glycolysis and TCA cycle, an activation of Pentose Phosphate Pathway and a disturbance in fatty acid oxidation and cholesterol synthesis, which could lead to insufficient ATP in hippocampus and relate to the behavioral changes of atherosclerotic rats.

LEFT VENTRICULAR DIASTOLIC FUNCTION IS ENHANCED AFTER PEAK EXERCISE IN ENDURANCE-TRAINED ADOLESCENTS

RUNDQVIST, L.

JÖNKÖPING UNIVERSITY

INTRODUCTION: The cardiac response to an intense exercise session has been widely studied especially in athletic, but also in sedentary adults. However, very little is known about the normal response to exercise of the growing heart in well-trained as well as in untrained adolescents. The echocardiographic technique provides useful insights into systolic function evaluated by using parameters including left ventricular ejection fraction (LVEF), while left ventricular (LV) diastolic function assessment include annular e' velocity and filling pressure estimated by mitral E/e' ratio. Also, cardiac volumes such as left ventricular end diastolic volume (LVEDV) are obtained by echocardiography. During exercise, ventricular filling time is reduced due to the higher heart rate, thus increase in LV inflow velocity is of importance to enable a larger stroke volume without further increase in filling pressure. An improved diastolic capacity in response to exercise may therefore be crucial in endurance trained subjects, to facilitate LV filling when the heart rate rises. The aims of the study were to explore the temporal development of cardiac functional changes after peak exercise in adolescents, and to explore how these functional changes relate to maximal oxygen uptake (VO2max).
METHODS: The participants were 27 endurance-trained adolescents aged 13-19 years, and 27 controls individually matched by age and gender. LV systolic and diastolic function was performed by echocardiography at rest and immediately after a maximal cardio pulmonary exercise test (CPET) on a treadmill. VO2 was estimated by the CPET.
RESULTS: Immediately after exercise, LVEF was increased (from 61% to 73% in the active group, and from 59% to 72% in the controls, $p<0.001$ for both), as well as the septal E/e'-ratio (from 9.2 to 11.0; $p<0.001$ in the active group, and from 8.7 to 10.2; $p=0.008$ in the controls). Further, when comparing the groups after CPET, the E/e' ratio was higher in the active group compared with the controls ($p=0.012$). We also demonstrated a correlation between VO2max and cardiac function after CPET where the strongest correlation was found between VO2max and LVEDV ($r=0.67$, $p<0.001$), and filling pressure E/e' ($r=0.34$, $p=0.013$).
CONCLUSION: LV systolic response to exercise was similar in endurance-trained adolescents and their controls. In addition, enhanced diastolic function was found in both groups, but was more pronounced in the active group. Much of the variation in VO2max was explained by a combination of increased cardiac dimensions (predominantly LV) and filling pressure. Regardless of the intensity of practicing endurance exercise, these findings have practical implications when assessing cardiac function during exercise in youngsters.

EFFECTS OF LOCAL AND REMOTE ISCHEMIC PRECONDITIONING ON CRITICAL POWER AND MUSCULAR OXYGENATION DURING 3-MIN ALL-OUT EXERCISE

CHENG, C.F.1, HSU, W.C.2, PAN, C.H.1, KUO, Y.H.3, LIN, Y.S.3, TING, S.F.1

1: NATIONAL TAIWAN NORMAL UNIVERSITY, 2: UNIVERSITY OF TAIPEI, 3: NATIONAL TAIWAN NORMAL UNIVERSITY

INTRODUCTION: The local (IPC) and remote (RIPC) ischemic preconditioning, involves brief cycles of ischemia and reperfusion, may have a cardioprotective benefit via humoral and neural pathways, e.g., increases in nitric oxide (NO) or decreases in sympathetic activity [3]. The 3-min all-out cycling test (3MT) has been developed to estimate critical power (CP) and the curvature constant for severe exercise (W') [4]. This study examines the effects of IPC and RIPC on 3MT performance, vascular function, and muscular blood flow in athletes.
METHODS: Fifteen male athletes (VO2max, 59 ± 5 ml/kg/min) were recruited in this study. At visit one, participants performed an incremental cycling test to determine the resistance of 3MT. Visits 2 and 3 served as familiarization and control (CON) trial. During the following visits, participants performed IPC, RIPC, or SHAM trial in a randomized crossover design, separated by 3 days. The 3MT was performed 45-min after each treatment. The tissue saturation index (TSI), deoxyhemoglobin (HHb), and total hemoglobin (tHb) of right quadriceps were measured by near-infrared spectroscopy at each trial. Blood samples for vascular endothelial growth factor (VEGF), NO, norepinephrine (NE), pH, lactate (La) concentrations were drawn before and 30-min after treatment, and 5-min after 3MT. The oxygen uptake (VO2) were continuously measured during 3MT.
RESULTS: The TSI during IPC intervention was significantly lower than those in RIPC and SHAM (IPC vs. RIPC vs. SHAM, 53.4 ± 4.2 vs. 64.5 ± 3.7 vs. 63.8 ± 3.6%, $P < 0.05$). During the rest interval between intervention and 3MT, HHb and tHb in IPC were significantly higher than those in RIPC and SHAM ($P < 0.05$). However, no significant differences on TSI and HHb during 3MT were found among treatments. No significant interaction effects in VEGF, NE, NO, pH, and La levels were found among treatments. There were also no significant differences in peak VO2 (IPC vs. RIPC vs. SHAM vs. CON, 58 ± 4 vs. 58 ± 5 vs. 57 ± 6 vs. 58 ± 4 ml/kg/min, $P > 0.05$), CP (IPC vs. RIPC vs. SHAM vs. CON, 242 ± 32 vs. 244 ± 32 vs. 238 ± 30 vs. 235 ± 34 W, $P > 0.05$), and W' during 3MT among treatments.
CONCLUSION: The IPC or RIPC might result in vasodilation and increase oxygen delivery and extraction [1, 2], thus improving aerobic performance [3]. This study found that IPC might increase the resting blood flow in affected muscles, however, this increase may not relate to the regulating factors of endothelial function. Overall, neither IPC nor RIPC could improve the 3MT performance and muscle blood flow during intense exercise. Supported by grants from Ministry of Science and Technology, Taiwan (MOST 106-2628-H-003-008-MY2).
References: [1] Kido K, et al. (2015). Physiol Rep, 3(5), pii:e12395. [2] Patterson SD, et al. (2015). Med Sci Sports Exerc, 47(8), 1652-8. [3] Sharma V, et al. (2015). Cardiovasc Drugs Ther, 29(6), 573-88. [4] Vanhatalo A, et al. (2007). Med Sci Sports Exerc, 39(3), 548-55.
Contact: andescheng@ntnu.edu.tw

VALIDITY OF SINGLE POINT ASSESSMENTS FOR DETERMINING LEG PULSE WAVE VELOCITY IN SITTING AND SUPINE POSITIONS

FRYER, S., STONE, K., ZIEFF, G., DICKSON, T., FAULKNER, J., BROWN, M., STONER, L.

UNIVERSITY OF GLOUCESTERSHIRE

INTRODUCTION: There has been a great deal of recent interest in the effects of sedentary behaviour on cardiovascular health. In particular, prolonged sitting has been shown to reduce leg vascular function. However, studies have relied on complicated techniques, which limits further investigation as such studies necessitate: (i) highly skilled investigation, and (ii) small sample sizes. One potential solution is the use of B-mode ultrasound to estimate pulse wave velocity (PWV, arterial stiffness) at a single point in the legs. Therefore, this study sought to determine the accuracy of single point PWV measures obtained using B-mode ultrasound in supine and seated positions by comparing to a criterion, conventional 2-point (femoral-posterior tibialis) pulse wave velocity (fptPWV). Single point PWV assessments were made on the superficial femoral and posterior tibialis (PT) arteries using three different equations. Two equations estimated PWV using local changes in arterial diameter and blood pressure, using a derivative of β-stiffness index or Bramwell-Hill (BH). The third equation estimated PWV using local changes in arterial diameter and blood flow (BF).
METHODS: Thirty-two young, healthy adults (25.7 y, 50% F, 24.7 kg.m2) were recruited, of which 31 had complete data. Following an overnight fast, and 10 minutes of quiet supine rest an ECG gated linear array ultrasound probe was used to capture 3 x 10 s images of the PT and femoral arteries in both seated and supine positions. From this, regional (criterion two-point) and site-specific (single point) measures of fptPWV were determined (transit time from femoral to PT artery) using β-stiffness and BH equations, as well as BF estimations in both positions.
RESULTS: The accuracy of the test was considered acceptable if the absolute standard error of estimates (aSSE) was <1.0 m/s. In the supine position, the aSSE for β-stiffness, BH, and BF equations was 1.7, 2.0 and 5.5 for the femoral artery, and 2.7, 3.2 and 6.1 for the posterior tibialis. In the seated position, the aSSE (m/s) for β-stiffness, BH, and BF equations was 1.5, 1.6 and 3.4 for the femoral artery, and 3.0, 3.4 and 5.6 for the posterior tibialis
CONCLUSION: The single-point PWV equation based on β-stiffness index was consistently closest to the criterion 2-point PWV, for both arteries and both body positions. However, β-stiffness PWV assessments did not meet the criteria for acceptable validity, meaning the two measures cannot be used interchangeably. Further work is warranted to determine whether both types of assessment respond similarly to perturbations, and which type of assessment best explains subsequent central hemodynamic burden.

THE VARIABILITY OF PHYSIOLOGICAL PARAMETERS DURING SPEEDWAY RACING

GABRYS, T.1, SZMATLAN-GABRYS, U.1, STANISZ, L.2

1JAN DLUGOSZ UNIVERSITY , 2PWSZ

INTRODUCTION: Physical effort in motorcycle sports was the subject of studies by Gobbi et al. 2005, DArtibale et al. 2007. A competitor in speedway during start, undertakes 5-6 times, the 60 second physical effort, in the course of which he increases velocity from 55-60km/h to 100 km/h and takes turns 8 times on a surface of variable hardness. The aim of the study was to determine the value of the physiological indexes during the starting effort as compared to the maximum values obtained by a given competitor.
METHODS: The participants of the study were 6 speedway riders (age, height, and body mass were 26 ± 3 years, 175 ± 6 cm, and 68.4 ± 3,2 kg), members of the Polish Speedway League. The subjects undertook, in laboratory conditions, an effort on cycloergometer Velotron (USA), in accordance with the GExT test program (Nolan et al. 2014) After 7 days, the participants undertook the starting physical effort 5 times on a speedway track. The values of the physiological indexes (VO2, VE,HR, VO2HR, and RF) were registered during both physical efforts by means of the K4B2 (Cosmed), and Polar Team (Polar) analyzers.
RESULTS: Physiological indexes during physical effort in speedway obtain variable values, as compared to the maximum values. HR is closest to the maximum values: 88-96% (181-192ud/ min), and so is RF : 82-90% (49-53 b/min) The VO2 values reach the level of 55-68% of the VO2max (35-44ml/kg/min), and VO2HR 60-68% (13-14 ml/bpm). The lowest values as compared to the maximum ones, are characteristic of VE: 40-49 (70-85 l/min). The variability of values between runs 1, and 5, is of the order of 6-8%, with the exception of VO2, and VE which exceed 10 %.
CONCLUSION: A low level of VO2HR during physical effort at the level of 60-70% of the maximum value, with heart systole frequency values from 90-95% of the maximum value, indicates a strong activation of the circulatory system without using it to transport oxygen. The competitor, during the effort on a cycloergometer, with the same HR values, supplies his organism with 30-40% more oxygen. The dynamics of the changes in the values between the runs, indicates a low level of index variability among runs 1, and 5. The greatest differences are: a decrease in the VO2 value by 10%, and an increase in VE by 11% . A competitor in speedway undertakes a physical effort, aided, to a significant extent by anaerobic metabolism, with the activation of the aerobic metabolism indexes, to the level of 55-70% of the individual maximum values.
References: DArtibale, E., Tessitore, A., Tibori, M., Capranica, L. (2007). Int. J. Sports Med. 28, 662–666.
Gobbi, A. W., Francisco, R. A., Tuy, B., Kvitne, R. S. (2005). Br. J. Sports Med. 39, 927–931.
Contact: tomaszek1960@tlen.pl

PECULIARITIES OF MUSCLE OXYGENATION IN WORLD-CLASS KAYAKERS

DADELIENE, R.1, NEKRIOSIUS, R.2, MILASIUS, K.3

1 VILNIUS UNIVERSITY; 2 LITHUANIAN SPORTS UNIVERSITY; 3 LITHUANIAN UNIVERSITY OF EDUCATIONAL SCIENCE

INTRODUCTION: The distance of 1000 m, performed by elite kayak rowers, takes 3-4 minutes. Essential role in such duration intense work is played by aerobic metabolism processes in muscles. Finding the training methods which could improve this metabolism appears as a rather difficult task. Therefore, the aim of the study was to analyze an effect of applying short distances interval training workouts of high intensity for world-class kayak rowers' muscle oxygenation.
METHODS: Case study was carried out during preparatory cycle in 1917- 2018. Two World vice champions (aged 29 and 30 years) participated in this study (K2). Athletes were respectively 184 and 186 cm high, body mass – 62.5 and 64.3 kg., muscle mass - 48 and 50 kg, maximal oxygen consumption – respectively 62.5 and 64.3 ml/min/kg. Muscle oxygenation was measured using MOXY Oxygen Monitor device while athletes worked on kayak ergometer DANSPRINT during high intensity interval training (0-10 sec – 300 W, 11-30 sec 80 W) training load repeated 6 times with 6 min rest. Sensors were fixed on athletes' Quadriceps and Pectoralis Major Muscles.

RESULTS: After 6 times repeated high intensity interval 10 sec training load, muscle oxygen consumption decreased to 45 pct in Quadriceps and to 20 pct in Pectoralis Major Muscle. During light work load (11-30 sec 80W) oxygen consumption recovery in both muscles reached 70-80 pct. After 6 min in rest position, oxygen consumption in the muscles recovered to 85 pct, while the lactate level was less 2 mmol/l.
CONCLUSION: This study revealed that high intensity interval training load provokes big changes in muscles oxygenation while the muscles are working in aerobic metabolism zone.

COUPLING OF LOCAL MUSCLE DEOXYGENATION AND HEART RATE CONTROL DURING INCREMENTAL CYCLING DEPENDS ON EXERCISE INTENSITY – INSIGHTS FROM TRANSFER ENTROPY ANALYSIS

WEIPPERT, M., BRUHN, S., PETELCZYC, M.

UNIVERSITY OF ROSTOCK, WARSAW UNIVERSITY OF TECHNOLOGY

INTRODUCTION: Besides other mechanism (e. g. local vasodilation and stroke volume) an increase in heart rate (HR) contributes to muscle perfusion and thus O2 supply. Regulation of this autonomic adjustment encompasses central command as well as afferent signaling mechanisms, i. a. feedback from local metaboreceptors. Here, we propose the analysis of the driving component between the period between adjacent heartbeats (R-R or instantaneous HR) and working muscle O2-desaturation (= relative portion of deoxygenated Hb/Mb to total Hb/Mb, %HHb) during incremental dynamic exercise performed until volitional exhaustion. Considering different contributions of feedback- and feedforward-mechanisms affecting autonomic HR control during incremental exercise, we hypothesized that during lower intensities the level of %HHb, s. l. afferent signaling from metaboreceptors, dominates R-R control, while the R-R „signal" should dominate over %HHb during higher exercise intensities.
METHODS: Ten regional level male triathletes participated in an incremental cycle test consisting of a 5 min baseline at 50 W, followed by 25 W*min-1 ramp increments until volitional exhaustion and a recovery period at 50 W immediately after peak exercise. R–R intervals and the level of right vastus lateralis (VL) %HHb as well as respiratory responses were continuously recorded. Five corresponding R-R interval and %HHb segments were used for the time series analysis: 1) at baseline; 2) segment before the gas exchange threshold (preGET); 3) between GET and the respiratory compensation point (preRCP); 4) after RCP (postRCP) and 5) during recovery (REC). The time series were interpolated and detrended before bivariate transfer entropy (BTE) [2] computations. A non-zero value of BTE is an indicator of coupling between the components (here R-R and %HHb), with a larger magnitude representing a stronger and a lower magnitude representing a weaker relationship between the physiological signals. The parameter dBTE, a measure of the difference of BTE values, indicates the direction of the coupling.
RESULTS: ANOVA revealed a strong effect of exercise intensity on the coupling between %HHb and HR ($F(4;36) = 4.416$, $p = 0.005$, $\eta p2 = 0.329$).
CONCLUSION: Successive phases during incremental exercise are characterized by changing BTE magnitudes for HR and VL %HHb and thus, dBTE. Significantly different dBTE are obtained for the preGET, preRCP and REC. While %HHb is the leading signal during low intensity aerobic exercise, the opposite relation is observed during moderate intensity exercise. These changes may indicate distinct autonomic modulation patterns and mechanisms of cardiovascular control during incremental cycling [3].
1. D. Iannetta, A. Qahtani, GY. Millet and JM. Murias Front Physiol 2017; 8:686.
2. L. Faes, A. Porta and G. Nollo Entropy 2015; 17, 277-303.
3. M. Weippert, M. Behrens, A. Mau-Moeller, S. Bruhn and K. Behrens Front Physiol 2017; 8: 844.

PRESSURE-DEPENDENCY AND MEASUREMENT OF ARTERIAL STIFFNESS

STONE, K.1, ZIEFF, G.2, FRYER, S.1, BURNETT, K.2, KELSCH, E.2, FAULKNER, J.3, STONER, L.2

1UNIVERSITY OF GLOUCESTERSHIRE , 2UNIVERSITY OF NORTH CAROLINA , 3UNIVERSITY OF WINCHESTER .

INTRODUCTION: Arterial stiffening (AS) is thought to be one of the earliest stages of the atherosclerotic process, and is an independent predictor of cardiovascular risk. AS can be measured at a single site of physiological importance using ultrasound. Ultrasound-derived AS measures include distensibility coefficient (DC), compliance coefficient (CC), beta-stiffness index (ß) and estimations of pulse wave-velocity (PWV). Estimates of PWV include a derivative of the ß-stiffness index (PWVß), the Bramwell-Hill equation (PWVbh), as well as an estimation based on local changes in blood-flow (PWVbf). Of concern, measures of arterial stiffness, including those derived from ultrasound, are known to be confounded by blood pressure (BP), making it challenging to compare individuals and track longitudinal cardiovascular risk. The purpose of the current study was to assess which of the six single-point ultrasound-based methods used to estimate AS is least dependent on BP.
METHODS: Twenty healthy young adults (26.7 y, 55 % F, 24 kg/m2) were recruited. BP was acutely manipulated using gravity. In a randomized order, a linear array ultrasound transducer was used to capture three 10 s images of the brachial artery of the experimental left arm, with the arm positioned at (0 deg.), above (+30 deg.) and below (-30 deg.) heart level. Peripheral BP was simultaneously measured on experimental and control arms. The control arm was kept at heart level. The AS markers DC, CC, ß, PWVß, PWVbh and PWVbf were calculated. The AS method with the smallest effect size (partial eta squared, ηp) was presumed to be the least pressure-dependent.
RESULTS: There was a significant main effect of arm position on all AS measures, with a large effect size ($\eta p = 0.297 – 0.511$) for all measures except PWVbf for which the effect size was medium ($\eta p = 0.068$). For all measures, there was a non-significant change when the arm was elevated above the heart; however, each measure, except CC and PWVbf changed when the arm was positioned below the heart. When the arm was positioned below the heart, and when compared to heart level, the contrast indicated a non-significant 23% decrease in CC, and 12% non-significant increase in PWVbf.
CONCLUSION: This study demonstrated that six ultrasound based, single-point methods for assessing AS are all impacted by BP, with the order from least to most dependent on BP being: PWVbf, CC, ß, DC, PWVbh, and PWVß. While the PWVbf method appeared to be the least BP-dependent, potential sources of error, regarding the physiological principles within the mathematical models as well as operator-error, must be considered. Based on the current findings, and considering potential sources of error, CC would appear to be the most robust single-point measure of AS.

PLASMA ATRIAL NATRIURETIC PEPTIDE VS. CVP FOR EVALUATION OF PRELOAD TO THE HEART DURING EXERCISE IN HUMANS

VOLIANITIS, S., YOSHIGA, C., DAWSON, E.A., WARBERG, J., SECHER, N.H.

AALBORG UNIVERSITY

INTRODUCTION: This study evaluated the effect of the presumed different central venous pressure (CVP) response to running and rowing on preload to the heart. Preload was indicated by distension of the atrium as evaluated by plasma arterial natriuretic peptide (ANP) and related to cardiac output (CO).
METHODS: Seven healthy subjects rested in sitting and standing positions and then rowed and ran (in random order) at submaximal workloads, while CVP was recorded, CO (Modelflow) calculated, and arterial plasma ANP determined by radioimmunoassay.
RESULTS: While sitting CO was 6.2 ± 1.6 l/min, plasma ANP 70 ± 10 mg/ml, and CVP 1.8 ± 1.1mmHg (mean ± SD) and decreased to 5.9 ± 1.0 l/min, 63 ± 10 mg/ml, and -3.8 ± 1.2 mmHg when standing ($P<0.05$). Ergometer rowing elicited an increase in CO to 39.9 ± 9.8 l/min as plasma ANP increased to 156 ± 11 mg/ml and CVP to 3.8 ± 0.9 mmHg. Similarly, CO increased to 38.3 ± 9.8 l/min during running with a similar albeit smaller ($P<0.05$) increase in plasma ANP, but with little change in CVP (around -0.9 ± 0.4 mmHg).
CONCLUSION: During exercise the increase in CO is curvilinearly related to plasma ANP, as an indication of preload to the heart, but it is unrelated to CVP. The results indicate that in the upright posture CVP reflects the gravitational influence on central venous blood and not preload to the heart.

EFFECTS OF ENVIRONMENTAL ENRICHMENT ON PHYSICAL ACTIVITY AND BODY TEMPERATURE IN MICE

KIMURA, M., ISHII, R., HIRANO, N., UCHIDA, R., SAITO, Y., SAITO, H.

KEIO UNIV., FACULTY OF PHARMACY

INTRODUCTION: There is little evidence of the effect of Environmental Enrichment (EE) on many research fields. The purpose of this study was to investigate the effects of EE condition on physical activity and body temperature compared to other physical activity increased conditions in mice.
METHODS: 24-week-old male ICR mice were assigned to an EE condition (56x30x38 cm cage with a dome, ladders, tunnels, and wheels), a free wheel running condition (WR), a daytime one-hour treadmill running training condition (TR), or a normal condition (CO: 30x20x12 cm cage) under individual (Experiment I, n=1) or group (Experiment II, n=4) housing. Mice were continuously monitored their 3-dimensional activity and body temperature using the NanoTag wireless telemetry device implanted within their peritoneal cavity. In Experiment III, 4-week-old male ICR mice were assigned to EE (n=8) or CO (n=8) condition for 20 weeks. After the experimental period, a grip strength test, a beam walk test, and an escape test were performed for all mice.
RESULTS: Under EE condition, mice performed more active moving using many equipment in group housing compared to individual housing. They showed high body temperature during night time as same as WR condition. TR condition induced very low activity during night time. Mice in EE condition did not show significant increase in muscle strength, but they could get good balanced walking and quick vertical jumping abilities compared to mice in CO condition.
CONCLUSION: These data suggested that the Environmental Enrichment may produce beneficial effects on the health compared to other physical activity increased conditions especially in group housing mice.

EFFECT OF IMMERSION IN THE VIRTUAL REALITY USING OCULUS RIFT OF THE POSTURAL STABILITY AND CIRCULATION.

TAKAHASHI, K.

TOKYO ARIAKE UNIVERSITY OF MEDICAL AND HEALTH SCIENCES

INTRODUCTION: The oculus rift is very well-developed virtual reality. We have studied injury protection using virtual reality. Further we have studied heart rate and blood pressure using virtual reality. This study investigated biological response to immersion in the virtual reality induced by oculus rift.
METHODS: Healthy ten adult participated in this study. We measured their height, body weight, center of gravity sway and electromyogram (EMG), heart rate (HR), blood pressure. The center of gravity sway was measured by the force plate and total locus length (LNG) and rectangular area (REC.A) were calculated. EMG of rectus femoris muscle, hamstring, gastrocnemius muscle and tibialis anterior muscle were measured. Posture measurements were compared between normal condition and virtual reality condition during a standing position. Video of ski jump was used for the virtual reality condition. Circulation measurements were compared between normal condition and virtual reality condition during a sitting position. Video of roller coaster was used for the virtual reality condition.
RESULTS: REC.A at normal condition was 3.98 ± 2.25 cm2. REC.A significantly increased in the virtual reality condition (8.28 ± 4.38 cm2). LNG also increased in the virtual reality condition. Rectus femoris muscle and hamstring activity did not differ between the two conditions. Gastrocnemius muscle activity significantly increased in the virtual reality. HR and blood pressure was changed after the virtual reality. HR at post was 69.2 ± 8.9 bpm HR significantly increased in the virtual reality condition (80.8 ± 9.7 bpm). Blood pressure significantly increased in the virtual reality condition.
CONCLUSION: The present study indicates that immersion in the virtual reality affect center of gravity and circulation in healthy adults. The present results suggest a possibility that the immersion in the virtual reality is effective to misunderstanding of recognition.

TREADMILL RUNNING IMPROVES WORKING MEMORY IN LACTATIONAL DI-(2-ETHYLHEXYL) PHTHALATE-EXPOSED MALE RATS

LEE, Y.C.

TAINAN UNIVERSITY OF TECHNOLOGY

INTRODUCTION: Aerobic exercise can improve learning and memory by enhancing the expression of brain-derived neurotrophic factor (BDNF) (Singh and Staines, 2015). Early life exposure to di-(2-ethylhexyl)- phthalate (DEHP), a plasticizer usually applied in polyvinyl chloride manufacture, may impair the expression of BDNF in rats (Smith and Holahan, 2014). In this study, we investigated the effects of treadmill running on the expression of BDNF and the performance of working memory in juvenile male rats that were exposed to DEHP during their lactational period.

METHODS: Rat dams were fed with vehicle or DEHP (10 mg/kg per day) during lactation. After weaning, the male offspring were divided into 4 groups: control (C), DEHP (D), exercised control (Cex), and exercised DEHP (Dex). Rats were trained to exercise on a treadmill for 8 weeks from the ages of 4 weeks to 12 weeks and then the working memory was examined by delayed non-match-to-sample task. The biomarker of exercise on brain was evaluated by measuring the plasma levels of brain-derived neurotrophic factor (BDNF).
RESULTS: The results demonstrate that the DEHP-exposed rats exhibited decreased working memory at their juvenile stage. Decreased expression of hippocampal BDNF was observed in the DEHP-exposed animals. Importantly, in the DEHP-exposed animals, treadmill running recovered the working memory by normalizing the expressions of BDNF.
CONCLUSION: Early-life exercise can enhance capacity to evoke memories and reduced risk of neurodegenerative diseases in later life. The findings of this study suggest that treadmill running may provide beneficial effects on ameliorating the dysfunction of brain in the lactational DEHP-exposed male rats at their young age.

EFFECT OF CHRONIC AEROBIC EXERCISE ON OVALBUMIN - INDUCED ANAPHYLAXIS IN MICE.

SHIIBA, D., ONO, D., TOKIMITSU, H., INOUE, S., ITAMI, H., URAKAMI, T., OKAZAKI, T., KURODA, S., YAMAMOTO, K., FURUMOTO, K.

KURASHIKI UNIVERSITY OF SCIENCE AND THE ARTS

INTRODUCTION: Past few decades, there is an increased the patient with food allergy including anaphylaxis in the world, especially western countries. It has hoped that establish the novel approaches for preventing to food allergy. Recently, several studies reported that chronic aerobic exercise induces immunomodulatory cells such as regulatory T cell (Treg) that it involved to prevent the allergic reaction including allergen-specific antibodies production. Therefore, chronic aerobic exercise might prevent food-dependent anaphylaxis. However, effect of chronic aerobic exercise on food-dependent anaphylaxis remains unclear. In this study, it was determine the effect of chronic aerobic exercise on chicken egg ovalbumin (OVA) - induced anaphylaxis in mice.
METHODS: 6-week-old male BALB/c mice were randomly assigned to two groups that sedentary groups (SED) and chronic aerobic exercise (EX). EX mice engaged the voluntary wheel running for eight weeks (from Week 1 to Week 8). SED and EX mice were immunized intraperitoneally with 50μg of OVA emulsified in 2 mg of aluminium hydroxide as adjuvant in a total volume of 100ul on Week 4, 5 and 7. Anaphylaxis was induced by 300μg OVA intraperitoneal injection on Week 8 to SED and EX mice. Anaphylactic symptoms were evaluated with rectal temperature and hematocrit value. Rectal temperatures were measured 5, 10, 15, 20, 25, 30, 45, 60 and 90 minutes after OVA injection. Blood sample were collected to measure the hematocrit value on 90 minutes after OVA injection.
RESULTS: In time-course of the change of rectal temperature, the decreases in rectal temperature by OVA injection were significantly prevented in EX mice compered with SED mice ($p<0.05$). In addition, elevation of hematocrit value were tendency to prevent in EX mice compered with SED mice (SED : 50.3±1.9% vs EX : 46.0±2.3%).
CONCLUSION: Our study suggest that that is voluntary wheel running prevents OVA-induced anaphylaxis in mice. These findings might indicate that chronic aerobic exercise has potential approaches of preventing a food allergy and anaphylaxis.

ACUTE MODERATE INTENSITY CYCLING IMPROVES RECOGNITION MEMORY AND INCREASES CIRCULATING BRAIN-DERIVED NEUROTROPHIC FACTOR IN YOUNG ADULT MALES

MCCREDDIN, S.V., GILLIGAN, K., KELLY A.M.

TRINITY COLLEGE DUBLIN

INTRODUCTION: Regular physical activity targets several aspects of brain function and positively affects brain health across the lifespan (Kelly 2015). A growing body of evidence, however, shows that single bouts of exercise may improve short-term cognitive function, perhaps in a task-specific manner, but the biological mechanisms underlying this effect are not well understood. Furthermore, it has been suggested that exercise-induced cognitive improvements may depend on exercise duration, modality and intensity (Grego et al 2004). Here, the effects of moderate and maximal intensity cycling on measures of executive function and recognition memory were assessed in sedentary young men. In parallel, the circulating concentration of brain-derived neurotrophic factor (BDNF), which has been suggested to mediate exercise-induced effects of exercise on cognitive function in both humans and animals, was also assessed.
METHODS: Participants (n=20) completed an object scene recognition task and a Stroop colour-word task pre- and post-cycling exercise on two separate laboratory visits. In the case of controls, a period of rest was substituted for exercise. Exercise bouts consisted of a VO2max test in the case of maximal exercise, or a 30min cycle corresponding to 60% VO2max in the case of moderate exercise. Venous blood samples were taken prior to exercise, immediately post-exercise and 30min post-recovery; plasma was prepared and later analysed for BDNF by ELISA.
RESULTS: Neither maximal not moderate exercise induced any change in performance of the Stroop task, indicating no modulation of executive function as a result of physical activity. In contrast, recognition memory was improved following moderate, but not maximal exercise. Both maximal and moderate exercise resulted in a transient but significant increase in circulating BDNF, that returned to baseline by 30min post-exercise.
CONCLUSION: The data indicate that exercise-induced improvement in recognition memory is dependent on exercise intensity and suggest that exercise-induced increases in circulating BDNF do not necessarily translate to improvements in cognitive function.
References: Kelly Á M (2015) Handbook of Experimental Pharmacology 228, pp. 417-439
Grego F, Vallier JM, Collardeau M, Bermon S, Ferrari P, Candito M, Bayer P, Magnie MN, Brisswalter J (2004) Neurosci Lett 364:76–80
Contact: aikelly@tcd.ie

CAN 3DPS METHOD VALIDLY ESTIMATE %FAT OF CHILDREN?

OHTA, M.1, MIDORIKAWA, T.2, HIKIHARA, Y.3, SHITARA, K.4, TORII, S.4, SAKAMOTO, S.4

1: CHUKYO UNIV. , 2: J.F. OBIRIN UNIV. , 3: CHIBA INSTITUTE OF TECHNOLOGY , 4: WASEDA UNIV.

INTRODUCTION: The percent body fat (%fat) can be obtained by using measured values of height, weight, and fat thickness. This method is convenient for the measurement in itself. However, there are some problems: three conversion formulas—formula to calculate body surface area from height and weight, formula to calculate body density from body surface area and fat thickness, and formula to calculate %fat from body density—must be used, errors are more likely to occur in using various combinations of conversion formulas and the conversion formula for children is limited. Therefore, we focused on the three-dimensional photonic image scanning (3DPS) method. We aimed to examine the validity of %fat by using the body surface area and volume data obtained by 3DPS method.

METHODS: 164 healthy boys and girls (age: 9.5 ± 1.7 years, height: 138.0 ± 11.3 cm, body weight: 34.3 ± 9.2 kg) participated in this study. Body surface area and volume data were obtained by the 3DPS method. Subcutaneous fat thickness was measured from the posterior of the upper arm, the subscapular, and the abdomen by using a caliper. The body composition was measured by the dual-energy X-ray absorptiometry (DXA) method. We compared %fat obtained by the following four methods. A: Values calculated from the height, weight, and fat thickness by using the formulas of Fujimoto et al., Nagamine & Suzuki, and Lohman et al. B: Values calculated from the body surface area data that were obtained by the 3DPS method and then used equations of Nagamine & Suzuki and Lohman et al. C: Values calculated from the volume that was obtained by the 3DPS method and then used the equation of Lohman et al. and D: Values obtained by the DXA method.
RESULTS: The %fat obtained were A: 34.8 ± 16.1%, B: 36.7 ± 16.8%, C: 40.9 ± 10.2%, and D: 25.9 ± 8.1%. There were significant differences in every estimate value except between A and B.
CONCLUSION: We would have to say that it is difficult to estimate %fat by using the value obtained by the 3DPS method, especially body volume. However, the reproducibility of the 3DPS method is high, so we consider it possible to adjust by adding other factors.
REFERENCES:
Fujimoto et al. (1968), Japanese J. Hygiene. 23, 443-450.
Nagamine & Suzuki. (1964) Human Biol. 36, 8-15.
Lohman et al. (1984) Human Biol. 56, 667-679.
CONTACT:
m-ohta@lets.chukyo-u.ac.jp

BODIPY 493/503 IS SUPERIOR TO OIL RED O FOR DETECTING AND QUANTIFYING FIBRE SPECIFIC INTRAMUSCULAR TRIGLYCERIDE IN HUMAN SKELETAL MUSCLE

STRAUSS, J.A., SHEPHERD, D.A., JEVONS, E.F.P., MACEY, M., SHEPHERD, S.O.

LIVERPOOL JOHN MOORES UNIVERSITY

INTRODUCTION: Oil red O (ORO) and bodipy are lipid dyes used to investigate lipid metabolism. Importantly though, ORO labels all neutral lipids (including membrane lipids) whereas bodipy specifically detects IMTG. Furthermore, ORO has a large emission spectrum compared to the narrow emission spectrum of bodipy, making it challenging to use in dual or triple labelling experiments and often resulting in a high background level of staining. The aim of this study was to compare the use of bodipy and ORO for quantification of IMTG content and use during exercise as well as investigation of lipid droplet (LD) morphology in human skeletal muscle.
METHODS: Biopsies were obtained from the m. vastus lateralis of six healthy, lean sedentary males (age: 20±1y, BMI: 24.8±1.2kg.m2, VO2peak: 39.8±2.4ml.min-1.kg-1) following an overnight fast and prior to and immediately following 60min cycle ergometer exercise at ~60%VO2 max. Cryosections were labelled using antibodies targeting MHCI and MHCIIa. Anti-laminin was used to identify the cell membrane. LD's were labelled with either bodipy or ORO. Images were captured using confocal immunofluorescence microscopy and analysed using Image Pro Plus.
RESULTS: IMTG content (% area stained) was greater when using bodipy compared to ORO (P=0.006), and bodipy detected more LDs (P=0.03) with a greater mean LD size (P=0.03) than ORO. Regional distribution was also different for the two dyes with IMTG content with bodipy being greater in the central compared to the peripheral region (5um from plasma membrane) in both type I (central: 3.1±0.5% vs. peripheral: 2.8±0.5%) and type IIa fibres (central: 1.4±0.3% vs. peripheral: 1.3±0.2%; P=0.036). The opposite was true when using ORO, with a greater IMTG content observed in the peripheral compared to the central region in all fibre types (P=0.013). These regional differences in IMTG content for bodipy and ORO were attributed to differences in LD number (P = 0.039). Following exercise, using bodipy, IMTG content was decreased in both the peripheral (-58±21%, P=0.014) and central regions (-63±21%, P=0.016) of type I fibres. However, using ORO only a significant decrease in IMTG content in the peripheral region of type I fibres was observed (-85±19%, P=0.021).
CONCLUSION: ORO detects more lipid content and use compared to bodipy in the peripheral region of the cell likely due to the detection of membrane lipids in addition to IMTG. We propose that bodipy is preferable to investigate IMTG in skeletal muscle due to its superior LD detection capabilities and its specificity for detecting IMTG avoiding labelling of membrane structures, compared to ORO. We demonstrate the importance of this in the context of regional distribution of IMTG detected using ORO and bodipy and differences in region-specific IMTG utilisation during exercise. Therefore, it is possible that the choice of lipid dye could impact the conclusions drawn in studies in which subcellular IMTG distribution is considered.

EXERCISE UNTIL EXHAUSTION CHANGES THE SKIN CONTENT OF NICOTINAMIDE ADENINE DINUCLEOTIDE IN HIGHLY-TRAINED ELITE ATHLETES

KANTANISTA, A.1, BUGAJ, O.1, KUSY, K.1, GUZIK, P.2, WIELINSKI, D.1, ZIELINSKI, J.1

1: POZNAN UNIVERSITY OF PHYSICAL EDUCATION (POZNAŃ, POLAND), 2: UNIVERSITY OF MEDICAL SCIENCES (POZNAŃ, POLAND)

INTRODUCTION: Although the nicotinamide adenine dinucleotide (NADH) is produced both in the cytoplasm and in mitochondria, it is oxidized to NAD+ only in mitochondria. The flow-mediated skin fluorescence (FMSF) method measures non-invasively the dynamic NADH changes in the epidermis during the controlled ischemia and reperfusion of the forearm. Intensive exercise usually causes a shift from the aerobic to anaerobic energy metabolism and potentially influences the cellular content of NADH. The study aimed to evaluate the influence an exercise until exhaustion on the skin NADH and its changes during ischemia and reperfusion in highly-trained athletes.
METHODS: The FMSF was measured in 121 highly-trained elite athletes (age 23.4 ± 5.3 years, 27 women) before the exercise treadmill test and within 10 minutes of the post-exercise recovery [1]. All athletes started the exercise at a speed of 4 km/h; the speed was increased by 2 km/h every 3 minutes until athletes reached volitional exhaustion. Skin fluorescence was quantified with the use of the AngioExpert device (Angionica, Poland). The following parameters were recorded: Bmean – the baseline skin fluorescence; FImax – maximal fluorescence during ischaemia; FRmin – minimal fluorescence during reperfusion; IRampl – the amplitude of fluorescence change during ischaemia and reperfusion (an index of the potentially maximal amount of NADH metabolised during ischaemia and reperfusion); CImax – the relative contribution of the NADH generation during ischaemia to the total amount of NADH turned over during ischaemia and reperfusion; and Imax – an increase of fluorescence above the baseline value.
RESULTS: After the exercise, there was a significant (all $p \leq 0.0001$) increase in Bmean (404.19 ± 214.31 vs 455.30 ± 256.76 ku), FImax (480.98 ± 258.19 vs 514.46 ± 282.99 ku), FRmin (321.22 ± 168.90 vs 359.06 ± 196.50 ku) and Rmin (82.97 ± 50.22 vs 96.24 ± 65.98 ku), and a reduction in Imax (76.79 ± 47.64 vs 59.16 ± 36.33 ku) and CImax (0.48 ± 0.08 vs 0.40 ± 0.11). There was no significant difference for IRampl (159.76 ± 944.89 vs 155.40 ± 95.46; $p = 0.2608$).

CONCLUSION: The until exhaustion exercise causes a significant increase in the absolute amount of the skin NADH at rest, during ischemia and reperfusion. However, after such exercise, the magnitude of NADH change during ischemia as well as the contribution of the ischaemic part to the maximal range of the ischemia-reperfusion NADH turnover becomes reduced. Alterations in the cellular metabolism triggered by the until exhaustion exercise significantly shift the NADH-NAD+ balance towards increased absolute amounts of NADH, however with a significant reduction in its availability during ischemia. Translation into the practice of our findings requires further investigations.

1. Sibrecht G et al. PBK, 2017; 44: 333–352.

This work was supported by the European Union from the resources of the European Regional Development Fund under the Smart Growth Operational Programme, Grant No. POIR.01.01.01-00-0540/15.

INDIVIDUALISING LOADING STRATEGIES TO MAXIMISE THE EFFICACY OF BICARBONATE SUPPLEMENTATION: A PILOT STUDY

SIEGLER, J.C., BOEGMAN, S., STELLINGWERFF, T., SHAW, G.

WESTERN SYDNEY UNIVERSITY; CANADIAN SPORT INSTITUTE PACIFIC; AUSTRALIAN INSTITUTE OF SPORT

INTRODUCTION: Athletes commonly ingest 0.3g/kg body weight (BW) sodium bicarbonate (NaHCO3) 60 to 90 minutes prior to competition under the assumption that this time frame corresponds with a peak in blood buffering capacity. For the past 30 years, this dosing strategy has been widely accepted as best practice, yet the small subject numbers (n < 9) coupled with their non-elite training status of the original research we believe warrants further inquiry (McNaughton 1992). In support, recent studies have illustrated that a large degree of variation exists between individuals' time-to-peak buffering (Stannard et al., 2016), and that this may influence the efficacy of the supplement (Saunders et al., 2014). We are currently undertaking a multi-centre investigation to determine whether administering NaHCO3 doses based on an athlete's blood buffering profile improves the efficacy of this supplement. We initially undertook a pilot investigation to determine the inter and intra-individual variability of NaHCO3 absorption and time to peak buffering capacity (TTP) over multiple sessions at rest, which we present in this abstract.

METHODS: Eight (n=8) volunteers consumed NaHCO3 capsules at 0.3g/kg BW along with 1g carbohydrate/kg BW and 7ml water/kg BW (to minimise gut disturbance) over a 30-min period on two separate occasions. 45 min after ingesting the final capsule, capillary blood HCO3- levels were collected and analysed via one of two blood gas analysers (WSU: ABL 800 series; CSPI: ABL 80 series; Radiometer, Copenhagen, DK) every 10 min for 100 min or until HCO3- declined over three consecutive measurement time points. For both trials, participants replicated diet and training for 24 h before and during each passive ingestion period to minimise the effect of diet, hydration and exercise (confirmed via interview). Measurement time points were compared across the two trials using a customised spreadsheet (Hopkins, 2015). TTP was identified visually for each participant as the highest blood HCO3- measured over a trial.

RESULTS: Week-to-week reproducibility of the HCO3- collection periods (10 min measurement intervals) was good within participants (mean difference 0.52±0.03 (0.37 to 0.57) mmol/L; ABL 800 r=0.87; ABL 80 r=0.82). TTP was consistent within 20 min for each participant, with the range of achieving TTP varying from 40 to 170 min.

CONCLUSION: The findings of this pilot suggest that with proper control measures in place, good measurement reliability exists across weeks and within participants. This data is currently being used to support the larger study investigating TTP buffering capacity and exercise performance.

References: McNaughton L. (1992) J Sport Sci, 10(5), 425-435.
Stannard RL, Stellingwerff T, Artioli GC, Saunders B, Cooper S, Sale C (2016) Int J Sport Nutr Exerc Metab 26(5), 445-453.
Saunders B, Sale C, Harris RC, Sunderland C. (2014) Int J Sports Phys Perf 9, 627-632.
Hopkins WG. (2015) Sportscience 19, 36-42 (sportsci.org/2015/ValidRely.htm).

THE EFFECT OF IPC ON CENTRAL AND PERIPHERAL FATIGUING MECHANISMS FOLLOWING SUSTAINED MAXIMAL ISOMETRIC EXERCISE

HALLEY, S.L., SIEGLER, J., MARSHALL, P.

WESTERN SYDNEY UNIVERSITY

INTRODUCTION: Ischemic preconditioning (IPC) has been speculated to elicit performance benefits by inhibiting neural feedback from metabolically sensitive muscle afferents during exercise. We hypothesized that IPC could affect the mechanism of centrally mediated fatigue following a maximally fatiguing protocol.

METHODS: Eleven resistance trained males completed three 2 min maximal voluntary contractions (MVC's) via an isometric leg extension in a repeated measures crossover design separated by a minimum of 48 h. These tests were preceded by treatments of IPC (3 × 5 min intervals at 220 mmHg bilateral leg occlusion), SHAM (3 × 5 min intervals at 20 mmHg bilateral leg occlusion) or CON (30 min passive rest). Femoral nerve stimulation was utilised to explore central and peripheral mechanisms associated with reductions in maximal force and rate of torque development. This was profiled at baseline (BL), following treatment/prior to the 2 min MVC (Pre), and then again 10 s post (Post). Tissue oxygenation was measured throughout the 2 min MVC's via near-infrared spectroscopy.

RESULTS: MVC torque levels declined (-71 ± 39.7 Nm; p = 0.007) (mean ± SD) between Pre (237 ± 56 Nm) and Post (166 ± 40 Nm) 2 min MVC measures without differences between conditions (p = 0.676). This decline coincided with decreases in twitch torque (-59.1 ± 22.2 Nm; p < 0.005) from Pre to Post however voluntary activation was unchanged (p = 0.298). Neither twitch torque (p = 0.388) or voluntary activation (p = 0.795) was affected by condition. There were no differences between conditions in the total work (p = 0.115) or time profiled work (P = 0.275) completed during the 2 min MVC's. Peak deoxyhemoglobin concentrations were elevated in the IPC trials (Δ15.1 ± 2.8 μmol/L; p = 0.006) relative to SHAM (Δ12.1 ± 3.0 μmol/L) and CON (Δ11.3 ± 3.6 μmol/L), however there were no such differences in oxyhemoglobin (p = 0.687) or total hemoglobin (p = 0.099) measures.

CONCLUSION: These findings demonstrate that IPC does not affect central or peripherally mediated mechanisms of fatigue during a sustained 2 min maximal effort isometric leg extension task. In addition to this, total work was unaffected despite evidence of increased oxygen delivery, suggesting that the ergogenic benefits of IPC are dependent on blood flow.

ADIPONECTIN AND OSTEOCALCIN RESPONSES TO ACUTE ROWING EXERCISE IN FEMALE ROWERS

JÜRIMÄE, J.

UNIVERSITY OF TARTU

INTRODUCTION: The aim of the investigation was to study the effects of acute exercise and menstrual phase on adiponectin and osteocalcin concentrations, and the possible role of these biomarkers in exercise-induced substrate oxidation in rowers.
METHODS: Thirteen female rowers (19.3 ± 2.3 years; height: 172.7 ± 3.9 cm; body mass: 66.5 ± 7.9 kg) performed 1-h rowing ergometer exercise at 70% of maximal oxygen consumption (VO2max) during follicular phase and luteal phase of the menstrual cycle. Oxygen consumption (VO2), total energy expenditure (EE), carbohydrate EE, and lipid EE were assessed during the exercise. Venous blood samples were collected before and after ergometer exercise.
RESULTS: No differences ($p > 0.05$) were observed in substrate oxidation values during exercise across menstrual cycle. Exercise resulted in an acute rise in osteocalcin and no changes in adiponectin at both menstrual cycle phases. Adiponectin and osteocalcin were not related across phase or time ($r < 0.21$; $p > 0.05$). Post-exercise adiponectin was related ($p < 0.05$) to mean VO2 ($r = 0.46$) and total EE rate ($r = 0.60$), while post-exercise osteocalcin was correlated ($p < 0.05$) with mean total ($r = 0.41$) and lipid ($r = 0.56$) EE rates.
CONCLUSION: In conclusion, menstrual cycle phase had no effect on substrate oxidation, and adiponectin and osteocalcin responses to acute exercise. It appears that adiponectin and osteocalcin may serve as signals for metabolic reaction to the energy cost of the acute exercise in female rowers.

EFFECTS OF WATER IMMERSION IN VARIOUS WATER LEVELS ON URINE VOLUME DURING ARM-CRANKING EXERCISE

WADA, T.1, TAMARI, Y.1, YOSHIDA, N.2, HAMADA, H.2, NOSE, Y.3, YOSHIOKA, A.4, ONODERA, S.1

1. KAWASAKI UNIVERSITY OF MEDICAL WELFARE , 2. GURADUATE SCHOOL, KUMW , 3. YASUDA WOMEN'S UNIVERSITY , 4. OU

INTRODUCTION: Previous studies have demonstrated that physiological responses to the different physical environment in water compared to land are different (Onodear et al., 2013). However, subjective micturition during the arm-cranking exercise has not been studied. Therefore, this study aimed to examine if the subjective micturition during hand ergometer exercise causes urine volume changes in water.
METHODS: Seven healthy Japanese adult males (age; 22 years, height; 171 cm, and body weight; 65 kg) participated in this study. All procedures were approved by the Ethics Committee of Kawasaki University of Medical Welfare and conformed to the Declaration of Helsinki. Two experimental conditions ware studied: the xiphoid condition and the greater trochanter condition. The water levels were set to the level of a human xiphoid and that of a human greater trochanter process. Both conditions were performed during constant intensity exercise (20%VO2peak) using a hand ergometer with rotational speeds of 60 rpm. Measurements were urine volume, subjective micturition, rating of perceived exertion and heart rate. Subjects sat on land in a chair (Rest) for 20minutes. Then, for the next 20 minutes, subjects under both conditions performed arm-cranking exercise in the water. Finally, they sat on land in a chair for 20minutes. The water temperature was 30 degrees Celsius.
RESULTS: Urine volume after immersion in the xiphoid condition was higher than that for the greater trochanter condition ($p<0.05$). Subjective micturition after immersion and recovery at 20 minutes the xiphoid condition was higher than that in of the greater trochanter condition ($p<0.05$). No significant differences were found in heart rate and rating of perceived exertion between the xiphoid condition and the greater trochanter condition. It could be concluded that when water level is increase, volume of the venous return could increase, and when water level is decrease, volume of the venous return could decrease.
CONCLUSION: Urine volume and subjective urination after immersion in the xiphoid process were higher than urine volume in the greater trochanter state. Therefore, urine volume and subjective urination increase as the water level increases.
REFERENCES :
Wada T, Hayashi S, Nose Y, Kremenik MJ, Onodera S. (2014). XIIth International Symposium on Biomechanics and Medicine in Swimming, 526-530.
Onodera S, Yoshioka A, Nishimura K et al. (2013). The Journal of Physical Fitness and Sports Medicine, 2(4),393-399.
CONTACT :
Please include your email address at the very end of your abstract [t-wada@mw.kawasaki-m.ac.jp]

THE EFFECT OF SLEEP RESTRICTION ON PHYSICAL PERFORMANCE, MUSCLE REGENERATION AND ENDOCRINE PARAMETERS IN AN CROSSFIT(R) BASED WORKOUT

GEISLER, S., DWORAK, M., BAYER, S., BAIER, C., DIEL, P.

IST - UNIVERSITY OF APPLIED SCIENCES

INTRODUCTION: Sleep restriction is a common problem in the western society. Also in the context of elite sports there are certain circumstances that affect do not always
allow athletes to enter a competition or exercise in alert conditions.
Therefore the purpose of this study is to detect the influences of
one night's sleep restriction before a CrossFit (SR) training intervention (half Cindy) on performance and muscle damage.
METHODS: Twelve male healthy, young volunteers (age 23,3 ± 1,5) committed in the program once after normal sleep (6-8h, baseline, K) and once after sleep restriction (4h sleep opportunity, SR). Physical activity levels and sleep behavior was monitored by sense ware detection. Physical activity was measured by senseweare belts. A sleep diary according to the DGSM guidelines was filled and the Epworth Sleepiness Scale (ESS) was measured. At the morning of the second day blood was collected before breakfast and three hours after exercise. In the blood Creatine kinase as marker for muscle damage, Cortisol, Testosterone IL 10 and IGF-1 were detected. After a standardized breakfast, individuals performed the training intervention. At the third day, 24h after exercise, again blood was collected.
RESULTS: Sense wear clearly detected that the volunteers under sleep restriction had an average sleeping time of (03:55:35 +/- 00:47:27h) compared to the control group (06:32:25 +/- 01:27:43h. After sleep restriction Ess data clearly indicate a significantly increased sleepiness. Surprisingly, we did not find significant differences in completed rounds and repetitions between SR- and K. Physical performance was not negatively influenced by sleep restriction. Astonishingly there is a tendency that shows improved performance (more reps at workout) after sleep restriction. Sleep restriction resulted in a significantly decreased cortisol levels 3h after training before training. Neither testosterone, IGF-1 levels nor CK- or IL-10-levels in serum were significantly influenced by training neither under sleep restriction

nor in the control group following the intervention. There is a tendency that shows improved anabolic and reduced catabolic effects following the intervention under sleep restriction.
CONCLUSION: On top of this there is advice, that anti-inflammatory processes are disturbed in the morning after a sleep restricted night. As a reaction to physical strain the anti-inflammatory processes are increased in comparison to the control conditions.However our mayor result is that sleep restriction to four hours the night before short, intensivephysical strain does not significantly influence the performance and muscle damage afterwards. In Future investigations a longer duration of sleep restrictionshould be analysed. Further pro-inflammatory indicators could also be included to generate a complete view of the immunological processes.

EVALUATION OF RESTING AND POST-EXERCISE URINE IN FOOTBALL PLAYERS

SZABÓ, G.P., MIZSEI, O.2, SZABÓ, T.3, OLÁH, A.V.2

1 INSTITUTE OF HUNGARIAN SPORT MEDICINE, 2 UNIVERSITY OF DEBRECEN, DEPARTMENT OF LABORATORY MEDICINE, 3 UNIVERSITY OF DEBRECEN, DEPARTMENT OF PEDIATRICS

INTRODUCTION: Regular evaluation of athletes is mandatory to maintain their good health condition. Upon rigorous exercise and consequent dehydration changes in the water-and electrolyte homeostasis, as well as activation of compensatory endocrine - and vasoregulatory processes are activated.
METHODS: In our pilot study we compared resting and post-exercise urine samples of 39 first-class football players (age: 20-33 years). We detected their daily fluid intake and the overall environmental data such as temperature and humidity. First general (dipstick) urine analysis was performed (Clintek Status, Urisys 1100) followed by ion measurements using Cobra6000 analyzator, then marker of the tubular damage N-acetil-β-D-glukozaminidase (NAG) activity was measured via spectrophotometry and normalized to creatinine.
RESULTS: Either proteinuria or hematuria (4-4 cases), representing 20% of total samples (8/39), were detected in urine samples taken at rest. With emphasize, in post-exercise samples pathological urine alterations were detected in 61.5% of cases (24/39), hematuria n:11 and proteinuria n:18, while both alterations were found in 7 cases. Among 17 players wide anion gap was detected which alteration showed correlation with increment of sodium excretion in the urine. In 9 cases post-exercise wide anion gap (>55 mmol/L) was associated with lower as expected urine Na+ excretion while at the same time higher creatinine values and proteinuria (6/9) were detected. Over 90% of the cases the Cl- excretion decreased to 1/3 of its original value in post-exercise samples which exceeded the rate of Na+ reabsorption. Increasing proteinuria was seen in roughly 50% of the players measured in post-exercise samples (250-1500 mg/L, n:19/39). Among players in whom proteinuria exceeded 1500 mg/L we detected pathological NAG index in 3 cases (3/39) which finding may correspond with tubular dysfunction. We observed increasing creatinine values (18749 μmol/ vs. 31808 μmol/L) in parallel with seasonal changes in temperature (6 °C vs. 37 °C) presumably as a consequence of dehydration.
CONCLUSION: Significant hemodynamic changes occur in the kidney upon rigorous physical activity as a consequence of dehydration and circulatory redistribution. Due to the activation of the RAAS active sodium and consequent water as well as passive Cl- reabsorption occur in the proximal tubular system. Consequently, the level of Cl- anion decreased to roughly 1/3 of its original value. The most plausable explanation for wide urine anion gap measured after exercise is the observed decline of Cl- level. Besides, production of other anions such as lactate and bicarbonate may decrease the excretion of chloride. Adequate hydration before and after training or football game is of great importance. Although exercise-induced proteinuria is a known, benign phenomen, in case of persistent proteinuria further investigation and consultation with nephrologist should be initiated.

CHANGES IN THE MARKERS OF OXIDATIVE STRESS IN RESPONSE TO A SOCCER GAME

DEVRNJA, A., MATKOVIC, B.R.

FACULTY OF KINESIOLOGY

INTRODUCTION: Soccer, as one of the most popular modern sports, is an activity that involves both aerobic and anaerobic activities. During the game, players cover 9 to 12 km in total with different intensities of movement: walking, moving backwards, jogging, running and sprinting (Mohr et al, 2003). Because of the tough schedule and lack of the time for adequate rest and recovery, soccer players are more susceptible to oxidative stress and negative changes related to the development of oxidative stress. The aim of this research was to analyse the changes in the values of some of oxidative stress markers caused by a soccer game (malondialdehyde (MDA), glutathione peroxidase (GPx)) in adolescent soccer players.
METHODS: 43 male soccer players (16.8 ± 1.06 years) volunteered to participate in this research. All subjects signed informed consent. The study was carried out in accordance with and approved by the Research Ethics Committee of Faculty of Kinesiology University of Zagreb. They were divided into two groups according to their age (22 cadets aged 15.86 ± 0.35 and 21 U19 players aged 17.76 ± 0.54) and they played two soccer games. The games lasted 90 minutes each. 30 minutes before and immediately after the game, venous blood samples were taken in order to determine the markers of oxidative stress. Global positioning system (GPS, Catapult Innovations, Scoresby, Australia) was used to analyze player on-field activities. All statistical analyses were conducted by using the SPSS software (StatSoft Inc., Tulsa, OK, USA).
RESULTS: There were no statistically significant differences determined in the changes of concentrations of MDA (p=0,18; arithmetic mean of the differences=0,19; 95% CI=-0,09-0,47) or in the changes of GPx activity (p=0,23; arithmetic mean of the differences =-4,14; 95% CI =-11,03-2,75).
CONCLUSION: Greater GPx activity can be one of the adjustments to long-term participation in regular physical activity or training process (Powers et al, 1994). According to some studies, regular physical activity may also result in decreased lipid peroxidation (Radak et al, 2001). Therefore, the lack of significant changes in MDA concentrations and GPx activity may be explained by the long-term soccer training that subjects are involved in. The correlation with distances covered was not noticed. Based on the obtained results, the conclusion can be made that the intensity during a soccer game is not the only factor in the occurrence of oxidative stress.

BONE METABOLISM IN COLLEGIATE MALE SWIMMERS

WAKAMATSU, K.1, SAKURABA, K.2, FUJITA, S.2, SANOMURA, M.3, GUSHIKEN, T.4, NAGAI, H.5, KANDA, T.5

1: J.F.OBERLIN UNIVERSITY , 2: JUNTENDO UNIVERSITY, 3: TEIKYO UNIVERSITY, 4: NIPPON SPORTS SCIENCE UNIVERSITY, 5: YAMANASHI-GAKUIN UNIVERSITY

INTRODUCTION: Bone strength primarily reflects the integration of bone mineral density and bone quality. Bone quality refers to architecture, turnover, metabolism, damage accumulation, and mineralization of bone. Overuse injuries, including stress fractures, are serious

problems faced by athletes. Sports activities have been reported to be effective in increasing bone mass. However, competitive swimming has been cited as an instance where the effect is not observed. Bone metabolism markers, which can be measured as a result of recent developments, have been reported to be low in swimmers. The purpose of this study was to examine the usability of some bone metabolism markers for the prevention of overuse injury of bones in collegiate male competitive swimmers.
METHODS: The subjects included 18 male collegiate swimming athletes (SA). In addition, 16 men without exercise experience were included as the control group (CON). Bone metabolism markers, such as serum bone-specific alkaline phosphatase (BAP), and circulating bone-specific tartrate-resistant acid phosphatase (TRACP-5b) were measured in both groups.
RESULTS: BAP levels in the SA and CON groups were and 21.3 ± 6.0 and, 16.9 ± 3.7 U/L, respectively, with statistical comparison showing a significantly higher level in the SA than in the CON group ($p < 0.05$). TRACP-5b levels in the SA and CON groups were 610.1 ± 178.0 and, 480.8 ± 143.4 mU/dL, respectively, with statistical comparison showing a significantly higher level in the SA than in the CON group ($p < 0.05$).
CONCLUSION: The subjects are top-level university swimmers whose regular training routine includes running and jumping exercises and high-intensity weight training for the lower legs. Previous studies have demonstrated that the bone resorption marker NTX is not enhanced by the extent of resistance while running (Whipple Tj et al., 2004), and swimmers who undertake high-intensity leg training (running, jumping, etc.) show significantly higher values of TRACP-5b, having a sharp increase as an effect of the exercise (Rogers RS et al., 2011).

Psychology

SALSA DANCE AND PERCEIVED MENTAL HEALTH BENEFIT AT A WEST MIDLANDS, UK UNIVERSITY: A SERVANT LEADERSHIP THEORY-DRIVEN PILOT STUDY

DOMENE, P.A., LAWSON, C.

COVENTRY UNIVERSITY

INTRODUCTION: Salsa dance is a popular physical activity and potentially efficacious in terms of the enhancement of mental health outcomes . Currently, no empirical work has been published in the literature to assess whether Greenleaf's <1977> servant leadership theory can facilitate the teaching of mental health-enhancing physical activity to novice learners in a university setting.
METHODS: An eight-week salsa dance course was taught to university students using principles of servant leadership theory. Upon completion of the course, perceived mental health benefit was measured using a series of 100 mm visual analog scales. The validity of this method has been previously demonstrated . Additionally, dimensions of servant leadership were measured on six-point Likert-type scales using an adapted version of the Servant Leadership Survey validated by Van Dierendonck et al. <2017>.
RESULTS: Forty-three participants completed the study. Skill mastery was the most highly rated perceived mental health benefit in women, whereas in men, it was mood enhancement . There were differences between sexes in the servant leadership dimensions of authenticity , empowerment , humility , and stewardship . Moreover, authenticity was correlated with mood enhancement in women and stewardship was correlated with both mood enhancement and skill mastery in men.
CONCLUSION: This is the first study we are aware of to have applied principles of servant leadership theory in the teaching of salsa dance to novice learners. Servant leadership may have facilitated the high perceived mental health benefit observed.
REFERENCES:
Ahearn, E. P. <1997>. The use of visual analog scales in mood disorders: A critical review. Journal of Psychiatric Research, 31<5>, 569-579.
Domene, P. A., Moir, H. J., Pummell, E., & Easton, C. <2016>. Salsa dance and Zumba fitness: Acute responses during community-based classes. Journal of Sport and Health Science, 5<2>, 190-196.
Greenleaf, R. K. <1977>. Servant leadership: A journey into the nature of legitimate power and greatness. Mahwah, NJ: Paulist Press.
Maraz, A., Kiraly, O., Urban, R., Griffiths, M. D., & Demetrovica, Z. <2015>. Why do you dance? Development of the Dance Motivation Inventory . PLoS One, 10<3>, e0122866.
Van Dierendonck, D., Sousa, M., Gunnarsdottir, S., Bobbio, A., Hakanen, J., Pircher Verdorfer, A., … Rodriguez-Carvajal, R. <2017>. The cross-cultural invariance of the Servant Leadership Survey: A comparative study across eight countries. Administrative Sciences, 7<2>, 8.

MOTIVATION IN SPORTS AND "SENSE OF SOCIAL TOGETHERNESS"

NISHIDA, T.

AICHI GAKUIN UNIVERSITY, JAPAN

Motivation in Sports and "Sense of Social Togetherness"
Tamotsu NISHIDA
Faculty of Psychological and Physical Science, Aichi Gakuin University, Aichi, Japan
Introduction: Considering the shift in the focus of research on motivation from individual attributes such as motive and expectancy to environmental variables in which a person is placed, the question of how to build interpersonal relationships with significant others is extremely important. Motivation is connected with the way in which people perceive how they are evaluated by others who are close and important to them. When they feel there are people around them who trust, understand and accept them, their motivation will be strong. These feelings, "a Sense of Social Togetherness ", have a positive influence on human motivation in a range of situations.
This study aimed to clarify the differences in sex and sports experiences of the SST and the relationship between motivation in sports and the SST.
Methods: The subjects were 813 junior high school students <382 boys and 431 girls> from 3 junior high schools in Japan. Their ages ranged from 12 to 15 years . They were 492 students who had taken part in extracurricular sports club activities in the past and 321 students with no such experience.
A 9-item questionnaire test to measure the SST including trust, understanding and acceptance was developed. The reliability and validity of the test were sufficiently high. An 8-item test including motivation in sports was also administered to all subjects. The subjects indicated their degree of agreement with each item statement by responding on a 5-point Likert-type rating scale anchored from "strongly disagree" to "strongly agree".
Results and Discussion: The SST mean score for girls was significantly higher than those for boys . As girls have a stronger need for affiliation than boys, this need may be one of the factors behind the higher score for sense of social togetherness. The SST score for students who had taken part in extracurricular sports club activities in the past was significantly higher than those for students with no such expe-

rience . The results indicate that extracurricular sports programs may provide a valuable setting for the development of a sense of social togetherness. A positive correlation between the SST and motivation in sports activities was found . This finding was all in line with the initial hypothesis. In other words, when there is a strong sense of trust, understanding, and warm acceptance, a person is better able to devote herself or himself to sports activities.
Further investigation is necessary to explore the sense of social togetherness and its role by examining its relationship with other psychological concepts, what factors shape its development, its influence in the sports and school setting, and whether differences exist across different cultures.
Contact: tamotsu@dpc.agu.ac.jp

A STUDY OF WEIGHTLIFTING ATHLETES' SPORTS PARTICIPATION AND SOCIAL SUPPORT : KUO, HSING-CHUN CASE

HSIEH, Y.T., HSU, K.P.

NATION TAIWAN UNIVERSITY OF SPORT

INTRODUCTION: The Taiwanese weightlifter Guo Hsing Chun won the bronze medal at 2016 Rio Olympic Games, and broke the world record in the clean for the women's 58 kilogram weight class in 2017. Besides her physical ability, social support is an necessary factor (Côté, 1999). In 1974, Caplan advanced that social support is a various forms of assistance and support provided by families, teammates and others to individuals facing stress. Hence, the purpose of this study is to find out how social support, in terms of family, coach and peer, has affected Guo's weightlifting career.
METHODS: This article takes Guo as a case study, using literature analysis and semi-structured interviews to collect informations and documents, and summarize relevant informations.
RESULTS: 1. Family: Guo had participated in several sports and contacted weightlifting at the age of 15. Respecting her participation in sports, her family gave financial and emotional support.
2. Coach: Since Guo was 15, the coach has accompanied her through all the trainings. Besides giving professional knowledge, he cooks on his own to supply nutrition.
3. Peer: They provide technical exchanges, companionship and emotional support.
CONCLUSION: 1. Family: In 2010, Beets, Cardinal and Alderman concluded that family support was one of the major factors influencing the teenage sport. Oral encouragement may increase athletic performance in addition to material support provided by family. As Guo said, family influences her the most by their oral encouragement and presence to the match.
2. Coach: In 2011, Zourbanos mentioned that the forms of social support provided by coaches includes psychological, information and self-esteem level. Guo's got the same supports from her coach and extra material support.
3. Peer: Morgan interviewed 8 NCAA players in 2006 and found that peer support was important in growth process. Peers assist in training, listen to others' thoughts, which is similar to Guos peer support.
References:
Beets, M. W., Cardinal, B. J., & Alderman, B. L. (2010). Parental Social Support and the Physical Activity–Related Behaviors of Youth: A Review. Health Education and Behavior, 37(5), 621-44.
Caplan, G. (1974). Support systems and community mental health consultation. New York, NY: Basic Books.
Côté, J. (1999). The infl uence of the family in the development of talent in sport. The Sport Psychologist, 13, 395-417.
Morgan, T. K. & Giacobbi, P. R. (2006). Toward Two Grounded Theories of the Talent Development and Social Support Process of Highly Successful Collegiate Athletes. The Sport Psychologist, 20, 295-313.
Zourbanos, N., Hatzigeorgiadis, A., Goudas, M., Papaioannou, A., Chroni, S., & Theodorakis, Y. (2011). The social side of self-talk: Relationships between perceptions of support received from the coach athletes' self-talk. Psychology of sport and Exercise, 12, 407-414.

MOTIVATION FOR WEIGHT CONTROL AMONG UNIVERSITY STUDENTS IN JAPAN AND SOUTH KOREA

IKEDA, T.O.1, IKEDA, T.2, YAITA, A.3, SAKAGUCHI, H.4, ITO, H.5, AOYAGI, O.5, HONG, Y.6, HAN, N.6, CHOI, T.6, NAM, Y.7, KOO, K.8

1: NISHI-KYUSHU UNIVERSITY, 2: FUKUOKA PREFECTURAL UNIVERSITY, 3: KYUSHU-KYORITSU UNIVERSITY, 4: JAPAN UNIVERSITY OF ECONOMICS, 5: FUKUOKA UNIVERSITY, 6: JEJU NATIONAL UNIVERSITY, 7: DUKSUNG WOMENS U

INTRODUCTION: In Japan, females in their 20s tend to have a thinner body than their older counterparts (Ministry of Health, Labour and Welfare, 2015). As younger females strongly desire to be slender, they also tend to engage in weight control (WC), even if their body weight is appropriate (Urata, 2001; Ikeda et al., 2005). Korean females also desire to be slender (Woo, 2014). The purpose of the present study was to investigate and compare motivational factors for WC between university students in Japan and South Korea.
METHODS: The participants were 823 students (Japan: 81 males, 264 females; Korea: 189 males, 289 females) who are/were engaging in WC and completed a questionnaire composed of 27 items on reasons and/or motivation for WC (Hando & Kawashima, 2009; Nishioka et al., 1993). A factor analysis was applied to investigate motivational factors for WC, and differences in nationality and gender were analyzed using two-way layout analysis of variance (ANOVA) with general linear modeling.
RESULTS: The following five factors were extracted by the factor analysis: Social influence [SI], Appearance [AP], Health [HE], Improvement of overweight [IW], and Economical effect [EE]. The results of ANOVA showed gender differences in SI ($F[1, 803] = 40.6$, M < F) and EE ($F[1, 803] = 11.1$, M > F). Interactions between gender and nationality were seen in AP, HE, and IW. A multiple comparison test showed gender differences for both country (JPN: $t[93] = -11.2$; KOR: $t[362] = -9.5$, M < F) and nationality ($t[255] = -4.8$, JPN < KOR) among males for AP, gender differences ($t[96] = 3.7$, M > F) in Japan and nationality differences ($t[523] = -3.2$, JPN < KOR) among females for HE, and gender and nationality differences (JPN: $t[90] = -5.7$; KOR: $t[350] = -4.2$, M < F) among females for IW in both countries ($t[544] = 8.0$, JPN > KOR).
CONCLUSION: HE and EE were identified as motivational factors for WC among males, whereas SI, AP, and IW were identified as motivational factors for WC among females. Having these factors as motivation for WC among females is problematic because of the already high proportion of thinner females in both countries. Among females, Koreans tend to be healthier, while Japanese tend to want to improve their overweight status. In addition, Korean males tend to want to look thinner than their Japanese counterparts. The present study clarified the five factors and their differences between Japanese and Korean university students on motivation for WC.

COOPERATIVE GAMES AND CHILDREN: REFLECTIONS ON A PSYCHOLOGY GROUP OF A HEALTH CENTER IN FLORIANÓPOLIS (SC, BRAZIL)

MARINHO, A., LECUONA, S.D.

STATE UNIVERSITY OF SANTA CATARINA

Nowadays, it is possible to identify characteristics of competitive behavior in various social spheres. An example is the competition in work environment. However, this social behavior is also shrouding children's relations. It may be possible because of the several competitive sports taught in school, forgetting the cooperative possibilities. The cooperative games have as pretense to redirect the perceptions to this reality, seeking to transform the mode of existence, the barriers on bridges and the treatment of its practitioners, of opponents in solidarity in different contexts. Thus, this study aimed to know the activities promoted to children participating in a Psychology Group in a health center of Florianopolis (SC, Brazil) and to provide practice with cooperative games to investigate its influence and its consequences for the treatment and promotion of health of the participants. The participants were seven children aged eight to twelve years, and the professional responsible for the activities of the group. This field research was configured as descriptive and exploratory in which semi structured interviews were conducted after four meetings with the practice of cooperative games. The data were analyzed using the Content Analysis Technique. For the organization of such information was used NVivo software, version 11.0. The results indicate the acceptability of cooperative games of the children investigated. It also shows that cooperative games can contribute to the promotion of better living among children, and can allow them a perception of change in their attitudes to themselves and each other. These findings emphasize the importance of rethinking the changing needs of the strategies with the "care", which promote, through the effective humanization, the possibility of the patient having a full treatment, able to supply not only their biological needs.

PERCEIVED COACH EMPOWERING CLIMATE AND ENJOYMENT IN MEXICAN PITCHERS: A MODERATED MODEL OF MOTIVATION.

GUTIERREZ, P.1, LOPEZ-WALLE, J.2, BALAGUER, I.3, TRISTAN, J.2

1: UES , 2: UANL , 3: UV

INTRODUCTION: When athletes perceived the environment to be more empowering they reported more autonomous forms of motivation (Smith et al., 2016) and optimal engagement (e.g. enjoyment, wellbeing, embracing the challenge) (Duda, Appleton, Stebbings, & Balaguer, 2018). Studies have revealed that empowering climate predicts optimal consequences, however, less is kwon about the underlying processes that may moderate this relationship. This study examines the moderating role of forms of motivation (autonomous and controlled) between perceived coach empowering climate and enjoyment.
METHODS: Participants were 97 pitchers ranged in age from 13 to 16 years old (M = 14.12, SD = 1.09) representing different childrens baseball leagues in Hermosillo, Sonora, Mexico. At same training camps, the participants were administered the Mexican version of a multi-section questionnaires tapping the variables of interest (EDMCQ-C, SMS-II, SSI). For the analyses of the data, the macro PROCESS for SPSS was used.
RESULTS: The objective of the study was to examine the moderating role of forms of motivation (autonomous and controlled) between perceived coach empowering climate and enjoyment.Model 1. The perceived coach empowering climate was a positive predictor and explain 31% of reported enjoyment (R2 = .307). Change in the R2 with the addition of the moderating effect of autonomous motivation (AM) was low but significant ($F = 7.318$, $p < .01$). The conditional effect between the perceived coach empowering climate and enjoyment in the different values of the AM were not significant. Model 2. The perceived coach empowering climate was a positive predictor and captured 25% of reported enjoyment (R2 = .248). The observed change in R2 with the inclusion of the moderating effect of controlled motivation (CM) was low but significant ($F = 12.049$, $p < .01$). The relationship between perceptions of the coach empowering climate and enjoyment was significant with pitchers of low and medium CM only.
CONCLUSION: The purpose of the study was to analyze the moderating effect of forms of motivation (autonomous and controlled) among the perception of the empowering climate created by the coach and the enjoyment of the pitchers, for which it was confirmed only when the controlled motivation is medium or low. It is reinforced that empowering climates predict welfare indicators (Duda et al., 2018).
References: Duda, J. L., Appleton, P. R., Stebbings, J., & Balaguer, I. (2018). Towards more empowering and less disempowering environments in youth sport. In C. J. Knight, C. G. Harwood, & D. Gould (Eds.), Sport Psychology for Young Athletes (pp. 81-93). New York, NY: Routledge.
Smith, N., Tessier, D., Tzioumakis, Y., Fabra, P., Quested, E., Appleton, P., Sarrazin, P., Papaioannou, A., Balaguer, I., & Duda, J. L. (2016). The relationship between observed and perceived assessments of the coach-created motivational environment and links to athlete motivation. Psychology of Sport and Exercise, 23, 51-53.

EGO AND TASK ORIENTATION DIFFERENCES AMONG UNIVERSITY STUDENTS

TAKSIC, I.

UNIVERSITY OF APPLIED HEALTH SCIENCES

Ego and task orientation differences among university students
Taksic, Iva
University of Applied Health Sciences, Zagreb, Croatia
Introduction: In a last few decades, physical (in)activity has become a big issue that raises a lot of questions in a health community. There are several theories that explain motivation in achievement contexts related to sport and exercise (Nicholls, 1989; according to Baric, 2006). Task- and ego-goal orientations are considered as orthogonal dimensions (Duda, 2001) and a person can be high or low in either or both. The aim of this research was to determine are there any gender and study differences considering task and ego orientation during physical activity.
Methods: Study was conducted on 570 University of Zagreb students; of which there are 329 female and 241 male participant. There were 419 participants involved in social sciences and 159 in technical science studies. Average age of participant was 19,94 (SD=1,74). We used Croatian version of the Task and Ego Orientation in Sport Questionnaire (Baric and Horga, 2006) which consists of two subscales that measure goal orientation: task orientation and ego orientation. Items were modifed so they are appropriate for measuring goal orientation in exercise.

Results: Results have shown that there is a statistically significant difference in ego orientation task; males have shown higher results than females. When it comes to task orientation, no difference has been found. We have found that social sciences students show statisticaly higher results both in ego and task orientation than techincal science studies
Discussion: Men have higher results in ego orientation than women, so we can say that men, while involved in physical activity tend to compete with others, and they think of succes only if theyre performance is better than others (Baric, 2006). When it comes to studies differences, social sciences studies are significantly more ego oriented than technical sciences students. Social sciences students have shown statistically higher results in task orientation than technical sciences students. It means that social sciences students regard their success in the sport environment as a personal improvement in their skills and mastery through the effort invested (Baric, 2006).
Conclusion
In this research, we have shown that men are statistically higher on ego orientation than women, while in task orientation there is no gender difference. Social sciences students show significantly higher results in both ego and task orientation than techincal science studies.
References: Barić, R.; Vlašić, J.; Cecić Erpić, S. (2006). Psychometric properties of the Croatian version of task and ego orientation in sport questionnaire (cteosq). Kinesiology 38 2:135-142
Duda, J.L. (2001). Achievement goal research in sport: pushing boundaries and clarifying some misunderstandings.
In G. C. Roberts (Ed.), Advances in Motivation in Sport and Exercise (pp. 129-183). Champaign, IL: Human Kine

A SELF-DETERMINATION THEORY APPROACH TO INVESTIGATE THE ASSOCIATION BETWEEN MOTIVATION, CARDIO-VASCULAR FITNESS AND OBESITY IN ADOLESCENTS

ABOALMATY, H.
TANTA UNIVERSITY

Introduction: Overweight and/or obesity would cause significant health problems for children and adolescents. Rates of overweight and obesity in children have increased 45% in the last decade and have increased three-fold since 1980. Since children who are physically active are at lower risk for the development of obesity, it is crucial to identify and understand the main factors, which influence childrens physical activity patterns. Evidence from recent research suggested that controlling the cardiorespiratory fitness would offset the association between motivation and weight status. Therefore, this study was undertaken to investigate the relationship between motivation, cardiorespiratory fitness, and weight status, which is defined in this study as obese or non-obese.
Methods: This is a cross-sectional survey, in which participants included were physically active middle school students. Participants age ranged between 11-15 years (N=80, 51% female) who were part of the Teen Eating and Activity Mentoring in Schools. The main aim of this study was improving health and preventing obesity among middle school students. Student involved in this study completed attitudinal questionnaire related to physical activity and self-determination as well as participating in a number of fitness performance tests, health behaviour, and anthropometric assessment.
Results: Non-obese adolescents showed higher intrinsic motivation scores than obese adolescents. Mediational analyses demonstrated that cardiorespiratory fitness mediated the relationship between motivation and weight status.
Conclusions
The results of this study demonstrate differences in physical activity motivation as a function of adolescent weight status, but only for intrinsic motivation. As predicted, adolescents who were intrinsically motivated for physical activity were more fit and therfore less likely to be obese. The findings are consistent with self-determination theory.

EFFECTS OF REGULAR EXERCISE, GENDER AND BODY IMAGE ON SPORTS MOTIVES FOR UNIVERSITY NOVICE ROWERS

NG, S.K.R.
THE CHINESE UNIVERSITY OF HONG KONG

Purpose
The aim of this study was to examine the effects of regular exercise, gender, self-esteem, and body appreciation scale on motives for sport participation of novice rowers.
Method
Before the commencement of the 3-month university rowing team training program which consisted of three 2-hour water and land training sessions per week, one hundred fifty-six novice rowers (103 men, 53 women; mean age: 19.5±1.5 years old; BMI=20.9±2.2 kg/m2) completed the Exercise Motivation Inventory-2 (EMI-2; Markland & Ingledew, 1997), Rosenberg's Self-Esteem Scale (Chinese translation: Ng, Barron & Swami, 2015) and Body Appreciation Scale-2 (BAS-2; Swami & Ng, 2015). They also reported whether they were engaging in regular exercise, defined as at least 150 minutes moderate exercise per week.
Results: In the present study, each of the scales from the Chinese translation EMI-2 demonstrates good internal reliability, ranging from 0.63-0.89. Among all the participants, the three major reasons for participating in training were positive health (M = 4.05, SD = 0.67), strength and endurance (M = 3.97, SD = 0.66), and challenge (M = 3.84, SD = 0.70).
Results of MANOVAs test showed no statistically significant main gender effect on the combined dependent variables, Wilks Lambda = 0.875, F(17, 136) = 0.801, p = 0.317, η2 = 0.125; a significant main effect for regular exercise, Wilks Lambda = 0.745, F(17, 136) = 2.733, p = 0.001, η2 = 0.255; and no statistically significant interaction of gender and regular exercise, Wilks Lambda = 0.909, F(17, 136) = 0.801, p = 0.690, η2 = 0.091.
Independent samples Mann-Whitney U test results revealed that students with regular exercise (n = 105; 68 men, 37 women) had significantly higher mean scores than those without regular exercise (n = 51; 35 men, 16 women) for strength and endurance, competition, stress management, affiliation, enjoyment, revitalization, positive health, self-esteem and BAS-2.
In conclusion, participants with and without regular exercise were motivated to take part in regular training by intrinsic factors such as positive health, strength and endurance, revitalization and challenge.
References:
Markland D, Ingledew L. (1997). The measurement of exercise motives: factorial validity and invariance across gender of a revised exercise motivation inventory. Br J Health Psychol., 2:361-376.
Ng S. K., Barron D. & Swami V. (2015). Factor structure and psychometric properties of the body appreciation scale among adults in Hong Kong. Body Image,13, 1-8. doi:10.1016/j.bodyim.2014.10.009

Swami V. & Ng S. K. (2015). Factor structure and psychometric properties of the Body Appreciation Scale-2 in university students in Hong Kong. Body Image, 15, 68-71. doi:10.1016/j.bodyim.2015.06.004

A QUALITATIVE EXAMINATION OF SOURCES OF STRESS IN INTERNATIONAL TENNIS UMPIRES

MURAKAMI, K.1, MATSUURA, M.1, SAKATA, S.2

1: TOKYO UNIVERSITY OF SCIENCE, 2: KYUSHU UNIVERSITY

Introduction: Sport officials must continuously endure physical pressure; they should, however, also be willing to psychologically endure various stressors. Tennis judgement is also a very exciting occupation and a stressful one in any stage. As the best performance cannot be expected from athletes and coaches who are under a great deal of stress, officials are sometimes unable to demonstrate proper performance (Reilly and Eregson, 2006). The purpose of this study, therefore, is to investigate the source of stress for international tennis umpires, and compare it to those identified in past studies of other sports.
Methods: Eight umpires with International Tennis Association budges of gold, silver, or bronze were interviewed about the stress they experienced as international umpires and asked to identify specific sources of stress. At the time of the interview, the average age of the participating umpires was 46.1 yr. with a range of 37 to 52 yr. Qualitative methodology was utilized in this investigation. An interview guide, comprising a series of open-ended and guided questions was developed for this investigation. Qualitative interviews were between 35 and 60 minutes long and were transcribed, coded, and analysed by three experienced qualitative researchers.
Results: Participants were asked the general question, "Can you think of anything else that may have been a source of stress?" Ninety-one raw data themes were identified from the analysis of the interview data. These raw data responses were content analysed; the three researchers discussed and came to a consensus on the grouping of the raw data responses, transforming them into meaningful subcategories and larger groupings. This procedure resulted in 24 subthemes that were grouped into 26 higher-order themes; these were then summarized with seven overall stressor categories: 1) confrontation, 2) pressure of the game, 3) fear of failure and mistakes, 4) interpersonal conflicts, 5) time demands, 6) financial problem, and 7) prolonged travel for expedition.
Discussion: This study examined the sources of stress experienced by tennis umpires. Overall, the present investigation revealed that the umpires in the present sample experienced similar sources of stress as other sport officials from previous research (Voight, 2009). The research suggests that there is a small minority of sport officials who could benefit from help for their stress, and psychologists have identified several stress management techniques that could be applied to officials. The information gathered from this work also provides insight into how we can better create stress management programs for this population.
Reference
Reilly, T. and W. Eregson, 2006 Special populations: The Referee and Assistant Referee. Journal of Sports Science, 24(7): 795-801.
Voight, M. 2009 Sources of stress and coping strategies of US soccer officials. Stress and Health, 25: 91-101.
Contact: kiso@rs.kagu.tus.ac.jp

A STUDY OF SOCIAL SUPPORT AND RESILIENCE ON THE COLLEGE STUDENT ATHLETES IN TAIWAN

YEH, S.W., CHEN, M.Y., TSAI, Y.T.

NATIONAL TAIWAN NORMAL UNIVERSITY

A study of Social Support and Resilience on the College Student Athletes in Taiwan
Shao-Wei Yeh1, Mei-Yen Chen1, Yi-Ting Tsai2
1 Graduate Institute of Sport, Leisure and Hospitality Management, National Taiwan Normal University, Taiwan
2 Department of Physical Education, National Taiwan Normal University, Taiwan
Introduction: The perceived availability of social support has been found to protect against the potential of stressful events to elicit psychological distress, depression, and anxiety (Schwartzer & Leppin, 1989; Kawachi & Berkman, 2001). Besides, resilience is a multidimensional characteristic that varies with context, time, age, gender, and cultural origin, as well as within an individual subjected to different life circumstances (Garmezy, 1985; Seligman & Csikszentmihalyi, 2000; Werner & Smith, 1992, Connor & Davidson, 2003) and it has been defined that could promote one's positive adaptation under stress and adversity (Wagnild 2003). The purposes of this study are following: (1) to assess the reliability and validity of the scales, and (2) to explore the relationship between social support and resilience of college student athletes, and to examine linear relationship between social support and resilience of athletes.
Methods: The data collected from National Sports Training Center during April, 2017. Consisted 241 collegiate athletes (121 males, 120 females), mean age was 22years (SD = 2.73 years) for all participants, from 15 sport teams. Measures included social support and resilience scales. Data analysis methods included the descriptive statistics, Pearson correlation analysis, regression analysis, and CFA.
Results: Based on the CFA, social support ($\chi 2/df$, $p > .05$, RMSEA = .06, CFI = .90) and resilience scales ($\chi 2/df$, $p > .05$, RMSEA = .08, CFI = .89) were both fit with the data. Also, social support were significantly associated with resilience of college student athletes (Adjusted $R2 = .46$, $p < .05$). The results revealed the positive correlation among social support and resilience. The finding indicated that in spite of the structure for social support and resilience had stronger theoretical support, but lacked enough empirical evidences to support and resolve the issues.
Discussion: This study suggested that when athletes take training to upgrade performance, we will have to provide effectively solution to send the messages to athlete to support them correctly. Furthermore, the study suggested the future study that further to explore the reason to affect the correlation between subscales by approaches of bi-factor or Bayesian factor analysis.
References: Schwarzer, R., & Leppin, A. (1989). Social support and health: A meta-analysis. Psychology and health, 3(1), 1-15.
Seligman, M. E., & Csikszentmihalyi, M. (2000). Special issue on happiness, excellence, and optimal human functioning. American Psychologist, 55(1), 5-183.
Contact: meiyen686@gmail.com

THE IMPACT OF DIFFERENT MOTOR INTERVENTIONS ON EXECUTIVE FUNCTIONS IN HEALTHY YOUNG ADULTS – MULTIMODAL- VERSUS SINGLE-INTERVENTION FORMS.

STUHR, C., STÖCKEL, T.

UNIVERSITY OF ROSTOCK

Introduction: It has long been postulated that executive- and motor functions are functionally intertwined [1]. The idea received convincing support from intervention studies, reporting improved motor skill proficiency and/or participants' physical fitness being associated with

enhanced executive functions, such as working memory, inhibitory control and cognitive flexibility [2]. There is consensus in the literature that different kinds of motor interventions differ in their impact on executive functions and that a multimodal approach could multiply those positive effects [2,3]. Currently most of the studies focused on intervention effects on frail older participants or children [3,4]. The aim of our study was to confirm the gain of a multimodal motor intervention compared to a single-intervention form in healthy young adults.
Methods: A control group (CG) and two intervention groups (IG) completed a pre- and a posttest. We assessed working memory (Corsi Block task), inhibitory control (Flanker; Hearts and Flowers), cognitive flexibility (Wisconsin Card Sort test, Flanker, Hearts and Flowers, Trail Making Test) and planning (Tower of London task). IG 1 undertook a bimanual coordination training with juggles (single-intervention) while IG 2 (multimodal-intervention) completed a training combining both bimanual coordination exercises and running at individual heart rate guided moderate intensity. Participants of the IGs completed 12 training sessions of 40 min over a period of four weeks (3 sessions/ week). A repeated-measures ANCOVA was carried out to test for the effects of time (pre vs. post) and group (CG, IG 1, IG 2) and their interaction on cognitive performance.
Results: ANCOVA resulted in statistical trends for an effect of time × interaction on cognitive performances. Both IGs outperformed CG and the multimodal-intervention form gained advantage over the single-intervention form regarding cognitive flexibility. Detailed results will be presented.
Discussion: Although participant were healthy young adults, results confirm previous research with clinical populations. Outcomes will be discussed respecting the explanatory power of the study due to the limited number of participants as well as the validity of executive function tests.
[1] Weimer (1977). A conceptual framework for cognitive psychology: Motor theories of the mind . In R. Shaw & J. Bransford (Eds.), Perceiving, acting, and knowing: toward an ecological psychology (pp. 267–311). Hillsdale: Erlbaum.
[2] Saez de Asteasu et al. (2017). Ageing Res. Rev,, 37:117–134.
[3] Voelcker-Rehage & Niemann (2013). Neurosci. Biobehav. Rev, 37: 2268-2295.
[4] Koutsandréou et al., (2016). Med Sci Sports Exerc, 48: 1144-1152.
Contact: christina.stuhr@uni-rostock.d

RELATIONSHIP BETWEEN PHYSICAL FITNESS AND NON-COGNITIVE ABILITY IN YOUNG CHILDREN

TAKAHIRO, N.1, KOSHO, K.2, TOMOAKI, S.1, KAZUO, O.3
1: NAGOYA GAKUIN UNIVERSITY , 2: GIFU UNIVERSITY , 3: GIFU SHOTOKU UNIVERSITY

Introduction We have examined the various aspects of the importance of exercise in young children, such as improving physical fitness. In recent years, it has been observed that improving non-cognitive ability is important for children's future success (Pearce et al., 2016). Considerable research has shown a relationship between physical fitness and measures of cognitive ability such as academic achievement and memory (Castelli et al., 2007); however, there is little research showing a relationship between physical fitness and non-cognitive ability. Therefore, the aim of this study was to examine relationship between physical fitness and non-cognitive ability in young children.
Methods The subjects were 379 young children. We investigated the childrens non-cognitive ability using a questionnaire consisting of 20 items. We carried out a physical fitness test and analyzed the results using values standardized by sex and grade levels. We analyzed non-cognitive ability using both the evaluation value of each item and the composite score. The correlation coefficient between non-cognitive ability and physical fitness was calculated. We further examined the difference in non-cognitive ability between the group with greater than average physical fitness and the group with less than average physical fitness using independent t-test.
Results A significant correlation was found between physical fitness and non-cognitive ability in all sex and grade groups. In particular, standing long jump performance was significantly correlated with non-cognitive ability in all sex and grade groups. Upright handstanding time showed a significant correlation in 3-year- and 5-year-old class boys. In all measures of physical fitness except for sitting trunk flexion, the composite score for non-cognitive ability was significantly higher in the group with above-average physical fitness. The two groups showed marked differences in non-cognitive abilities especially on measures of "leadership," "grit," "coping well with things," and "positive self-perception."
Discussion Therefore, it was confirmed that there was a clear relationship between physical fitness and non-cognitive ability in young children. We suggest that promoting exercise among young children will improve their non-cognitive abilities. In particular, we would expect to see exercise beneficially affecting the qualities of "leadership," "grit," "coping well with things," and "positive self-perception."
[References]
Pearce A, Sawyer A. C. P, Chittleborough C. R, Mittinty M. N, Law C, Lynch J. W. (2016). Social Science and Medicine, 165, 108-118.
Castelli D. M, Hillman C. H, Buck S. M, Erwin H. E. (2007). Journal of Sport & Exercise Psychology, 29(2), 239-252.
[Contact] taka@ngu.ac.jp

PSYCHOLOGICAL DETERMINANTS OF COACHES' EMPATHIC SKILLS

TOTH, L.1, REINHARDT, M.2
1: UNIVERSITY OF PHYSICAL EDUCATION, 2: EÖTVÖS LORÁND UNIVERSITY

Introduction: Development of athletes' performance is going on in an interpersonal context (Poczwardowsky et al., 2002). Coaches have an important role in establishing and shaping the performance of their athletes. Beside sporting knowledge leadership skills are also relevant abilities of the coaches independently whether they are working in individual or team sports. One of the key factors of positive athlete–coach connection is empathic ability of the coach. Emotional closeness is also a major factor in the 3+1Cs relationship model of Jowett (2007) beside commitment, complementarity and co-orientation.
Methods: Our aim was to reveal the psychological determinants of empathic abilities of coaches. 298 coaches (69% male, 31% female) with different qualifications and sports took part in the research. Mean age was 33.97 ys, SD=12.71. We measured the following psychological constructs: empathy, Big Five personality traits, perfectionism and emotion regulation, furthermore the prosocial and antisocial behaviors facilitated by the coach.
Results: According to multiple regression analyses all of the four empathy components (fantasy, empathic concern, perspective-taking and empathic distress) was determined by certain Big Five personality traits and certain emotion regulation strategies, as well as by enhancing prosocial behaviors. The fantasy component of empathy was predicted by openness and rumination. Empathic concern was determined by agreeableness, conscientiousness, emotional stability and the support of the athletes' prosocial behaviors towards others. Rumination and blaming others weakened empathic concern. Perspective taking depends on agreeableness, openness, introversion and adaptive emotion regulation processes, like planning and positive reinforcement. Empathic distress was explained by maladaptive

emotion regulation strategies and emotional instability. Age, gender, level of education, years working as a trainer, and perfectionism have no effect on the components of empathy.
Conclusion
Agreeableness, conscientiousness and emotional stability as personality traits, as well as tendency to encourage prosociality can support the empathic capacity of coaches, which has a positive and stimulating influence on the effective athlete-coach relationship.
References: Jowett, S. (2007). Interdependence Analysis and the 3+1Cs in the Coach-Athlete Relationship. In S. Jowette & D. Lavallee (Eds.), Social Psychology in Sport (pp. 15-27). Champaign, IL, US: Human Kinetics.
Poczwardowski, A., Barott, J.E., & Henschen, K.P. (2002). The athlete and coach: Their relationship and its meaning. Results of an interpretive study. International Journal of Sport Psychology,33,116-140.
Contact: toth.laszlo@tf.hu

A STUDY OF CAREER FORMATION AND IDENTITY STATUSES IN JAPANESE UNIVERSITY FEMALE FOOTBALL PLAYERS

UEMUKAI, K., INABA, K., IIDA, Y.

MUSASHI UNIVERSITY

Introduction: Iida(2012) had conducted quantitative as well as qualitative researches of J-League academy players and their parents by focusing on their career formation and process. On the other hand, there are not many teams for girls and it is not easy for them to continue playing football after junior high school. Furthermore, there is no option available to become a professional even after they continue their football career up to a high level, so the options to play at a university compared to the male players are not enough either. That means female players have to build their career among unclear and limited options. What kind of impact does this environmental difference bring to the career development process? It is also an important factor to consider career formation that it is deeply related to adolescent identity formation such as entering high school, entering university, and occupation decision-making.
Therefore, the purpose of this study was to examine the career formation of university female football players with high competition level and to find out the relationship with identity which is a psychological developmental task of adolescence.
Methods: The content of questionnaire includes: when and why they started to play football; factors to carry on this career; background details and reasons for joining their current team; what they think of their current environment that they play football in; what they think of their future as footballers. Furthermore, the identity status scale was used in order to measure the state of identity. This scale is composed of 12 factors, "present commitment", "past crisis" and "future commitment pursuit". 212 University female football players provided valid data.
Results and Discussion: Almost subjects in this study started to play when they were in a lower grade of elementary school and belonged to local club rather than junior high-school team. This result reflects an issue of girls' football in Japan, which lacks the system of "club activities" at school after they move on to a junior high school. Furthermore, one of the reasons to choose their high school is because that was a school with a strong football team but only less than 20% of the students talked to their coach about their choice of school and a great number of them consulted their mothers. For each of the three factors(present commitment, past crisis and future commitment pursuit), a t-test was conducted to examine the difference between the selected national team and the selected regional team. As a result, a significant difference was recognized only for "past crisis" ($t = 2.39$, $df = 203$, $p < .05$). In other words, the players of the selected national team have not experienced "past crises" compared to the players of the regional team. It seems that they have been walking without worry, distress, discordance with the surroundings about their own career development centering on football.

PERSONOLOGICAL PROFILE AND VALUES ORIENTATION IN FOOTBALL ATHLETIC TRAINERS

VAGO, P.

UNIVERSITÀ CATTOLICA MILANO

INTRODUCTION: This study investigated the personality traits and values orientation in trainers.
Athletic trainers strive to monitor the players with the primary objective of enhancing the performance. Their goal is to achieve the best results on the pitch, physically and psychologically both for the individual player or team.
METHODS: Athletic trainers (N= 62; 23.9 ± 3.5 yrs) following a Masters degree were recruited. The participants completed a socio-anagraphic questionnaire - evaluating education and experience both in a football team and in sports context as fitness centers - the BFO (Big Five Observer) a questionnaire designed to investigate the main dimensions of personality (Energy/extraversion, Agreeableness, Conscientiousness, Emotional Stability, Mental Openness) through a list of 40 pairs of bipolar adjectives and the PVQ (Portrait Values Questionnaire) a list of 40 item that describe the values of a general person and subjects express how much they perceive themselves similar to the hypothetical person (in a Likert 6 points scale). The values orientation is organized in two bipolar dimensions: self-enhancement versus self-transcendence; conservatism versus open to change.
RESULTS: Results revealed that trainers – comparing to general population's standardized values - show high levels of mental openness (T higher points mean 57) and emotional stability (T points mean 58). There was a positive correlation (Pearsons' r 0,166 $p<0,05$) between age and energy/extraversion.
Regarding the bipolar values orientation, the sample showed higher values in self-transcendence (mean 4.37) and open to change (mean 4.79).
Discussion: Football athletic trainers should combine mental strategies in order to improve in their players physical readiness but also to achieve a holistic balance between physical, mental and emotional responses to game stimuli. Some personological aspects are important in this professional field. Trainers should demonstrate positive attitude, intrinsic motivation and willingness to listen the players, and in case of injury, good interpersonal communication skills, positive reinforcement, coach support and keeping the athlete involved with the team (prevalent values orientation of self-transcendence).
References:
1) Caprara, G.V., Barbaranelli, C., Borgogni, L., (1994) Big Five Observer, OS, Firenze
2) Schwartz, S.H. (2012), An Overview of the Schwartz Theory of Basic Values, Online Readings in Psychology and Culture

ATHLETES' SATISFACTION OF SOCIAL SUPPORT FROM COACHES AND ATHLETIC TRAINERS AT DIFFERENT STAGE OF INJURY REHABILITATION

LEE, M.Y., WU, H.T.

NATIONAL TAIWAN UNIVERSITY OF SPORT

Introduction: Recovering from injury and return to sport can be a tough challenge for athletes. It has been suggested that social support play an important role in the process of sport injury rehabilitation. Athletes who recovered from serious sport injuries have emphasized the importance of social support and how various types of social support from different people had helped them go through different stages of recovery (Bianco, 2001; Bianco, T., Malo, S., & Orlick, T., 1999). The purpose of this study was to examine whether there were differences in athletes' satisfaction of different types of social support from coaches and athletic trainers at different stage of injury rehabilitation.

Methods: Participants were 80 Taiwanese national level athletes form 9 different sports (45 males and 35 females, Mean age =25.22, SD=5.77) who had experienced sport injury with a rehabilitation period more than 14 days. They filled in a questionnaire measuring their satisfaction of different types of social support received (listening support, task appreciation, task challenge, emotional support, emotional challenge, and reality confirmation) from different providers (coaches and athletic trainers) at different stage of injury rehabilitation (early period, middle period, and late period). A 2 × 3 (provider × stage) repeated-measured MANOVA was conducted to analyze the data.

Results: MANOVA found a significant main effect of provider (Wilk'sλ=.68, F= 4.38, p=.001, partialη2=.32) and stage (Pillai's trace=.18, F=1.90, p=.035, partialη2 = .09), but no significant provider × stage interaction (Pillai's trace = .10, F=0.96, p=.489). Further univariate analysis showed that, in terms of provider, athlete trainers had a significant higher score than coaches in all types of social support except for reality confirmation. For main effect of stage, only the scores of task challenge varied across stages, with middle period and late period higher than early period, and no other significant difference was found.

Conclusion

Our data showed that injured athletes were more satisfied with athlete trainers than coaches for various types of social support across every stage of injury rehabilitation. These findings suggested that injured athletes expected more social support from their coaches and again emphasized the importance of coaches in the social support network for injured athletes during recovery.

References: Bianco, T. (2001). Social support and recovery from sport injury: Elite skiers share their experiences. Research Quarterly for Exercise and Sport, 72(4), 376-388.

Bianco, T., Malo, S., & Orlick, T. (1999). Sport injury and illness: Elite skiers describe their experiences. Research Quarterly for Exercise and Sport, 70(2), 157-169.

Contact wuhsiutin@yahoo.com Dr. Wu, Hsiu-Tin

THE PREDICTION OF ATTACHMENT STYLE ON COACH-ATHLETE RELATIONSHIP AMONG HIGH SCHOOL BASKETBALL PLAYERS: THE MODERATING EFFECT OF EMPOWERING MOTIVATIONAL CLIMATE

CHI, L., CHEN, S., CHEN, J.Y., CHUANG, H.Y.

NATIONAL TAIWAN NORMAL UNIVERSITY

The Prediction of Attachment Style on Coach-Athlete Relationship among High School Basketball Players: The Moderating Effect of Empowering Motivational Climate

Li-Kang, Chi, Szu-Yu Chen, Jo-Yun Chen, Hsin-Yun Chuang

NTNU (Taipei, Taiwan)

Introduction: The main purpose of this study was to combine the attachment theory (Bowlby, 1982) and empowering motivational climate (Duda, 1993) examining the prediction of attachment style and empowering motivational climate on coach-athlete relationship among youth basketball players. Furthermore, to examine the moderating effect of empowering motivational climate between attachment style and coach-athlete relationship.

Method

The participants were 268 high school Division-I basketball players (133 males and135 females). The average age of the athletes was 16.77 years. After received the informed consent, participants were asked to complete questionnaires which assess their coach-athlete attachment style, coach created empowering and disempowering motivational climates, and coach-athlete relationship.

Results: The results of multiple regression analyses indicated that empowering motivational climate positively predicted coach-athlete relationship. Disempowering motivational climate and insecure attachment style negatively predicted coach-athlete relationship. In addition, only the interactional effect of empowering motivational climate and insecure attachment style on coach-athlete relationship was found. Specifically, when perceived high empowering motivational climate, athletes reported better coach-athlete relationship regardless of their attachment style. However, when athletes perceived low empowering motivational climate, athletes who were high insecure attachment style reported worse coach-athlete relationship than those who were low insecure attachment style.

Discussion: The results of this study indicated that high school basketball players reported better coach-athlete relationship when they perceived greater empowering motivational climate from their coaches. In contrast, players reported worse coach-athlete relationship when players' perceived greater disempowering motivational climate and players who had greater insecure attachment style. Moreover, this study also found that empowering motivational climate played as a moderator between attachment style and coach-athlete relationship. It is suggested that coaches can create more empowering motivational climate especially for those athletes who have high insecure attachment style.

References: Bowlby, J. (1982). Attachment and loss: Vol. 1. Attachment. New York: Basic Books.

Carr, S. (2009a). Implications of attachment theory for sport and physical activity research: Conceptual links with achievement goal and peer-relationship models. International review of Sport and Exercise Psychology, 2(1), 95-115.

Duad, J.L. (2013). The conceptual and empirical foundations of empowering coachingTM : Setting the stage for the PAPA project. International Journal of Sport and Exercise Psychology, 11(4), 311-318.

Rehabilitation and Physiotherapy

EVALUATION OF THE TREATMENT OF PATELLOFEMORAL PAIN IN SOCCER ATHLETES WITH DYNAMIC VALGUS

EDUARDO, A.C.R., MICHEL, L.F., BEZERRA, R.A., KLAITR, D., BUENO, A.I., SANTOS, T.R. GARCEZ, E.C., SANTORO, C., LUIZ JR, H.S.

FACULDADE MAX PLANCK

INTRODUCTION: The knee, located between the hip and ankle, has its dynamic stabilization actualized by the muscles that are inserted to move this joint. The hip influences indirectly the kinematics and stabilization of the knee. Currently the knee joint is one of the most studied in the field of sports practice, high performance or not, due to the high incidence of injuries. Femoropatellar lesions and pain are related to the so-called dynamic valgus during knee flexion movements. which is attributed mainly to poor gluteal muscle performance
Muscle weakness or neuromuscular inactivation of these muscles leads to contralateral pelvic tumbling, increased internal rotation, and ipsilateral femur adduction during functional movements of the knee when flexing. Dynamic valgus is probably related to strength, coordination, ability, anatomical alignment, and arthrokinematic function.
The gluteus medius is an important abductor of the hip joint and the greater the hip flexion, the greater the activation of this muscle, while the gluteus maximus has primary function in the hip extension and is also an important lateral rotator. The strengthening of the maximal and medium gluteus leads to a decrease of the excess of dynamic valgus being of extreme importance in the treatment of patellofemoral dysfunction
METHODS: Twenty-three male volunteers, amateur footballers at competitive level, aged between 19 and 43 years, were evaluated.
Dynamic valgus evaluation was performed by positioning styrofoam markers fixed with double-sided tape, lateral malleoli, tibial tuberosity and anterior superior iliac spine. The subjects were instructed to climb on a raised platform 20 centimeters high, performing tests prior to the exercise learning exam. After the preparation phase, they were instructed to perform 10 consecutive repetitions of the step of descending the step in unipodal support without removing the calcaneus in the limb that reported patellofemoral pain. The tests were filmed by a digital still camera at a distance of 1.20 meters.
The electromyographic evaluation was performed using electromyographic Myotool, 4 channels, positioned in the gluteus maximus muscle.
The images were analyzed by biophotogrammetry, through SAPO software.
After the first collection, the subjects underwent exercises to strengthen the gluteus medius, using exercises with knee flexion in closed kinetic chain simultaneously performing abduction of the hip in isometry, which occurred by an elastic band where the contraction was maintained.
After 4 weeks of treatment performed 3x per week, the second evaluation was performed.
RESULTS: There was a statistically significant difference between the previous and post treatment for both dynamic valgus degrees as well as for the activation of the contraction of the gluteus maximus and maximal muscle
CONCLUSION: knee flexion exercises in closed kinetic chain with the aid of resistance to abduction promoted an increase in muscle strength the activation of the mean and maximum gluteus musculature, decreasing the dynamic valgus. This study by itself does not close the case, and further studies are needed on the subject

MUSCLE ACTIVATION IN A 10-YEAR-OLD BOY DURING THE ASYMMETRICAL TONIC NECK REFLEX

REILLY, E., RUSSELL, A., HIGGINBOTHAM, T., WILLIFORD, H., SCHAEFER, G.

AUBURN UNIVERSITY AT MONTGOMERY

INTRODUCTION: Children are born with a set of primitive reflexes to assist them as they progress through normal development from birth to around age 1. After age 1, these reflexes are integrated into the brain as children engage in physical movement and play, and should not still be evident. When primitive reflexes are retained beyond this point, children can experience difficulties with coordination, learning, behavior, and physical and emotional development. The asymmetrical tonic neck reflex (ATNR) is a primitive reflex initiated when the head turns to the side, causing the arm on the side of the body the head is turned toward to extend, and the arm on the other side of the body to flex. Although research has found an association between a retained ATNR and conditions such as dyslexia, attention deficit hyperactivity disorder, and autism spectrum disorder, less is known about the muscle activation that occurs during the reflex. Therefore, the purpose of this study was to assess the muscle activation of the biceps and triceps during the ATNR.
METHODS: Muscle activation of the left and right biceps and triceps of a 10-year-old boy with retained left and right ATNR's was measured using surface electromyography (EMG). The boy maintained a quadruped position on his hands and knees and a neutral cervical spine position while a researcher turned his head to the right and then to the left to elicit the ATNR on each side. Maximal voluntary contractions (MVC) of the boy's right and left biceps and triceps were also obtained. EMG values were recorded as the root mean square of the raw signal and analyzed using Acqknowledge 4.2 software (BIOPAC, Goleta, CA). Muscle activation for each muscle recorded was compared to that muscle's MVC value and reported as a percentage of MVC (%MVC). EMG values were recorded for the left arm during the right ATNR and for the right arm during the left ATNR.
RESULTS: During the right ATNR, the left biceps activation was 9.625 %MVC while the left triceps activation was 38.437 %MVC. During the left ATNR, the right biceps activation was 11.265 %MVC while the right triceps activation was 22.139 %MVC.
CONCLUSION: Although flexion of the elbow in the quadruped position is normally achieved by eccentric activation of the triceps, eliciting the ATNR reflex resulted in muscle activation of both the biceps and triceps of the arm that flexed. Antagonist muscle activation during the ATNR may help explain some of the difficulties in coordination experienced by children with this retained reflex. Further study with a larger number of children with retained ATNR's is warranted to determine the muscle activation profile of these children during the ATNR.

CHARACTERISTICS OF GENERAL JOINT LAXITY OF HIGH-SCHOOL COMPETITIVE SWIMMERS

KURIKI, A.1, KOKUBU, H.2, KOGA, T.3, EGO, K.4

1: CHIKUSHI JOGAKUEN UNIVERSITY, 2: TECHNICAL SCHOOL OF MEDICAL AND WELFARE RYOKUSEIKAN, 3: SAKAEMACHI ORTHOPEDIC CLINIC, 4: OMUTA CITY HOSPITAL

INTRODUCTION: Competitive swimmers have high joint flexibility, and the incidence of genu recurvatum is reported to be high (Kuriki et al., 2011). Although the joint laxity is a congenital physical characteristic and thought not to change, it may change under the influence of the muscle-tendon complex. Evaluation of joint laxity is widely used in physical examination, and relationships with sports injuries have

been reported. However, considering the possibility of acquired changes, a comprehensive understanding of the physical characteristics of swimmers is needed. Therefore, we investigated the characteristics of general joint laxity (GJL) of high-school student swimmers.
METHODS: Eighty-seven high-school student swimmers (44 boys and 43 girls) participated. A questionnaire was used to survey the years of experience and previous injuries, and Tokyo University's GJL test (Nakajima et al., 1984) was conducted. The GJL test uses a 7-point scale and requires the performance of 7 manoeuvres for wrist, elbow, shoulder, ankle, knee, hip and spine. The GJL score was calculated by adding 1 point (0.5 points on each side) on the positive side. A score of >4 indicates hypermobility.
The t test was used to compare gender differences. The chi-square test was used to analyse the association between the positive rates of each joint. To analyse the relationship between the score of each joint and the GJL score, the scores excluding the score of each joint from GJL score of the positive and negative groups was calculated and examined using the t test and effect sizes.
RESULTS: The GJL score was 3.5 ± 1.2 for the boys and 3.6 ± 1.5 for the girls, with no statistically significant difference ($p = .629$).
In both the boys and girls, wrist, shoulder, knee and spine had positive rates for GJL scores exceeding 50%. In the boys, the positive rates of right-shoulder and spine were high ($p < .001$). In the girls, the positive rates of left-wrist, right-shoulder and spine were high ($p < .001$). In the girls' ankle, the score of the positive group was significantly higher than the score of the negative group ($p < .05$, $d = .87$).
CONCLUSION: Swimmers GJL scores tended to be higher than other athletes (Narita et al., 2002). The GJL score is influenced by gender, and females are reported to have higher scores than males (Quatman CE et al., 2008); however, there was no gender-related difference among swimmers. The characteristics of swimming performance may have a greater influence than genetic factors.
Comparison of the scores between the positive and negative groups indicated that the girls' ankle suggested the GJL score. This means that if this joint shows positivity, the other joints are also likely to show high laxity. Especially the examination of ankle strongly suggests laxity of other joints and would be useful as a screening for GJL in the girls.
For effective physical examination, each joint should be evaluated in more detail according to these physical characteristics.

EFFECT OF VIBRATION FOAM ROLLING FOR DELAYED-ONSET MUSCLE SORENESS AND ATHLETIC PERFORMANCE

LIU, C.M., OU, S.C.

CHANG JUNG CHRISTIAN UNIVERSITY

INTRODUCTION: Lots of evidence shows that foam rolling can improve range of motion, flexibility, and performance in addition to reducing muscle soreness, pain, and recovery time after workouts. Besides, Vibration technology is also a proven tool of rehabilitation and therapy for sports. Vibration foam roller has become of increasingly common practice for treating soft-tissue restrictions which allows the user to apply vibration directly to a muscle group while also receiving the many benefits of compression and self-myofascial release. However, there's not much research behind this new take on the recovery tool. Therefore, the aim of this study was to explore the effects of the vibration foam rolling on delayed-onset muscle soreness and dynamic performance measures.
METHODS: Twenty-four college male subjects, involving 10 sets of 10 repetitions of back squats at 60% of their 1-repetition maximum, all participants were randomly assigned into vibration foam rolling (n = 8), foam rolling (n = 8), control (n = 8) groups. On Days 0-4, the creatine kinase (CK), lactate dehydrogenase (LDH), range of motion (ROM), visual analog scale (VAS), power, speed, agility and dynamic strength-endurance of all participants, including control subjects were measured. In this study, two-way mixed-design analysis of variance were employed for the statistical analysis. A LSD Post Hoc test was performed to the test for significant differences between interactions. An α level of .05 was used to indicate statistical significance.
RESULTS: After exercise triggered DOMS, the results showed that there were no significant differences within groups on all variables in this study ($p > .05$), but time factor showed substantial significant differences between pre-exercise and post-24 or post-48 after exercise on CK, ROM, VAS, speed, dynamic strength-endurance, respiratory ($p < .05$). According to the results in this study, exercise not only trigger DOMS, but also induced muscle damage. The foam rolling massage or vibration foam rolling cannot relief dynamic performance measures (power, speed, agility and dynamic strength-endurance) and the injury in muscles or connective tissue from exercise-induced muscle damage.
CONCLUSION: Even if the studies showed that foam rolling reduced subjects pain level while enhanced recover after DOMS (MacDonald et al., 2014; Pearcey et al., 2015). But there is no evidence explore how worse muscle damage is after trigger DOMS by intense exercise. This study approves that the foam rolling and vibration foam rolling can't relief DOMS and muscle damage after intense exercises. It seemed that the damaged muscle tissue or connective tissue could not sustain the pressure caused by the rolling massage or vibration directly. However, applying how much pressure on damaged muscle tissue would hinder the muscle tissue and connective tissue from recovering still needs further research to reveal.

CORTICOMOTOR EXCITABILITY ALTERATION OF QUADRICEPS AND HAMSTRING AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

FAN, T.

NATIONAL TAIWAN UNIVERSITY

INTRODUCTION: Short term or long term adaptations in spinal circuits and brain cortex following anterior cruciate ligament reconstruction (ACLR) is demonstrated, resulting the persisted muscle weakness, muscle activation deficit, poor proprioception and decrease activity level. Diminished corticomotor excitability of quadriceps and hamstrings may associate with impaired physical function, especially agility performance. Previous studies of cortical are focus on the corticospinal excitability of quadriceps muscle, but it is important to evaluate the corticospinal excitability of hamstrings muscle owing to the surgery method. Therefore, the purpose of this study was to evaluate the corticospinal excitability, muscle strength and functional activities in anterior cruciate ligament reconstruction patients.
METHODS: Sixteen male individuals (age = 27.19 ± 3.54 years, mass = 76.86 ± 13.05 kg, time postsurgery = 36.06 ± 29.48 months) who had undergone unilateral, primary ACLR using a hamstrings autograft at least 6 months before the study, and fully returned to pre-injury activity level were recruited. Corticomotor excitability of vastus medialis and hamstrings were quantified via active motor threshold (AMT) by transcranial magnetic stimulation (TMS). Maximum knee extensor and flexor isokinetic strength in 60°/s, one-leg hop, and t-run agility test were measured. Isokinetic strength was normalized by body weight (Nm/kg), one-leg hop was calculated by asymmetry index (between limb differences/construction limb*100%).
RESULTS: Participants with ACLR exhibited less quadriceps and hamstrings active motor threshold in the reconstructed limb than in the contralateral limb (quadriceps _AMT: 68.31 ± 5.13 vs 64.13 ± 5.14, p=0.02; hamstrings_AMT: 66.25 ± 6.67 vs 61.69 ± 5.31, p<0.01). There were no significant differences in both knee extensor (op side: 2.16 ± 0.58 vs control side: 2.43 ± 0.51, p=0.06) and flexor (op side: 1.03 ± 0.21 vs control side: 1.04 ± 0.13, p=0.84) isokinetic strength between limbs. Quadriceps active motor threshold in reconstruction limb was moderate associate with quadriceps_AMT in control limb(r=0.64, p=0.008) and hamstrings_AMT in both limb (reconstruction limb:

r=0.74, p=0.001; control limb: r=0.83, p<0.001). Knee flexor isokinetic strength in reconstruction limb was associated with one-leg hop(r=-0.51, p=0.045) and t-run test(r=-0.58, p=0.019).
CONCLUSION: Higher active motor threshold in both quadriceps and hamstrings muscle of involved leg demonstrated long-term neuromuscular deficits in our ACLR participants. In addition, decreased knee flexor isokinetic strength was associated with poor functional performance. Rehabilitation strategies for corticomotor excitability and knee flexor muscle strength may help improve postoperative outcomes.

ASSESSMENT OF EXERCISE TOLERANCE AND FUNCTION OF THE LOWER LIMBS OF PATIENTS AFTER CABG SUBJECTED TO CARDIAC REHABILITATION

SKOMUDEK, A., WAZ, G., ROZEK-PIECHURA, K.

OPOLE UNIVERSITY OF TECHNOLOGY

INTRODUCTION: Comprehensive cardiac rehabilitation following coronary artery bypass grafting (CABG) can critically impact patient health outcomes including cardiorespiratory function, exercise tolerance, and quality of life. The aim of the study was to assess the exercise tolerance of patients after CABG subjected to the second stage of cardiac rehabilitation.
METHODS: A clinically relevant sample of 47 male CABG patients (aged 59.8 ± 6.80 years) was selected and assessed pre-CR, and post-CR. Body composition analysis was performed by bioimpedance (Tanita BC 418 MA) to obtain body weight, BMI, FAT%, FAT MASS, FFM and TBW. The next analysis was exercise test was carried out according to the modified Ramp protocol (resting HR, exercise HR, MET, Borg scale). Lower limb function (ankle dorsiflexion/plantarflexion) was assessed by isokinetic testing (Biodex Multi Joint 4) to determine peak torque, peak torque relative to body weight, total work, and average power.
Funding for this study was obtained from the National Science Center grant no. UMO-2013/09/N/NZ7/03650 and registration ANZCTR: ACTRN12615000983505. The study protocol was approved by the Senate Ethics Committee for Scientific Research of the University of Physical Education in Wroclaw, Poland (March 27, 2013). They were recruited from October 2012 to April 2016.
RESULTS: Comparing the somatic parameters, a significant reduction in body weight and BMI after the use of rehabilitation was demonstrated (p≤0.0104). In the exercise test, there was a significant increase in MET after rehabilitation. There was no significant difference in resting, exercise and Brain scales before and after rehabilitation in the study group. In isokinetic studies, a significant increase was observed after the use of rehabilitation in the operated limb in the majority of the examined parameters assessing the function of dorsal and plantar flexors both at 60o / s and 120o / s.
CONCLUSION: 1. Before the beginning of rehabilitation, the subjects were characterized by an average level of exercise tolerance and after the 3-week improvement process there was a significant increase in exercise tolerance, which also oscillated at the level of the average level.
2. The assessment of somatic parameters in the examined group showed the effectiveness of the early-follow-up model, which was manifested by a significant reduction in body weight and BMI.
3. All assessed strength-speed parameters of the operated lower limb increased significantly after the use of three-week long-term cardiological rehabilitation.
4. A significant correlation between exercise tolerance (MET) and percentage of adipose tissue, fat mass, percentage of adipose tissue in relation to the limb and gross work of dorsiflexes at 120o / s was demonstrated.

EMG ANALYSIS OF THE FLATFOOT WITH AND WITHOUT ARCH-SUPPORT INSOLE DURING UPHILL WALKING

PENG, H.T., HUANG, Y.P.

CHINESE CULTURE UNIVERSITY

INTRODUCTION: Previous researches indicated that uphill walking with a constant speed can improve the symmetry and cardiovascular condition of body (Globas et al., 2012; Werner et al., 2007). However, people with flatfoot cannot practice the prolonged walking and they will demonstrate over foot-pronation inducing the fatigue of the lower-extremity (Panichawit et al., 2015). The assistive devices such as arch-support insoles could be helpful for people with flatfoot who want to engage a prolonged exercise. A normal foot-arch can make the foot like a spring for absorption or propulsion. The purpose of this study was to examine the effect of arch-support insoles in lower-extremity muscle fatigue on people with flatfoot during uphill walking. We hypothesize that the arch-support insoles can reduce the fatigue of lower-extremity muscles.
METHODS: Fifteen male college students with flatfoot were voluntarily to be the subjects. A Delsys wireless electromyography (EMG) system was used to collect EMG data of rectus femoris (RF), tibialis anterior (TA), bicep femoris (BF) and gastrocnemius (GAS) muscles at 2000Hz. Subjects were instructed to walk on a treadmill with the inclination of 9 degree and speed of 0.75 m/s (2.7 km/h) (Haight et al., 2014) for six minutes (Sparks & Hilton, 2015) to mimic uphill walking and randomly wear insoles with and without arch-support. The power spectral density (PSD) was used to analyze the EMG data for the none-fatigue and fatigue which were the first and last minute during uphill walking, respectively. Hanning window type and 0.5 second window length with 75% overlap (Clancy et al., 2005) were used for the power spectrum. The area under the power spectrum of 15-45 Hz was calculated and the larger area under the power spectrum of the lower frequency indicated the muscle was more fatigue (Allison & Fujiwara, 2002). A repeated-measures 2×2 two-way ANOVA (with and without arch-support insole × none-fatigue and fatigue) was used to examine the difference. The level of significance was set at $\alpha = .05$.
RESULTS: The results showed that there was interaction found in GAS. The simple main effect showed that the area of GAS without arch-support insoles was significant lager than that with arch-support insoles. The main effect showed that the area of TA in fatigue was significant larger than that in none-fatigue.
CONCLUSION: Wearing arch-support insoles can reduce the gastrocnemius muscle fatigue on the college students with flatfoot.

CHANGES IN ACTIVATION OF SERRATUS ANTERIOR, TRAPEZIUS AND LATISSIMUS DORSI WITH SLOUCHED POSTURE

LEE, S.T., MOON, J.K., LEE, S.H., MIN, K.

CHA BUNDANG MEDICAL CENTER, CHA UNIVERSITY

INTRODUCTION: To compare quantitative muscle activation between erect and slouched sitting postures in the muscles around the scapula, and to investigate the correlation between the angle of thoracic kyphosis and the alteration of muscle activity depending on two different sitting postures.

METHODS: Ten healthy males participated in the study. Unilateral surface electromyography (SEMG) was performed for serratus anterior, middle trapezius (MT), and lower trapezius (LT), which are scapular stabilizer muscles, as well as latissimus dorsi. Participants elevated their shoulders for 3 seconds up to 90 degrees abduction in the scapular plane, tilting 30 degrees anterior in the coronal plane. They were told to hold the position for 10 seconds and voluntary isometric contractions were recorded by SEMG. These movement procedures were conducted for three times each for erect and slouched sitting postures and data were averaged.
RESULTS: Activities of MT and LT increased significantly more in the slouched sitting posture than in the erect one. There was no significant correlation between kyphotic angle and the area under curve of each muscle.
CONCLUSION: Because MT and LT are known as prime movers of scapular rotation, the findings of this study support the notion that slouched sitting posture affects scapular movement. Such scapular dyskinesis during arm elevation leads to scapular stabilizers becoming overactive, and is relevant to muscle fatigue. Thus, slouched sitting posture could be one of the risk factors involved in musculoskeletal pain around scapulae.

EFFECT OF POWER ASSIST SUIT ON THE MECHANICAL AND PSYCHOLOGICAL STRESS OF LOW BACK PAIN DURING STOOP LIFTING WITH A HEAVY LOAD

TAKAYOSHI, Y.

UNIVERSITY OF FUKUI

INTRODUCTION: Low back pain is a work-related injury that accounts for 60% of all occupational diseases with a 4-day absence from work. Factors such as a high physical burden, unprepared movement, and maintaining static work for a prolonged duration; environmental factors, such as floor condition, vibration, and cold; and personal factors, such as physique, age, and muscle strength, proliferate the risk of low back pain. Because a power assist suit, which is designed to decrease the burden on low back during the loading and unloading of heavy load, decreases the high physical burden upon lifting a heavy load, the prevention of low back pain is anticipated. This study aimed to assess the effect of the power assist suit on the mechanical and psychological stress of low back pain during stoop lifting with a heavy load.
METHODS: We enrolled 15 healthy males (age, 22.4 ± 4.9 years) after obtaining informed consent from them. All participants were asked to lift a heavy load, which was equivalent to each participant's body mass (0%, 20%, and 40%), in the posture with extending back and knee joint and 90° flexing hip joint. We evaluated the mechanical stress of low back pain from the beginning of the lifting of heavy load to the completion using the peak and mean torque of the low back joint. In addition, we evaluated the psychological stress of low back pain with the lifting of heavy load using the visual analogue scale. Furthermore, the effect of the power assist suit and the difference among heavy loads for the mechanical and psychological stress of the low back joint were assessed using paired two-way analysis of variance. Furthermore, Tukey's honest significant difference (HSD) was conducted for the post-hoc analysis. Statistical significance was set at $P < 0.05$.
RESULTS: During the lifting of all heavy loads, low back joint torques significantly decreased with the power assist suit. In contrast, during the lifting of heavy load without the power assist suit, the low back joint torque linearly increased with an increase in the heaviness, whereas it remained constant with the power assist suit. In addition, the psychological stress during the lifting of all heavy loads with the power assist suit was significantly lower than that without the suit.
CONCLUSION: Thus, our study suggests that the mechanical and psychological stress of low back during stoop lifting with heavy load are significantly decreased using the power assist suit.

Sociology

EQ-INDEX AND SF12 MORE THAN EQ-VAS CORRELATES WITH PHYSICAL FUNCTION IN OLDER ADULTS

MONTEAGUDO, P.1, CORDELLAT, A.1, ROLDÁN, A.1, GÓMEZ-CABRERA, M.C.2, BLASCO-LAFARGA, C.1

UNIVERSITY OF VALENCIA, SPAIN

INTRODUCTION: Quality of life (QoL) measures such as the Euroqol-5Dimensions-5Levels "EQ" (Herdman et al., 2011) and the Short Form 12-item Health Survey Questionnaire "SF-12" (Ware, Kosinski, & Keller, 1996) are important tools to analyze the impact of elderly care interventions such as physical exercise programs. Also the ability to walk for a distance is an important component of QoL in older adults (OA) (Lord & Menz, 2002), as well as a quick and inexpensive measure of physical function (PF). This study aims to analyze the association among these traditional QoL indexes, with special attention to their relationship with this PF, in a population of OA.
METHODS: 53 healthy OA (71.02±4.45 years; 75.29±14.00 kg; 27 women and 26 men) participated in the study. Two questionnaires were provided for QoL assessment. EQ consists of 5 domains: mobility, selfcare, usual activities, pain and anxiety, which score from 1 (no problem at all) to 5 (extreme problems). The final EQ-index ranges between 0-1, and a single question about self-rated overall health (EQ-VAS) is posed (score 0-100). The 12 items in the SF-12 are summarized as the physical component summary (PCS) and the mental component summary (MCS). Finally walking ability (PF) was measured by the 6-minutes-walking-test (Rikli & Jones, 2001). Further correlation analysis (Spearman) were performed, considering: r=-0.1-0.3 small; r=0.3-0.5 means; r=>0.5 large (Cohen, 1988).
RESULTS: Significant positive correlations were found between PF and EQ-index ($r=0.44$, $p<0.01$); PF and PCS ($r=0.48$, $p<0.01$); PF and MCS ($r=0.35$, $p<0.01$); EQ-index and EQ-VAS ($r=0.43$, $p<0.01$); EQ-index and PCS ($r=0.66$, $p<0.01$); EQ-index and MCS ($r=0.47$, $p<0.01$); EQ-VAS and PCS ($r=0.33$, $p<0.05$); EQ-VAS and MCS ($r=0.38$, $p<0.01$); PCS and MCS ($r=0.73$, $p<0.01$). However, no correlations were found between PF and EQ-VAS ($p>0.05$).
CONCLUSION: Our results confirm that both questionnaires can be useful to assess QoL. EQ-index seems to explain better the physical and psychological function, whilst EQ-VAS might be explaining other influential factors in the QoL. The non- correlation between PF and EQ-VAS also reaffirms that QoL and health status constructs are not the same (Zangão, Mendes, & Braga, 2016).

GENDER DIFFERENCES IN LEISURE-TIME PHYSICAL ACTIVITY, EXERCISE MOTIVES AND LOCUS OF CAUSALITY IN EXERCISE IN UNIVERSITY OF ZAGREB STUDENTS

BABIC, J.

UNIVERSITY OF APPLIED HEALTH SCIENCES

Introduction: Influencing physical activity (PA) level should be public health system priority and by identifying and understanding individual variables, together with social, cultural and environmental factors that are potentially connected to PA level, is basis for developing suc-

cessful interventions (Burgos-Garrido et al., 2011). Aim of this research is to determine whether there is gender differences in leisure-time physical activity, exercise motives, locus of causality in exercise in University of Zagreb students.
Methods: Participants were 570 University of Zagreb students (329 female, 241 male), average age 19,94 years. Croatian version of IPAQ (Pedisic et al., 2011) which measures adult PA, Croatian version of EMI-2 (Vlasic et al., 2002) which measure 14 exercise motives, and The Locus of Causality for Exercise Scale (Markland and Hardy, 1997), which consists of 3 items that assess the extent to which individuals feel that they choose to exercise rather than feeling that they have to for some reason, were used.
Results: Male students were more physically active during their leisure time than females and were more motivated for exercise by group of psychological motives (enjoyment, affiliation, challenge), social motives (social recognition, health pressures, competition) and by strength/endurance motives, while female students were more motivated by group of health related motives (ill-health avoidance, positive health, nimbleness, appearance, weight management). Also, male students have more internal perceived locus of causality.
Discussion: Understanding students gender differences regarding their leisure-time PA level and specially their motives behind it is really important when it comes to planning and creating intervention programs that aim to increase student population PA.
Conclusion
Male students are significantly more physically active then female students, have more internal perceived locus of causality, and are more motivated for exercise by psychological, social and stength/endurance motives, while female students are more motivated by health related motives.
References: Burgos-Garrido, E, Gurpegui, M, Jurado, D. (2011). Personality traits and adherence to physical activity in patients attending a primary health centre. IJCHP, 11(3), 539-547.
Markland, D, Hardy, L. (1997). On the Factorial and Construct Validity of the Intrinsic Motivation Inventory: Conceptual and Operational Concerns. Res Q Exerc Sport; 68(1), 20-32.
Pedisic, Z, Jurakic, D, Rakovac, M, Hodak, D, Dizdar, D. (2011). Reliability of the Croatian Long Version of the IPAQ. Kinesiology, 43(2), 185-191.
Vlasic, J, Baric, R, Oreb, G., Kasovic, M. (2002). Exercise motives in middle-aged and eldery female population. Proceedings of the 3rd Internetional scientific conference Kinesiology-new perspectives, 462-466.

ONLINE SPORTS CULTURE: A CASE STUDY OF JAPANESE SPORTS FAN BLOG

OHHASHI, M.
KURUME UNIVERSITY

The scientific significance of the recent Internet information on sports is generally acknowledged by several scholars (Leonard, 2007; Wilson, 2007; Scherer and Jackson, 2008, Milling and Darnell, 2014). In particular, contemporary journalists have much higher chances of gathering information from blogs to write their articles (Farrell and Drezner, 2008). However, Millington and Wilson (2010) point out how "internet-based projects routinely fail to examine the confluence of "virtual" and "real" consumer/user experience". It was widely believed that blog posts were "wall graffiti." Although a large number of Japanese sport researchers have explored the contexts of sport in mass media, little is known about sport in Japanese online media. Also, few studies have examined Japanese online media contents such as blogs in relation to sports disciplines. Bloggers can always post if they connect to the Internet; at the same time, they always pay attention to readers' feedback (Nardi, 2004). This study presents the results of a preliminary exploration of the role of one of the biggest Japanese sports fan blogs, Sportsnavi Plus, in the coverage of one of the biggest sports events in Japan, the Tournament of Japanese High School Baseball (TJHB). In order to outline the characteristics of Sportsnavi Plus, this research tried to answer to the following research questions: (1) Who posts on Sportsnavi Plus? (2) What kind of content is posted? and (3) Are there any differences in the characteristics of the blog posts of the last 10 years? The answers to these questions contribute to describing the online Japanese sports culture, which includes bloggers articles and/or communications. The study analyzed data from Sportsnavi Plus blog posts about TJHB, posted during the month of August each year from 2006 to 2016, as August almost fully coincided with the period of the tournament. Content analysis was employed to analyze the collected data; therefore, it was possible to generalize the features of Japanese sports fan blogs. The bloggers were divided into three main categories: sports journalists, sports magazine editors, and baseball fans. Results show that, although a large part of blog posts dealt with the results of recent games, in the most recent years, the number of posts that analyzed each game in detail increased in comparison with the number of posts that were based on subjective impressions of the bloggers. In conclusion, this study suggests a tendency in Japanese sports fan blogs, which are increasingly becoming a more objective source of information.

DO SPORT JOURNALISTS HAVE COMPETENCE PROBLEMS AND KNOWLEDGE DEFICITS IN THE FIELD OF DOPING IN ORDER TO BE ABLE TO ADEQUATELY REPORT ON THEM?

SCHULZ, T.1, KAUTZ, F.2, SCHAFFRATH, M.2
TECHNISCHE UNIVERSITÄT MÜNCHEN

Introduction: Doping is one of the biggest negative side effects of elite sports. Media have a significant impact on public opinion on doping and attitudes. The way sport journalists report on the issue of doping is repeatedly the focus of criticism of affected athletes, coaches or external observers, as well as the professionals themselves. To what extent sport journalists can even adequately report on doping has not been investigated yet. Therefore, the study deals with the knowledge of sport journalists in Germany on doping and doping reporting.
Methods: To this end, an online survey was conducted among the members of the "Association of German Sports Journalists" (VDS) and the sports network. Of the 3,170 sport journalists who were contacted, 850 took part in the survey. The response rate was 26.8 percent and is very high for journalists. Based on the characteristics "gender" and "age", the study is representative for sport journalists in Germany. The questionnaire included 38 questions with a total of 122 items. 5 questions deal with the topic "education and training", 5 questions with "knowledge and expertise", 13 questions with "opinions and attitudes", 4 questions with the "NADA" as well as 10 questions with the demography, the intensity of the doping employment and the research methods. From the knowledge questions with 13 items a knowledge score was formed. The adjusted data sets were evaluated using descriptive and inferential statistical methods: group differences by means of one-factor ANOVA and correlations.
Results: Sport journalists assess doping reporting as more "superficial", more "person-oriented" and tend to be "prejudiced". The opinion of many respondents regarding the issue of doping is increasingly not "competent" or "adequately trained". Related to "medical", "physiological" and "sports law" aspects and the knowledge of the official definition of doping, only 30 percent state a good or very good knowledge. Deficits are also evident in the knowledge score: 14 percent of sport journalists have a high level of knowledge, 56.3 percent of respondents have a "middle" knowledge, 28.5 percent have a "low level" knowledge and 1.5 percent have "no" knowledge about

doping. Correlation analysis show that deficits in knowledge are significantly related to "reporting intensity", "formal education" or "attending training events on doping".
Conclusion
"Many-publishers" on doping issues know more than sport journalists who publish little or nothing on that topic. Since the sport journalists already admit competence problems and also feel badly educated, further education especially in the field of "sports physiology, sports medicine and sports law" is necessary. This is also the task of sports science institutions.
Contact: thorsten.schulz@tum.de

MIGRATORY PROCESS OF BRAZILIAN OLYMPIC WOMEN

MELO, G., FERRREIRA JUNIOR, N.S., RUBIO, K.
CATHOLIC UNIVERSITY OF BRASÍLIA

The process of professionalization of sport since the 1980s has radically altered the organization of world sport. In the passage to professionalism the athlete has become the representative of brands and commercial interests in a globalized world. Transformed into a worker in search of the job market he lives from the adolescence a migratory process in search of the best opportunities to develop his abilities. In this process he lives intensely phases of adaptation and losses, besides the acquisition of new values that reorganize his subjectivity. This article aims to present the national and international migrations experienced by the Brazilian Olympic athletes who participated in the Olympic editions until London in 2012. For that, were interviewed 444 athletes, and from these interviews variables were removed that made it possible to describe the migratory event. The results allow us to infer that Olympic athletes come from 24 states plus the Federal District, and that those born in the North, Northeast and Central West regions are the ones who experienced the most intense national migration in search of better training infrastructure. With regard to international migration, Brazilian womens sporting athletes are the ones who go out in search of better professional opportunities and go mainly to Europe. On the other hand, the athletes of individual modalities, depart in search of improvement or for the opportunity to undertake a superior course and the most sought after destination are the United States.

WELLFARE AND WELL-BEEING AMONG IN THE HEALTHCARE PROFFESIONALS WORKING

NAGYVÁRADI, K., MÁTRAI, Z.
EÖTVÖS LORAND UNIVERSITY

Introduction: A great number of research studies in the related international literature on sociology and health sciences deal with the state of health in one selected population. In these research studies the chosen sample is connected with special jobs, often with healthcare professionals and their working conditions. Their starting point is that healthcare professionals" jobs differ very much from other occupations" as they have a heavy workload under huge physical and psychological working conditions
Simple and method
The examined psychiatric institute Results: The methodological outcome of the research is that the case study has satisfyingly demonstrated that the results of health status measurements cannot be considered to be definitely true if they are based on self-assessment only. Furthermore, they are really well, whose mental and physical well being are in relative sync with each other.
Discussion: The direction of further research is basically suggested by the fact that the conclusions in the corresponding literature are based merely on subjective self-assessment. Therefore, it is worth conducting research in which the conclusions are based on the comparison of objective data and subjective indicators.
References: 1. Gray-Toft P, Anderson JG. <1981>: Stress among hospital nursing staff: its causes and effects. Soc Sci Med; 15A: 639–47.
2. Mavaddat N., Parker R.A. et al. <2014>. Relationship of self-rated health with Fatal and Non-Fatal Outcomes in Cardiovascular Disease: A Systematic Review and Meta-Analysis. www.plosone.org. letöltve: 2014.09.30.
3. Nagyváradi K. <2014>. Életminőség vizsgálat egy krónikus pszichiátriai betegeket gondozó intézmény szakdolgozóinak körében.
Contact:
nagyvaradi.katalin@ppk.elte.hu

Sport Management and law

ANALYSIS OF THE INFLUENTIAL FACTORS OF CHINESE PROFESSIONAL FOOTBALL MARKET ORDER STATUS

HOU, H.
MINZU UNIVERSITY OF CHINA

Introduction: After 24 years of development, the overall framework of Chinese professional football market has basically taken shape and achieved some praiseworthy achievements. However, due to the fact that the planned economy and market control coexist during the transitional period of institutional reform, the Chinese professional football market is directly caused by the unreasonable market structure and the irregular market competition. This has become the major obstacle in the development of the Chinese professional football market. Therefore, through the analysis and discussion of the Chinese professional football market order status and influential factors, it provides the basis and guidance for the standard management of the Chinese professional football market order.
Methods: On the basis of interviews with experts, a questionnaire about the influencing factors of Chinese professional football market order was compiled and 15,000 football fans, 800 coaches and athletes and 70 club managers of 29 Chinese professional football teams were investigated. We used the importance exponent= and factor analysis to deal with the original data, which provided an objective basis for analyzing the influencing factors of Chinese professional football market order.
Results: The results show that: firstly, Chinese professional football market is currently in a disorderly structure, an imperfect legal system and disorderly competition. Secondly, judging from a single factor, the existence of match-fixing and black whistles is the most influential factor in Chinese professional football market. From overall view, competition level factor, professional ethics factor, rule of law level factor and service level factor constitute the multi-dimensional structure influencing factor system of Chinese professional football market order.
Discussion: Regardless of single influence factor or overall influence factor, professional football players professional ethics and individual competitive ability are the most important factors, to affect the standard management of Chinese professional football market order. This requires that the Chinese Football Association and clubs should strengthen the professional quality education of professional football players and football practitioners, and at the same time improve the level of scientific training and the competitive ability of professional

football players. In addition, the Chinese Football Association needs to continuously strengthen the system construction and improve the level of legalization management, football clubs should continue to improve service awareness and service level.
References: Hou H. (2012). The Definition and Ideal State of Market Order of Professional Football. Sport Science Research, 31 (5), 64-67.

Sport Statistics and Analyses

THE CHARACTERISTICS OF EFFECTIVE APPROACH RUN FORM OF THE VAULT OF GYMNASTICS

YAMASHITA, R.1, MORII, D.2

1>UNIVERSITY OF KYUSHUKYORITSU 2>JAPAN WOMENS COLLEGE OF PHYSICAL EDUCATION

INTRODUCTION: In general, maximum speed during gymnastics vault run is approximately 8 m/s and at least 10 m/s is required to perform double salto during second flight (Čuk and Karácsony,2004).In recent years, vaulting techniques has developed drastically that an examination of effective running techniques during gymnastics vault run is necessary.
The purpose of this study was to elucidate the characteristics of effective gymnastics vault run to enable fast running speed by analysing gymnastics vault run of the world top gymnasts from a morphological viewpoint.
METHODS: Vault finalists from the world championships and Olympics between 2008 and 2017 were analysed.Gymnasts were divided into group (G) 1 (performed two types of double salto in 2nd flight, N = 12), G2 (performed one type of double salto in 2nd flight, N = 12) and G3 (did not performed double salto in 2nd flight, N = 11). Four to six steps before take-off were analysed by a university lecturer who is specialised in sprinting in athletics. The criteria for effective kicking movement was that a leg lands the floor with a small knee joint angle and a low centre of gravity (Tanigawa et al,2009). The criteria for assessing arm movement was: an angle of the arm swing when seen from the side; an elbow joint angle; an angle of cross arm swings; direction of arm swings (parallel or cross).
RESULTS: Effective kicking movements were performed by 97.1% of gymnasts. The forward arm swing angle which was seen from the side was around 45°in all gymnasts.On the other hand, angle of backward arm swing was different between the groups.A smaller backward arm swing compared to forward arm swing was demonstrated by 75.0%, 25.0% and 27.3% of gymnasts in G1, G2 and G3, respectively.
CONCLUSION: Top-level gymnasts in recent years showed large arm swings which were similar to sprinters in athletics and only a small number of performers demonstrated small arm swings to maintain balance during gymnastics vault run.This adjustment was probably caused by an increase in vault width from 30cm to 95cm which provides a greater number of choices to gymnasts to place their hands on the vault for push-off actions. A rationale for cross arm swings during gymnastics vault run is possibly the body shape of male senior gymnast as their shoulder blade tend to show abduction at resting position. It is difficult to perform parallel arms swings when shoulder blades are abducted and cross arm swings naturally occur. Greater the cross swings, greater the torsion of the body when large back swing is performed and that reduces leg speed.If cross-swing is unavoidable, the gymnasts should take smaller back swings which would probably raise running speed during gymnastics vault run.
Many opinions supported the necessity of improvement in gymnasts arm swing techniques. However, it was suggested that the running speed during gymnastics vault run can be raised by cross-swing and small back-swing even if gymnasts shoulder blades are naturally abducted.

SOMATOTYPES OF ELITE JUNIOR SAMBO ATHLETES FROM DIFFERENT WEIGHT CATEGORIES

DRID, P.1, TABAKOV, S.2, ELISEEV, S.2, AL FAZAZI, S.3, TRIVIC, T.1, OSTOJIC, S.M.1

1 UNIVERSITY OF NOVI SAD, SERBIA; 2 RUSSIAN STATE UNIVERSITY OF PHYSICAL EDUCATION, SPORTS AND TOURISM, MOSCOW, RUSSIA; 3 UNIVERSITY OF GRANADA, SPAIN

INTRODUCTION: Sambo is a relatively novel international martial art founded back in 1930's. It is mainly characterized by specific throws, holds, arm and leg locks, with successful performance in sambo seems to depend on specific technique and tactical skills along with optimal physical fitness (Drid et al., 2017). During a high-intensity action in sambo the opponents are trying to throw each other predominantly on the back or to control the opponent during the ground phase (Drid et al., 2015; Drid et al., 2017). The aim of the present study was to determine the somatotype and anthropometric profiles of elite junior sambo athletes comparing by weight categories.
METHODS: A total of 144 elite junior sambo athletes from 34 countries participants of the World Youth and Junior Championship (12 october - 16 october 2017, Novi Sad, Serbia) participated in the study (50 females and 94 males from 10 weight categories). Anthropometrical variables were taken in order to calculate somatotypes and body fat percentage. The 1 way ANOVA test showed significant differences by weight categories for all anthropometrical variables in both males and females. The 2 way ANOVA analysis showed significant effects of sex and weight category, without a statistically significant interaction between both variables. The Fischer's LSD method was used for post hoc analysis.
RESULTS: Results of this study suggests specific somatotypes for each weight category in elite junior sambo athletes. Lightweight sambo athletes are mesomorphic and ectomorphic, with an increase in the dominance of mesomorphic and endomorphic components in heavier weight categories. Sambo athletes from heavier categories had also a higher body mass index, body fat percentage, and height than sambo athletes from lighter categories.
CONCLUSION: This study highlights the importance of distinguishing between categories during the training and selection processes, since sambo athletes have a specific body composition in function of the weight category in which they compete. In addition, future research should attend to these differences to generate appropiated conclusions about the role of anthropometric characteristics in sambo.

Sport Technology

A THREE COMPONENT APPROACH TO SUPPORT TEAM HANDBALL COACHES

SCHWENKREIS, F.

BADEN-WUERTTEMBERG COOPERATIVE STATE UNIVERSITY STUTTGART

INTRODUCTION: Today, not much information is automatically collected in team handball. However, team handball coaches have a need for information to base decisions on during a match as well for addressing weak points of teams and players during training. While some information is collected by scouts e.g. collecting on behalf of betting service providers, like sportradar, in the German professional leagues of mens team handball, lower leagues as well as womens team handball cannot benefit from such a service. Furthermore,

todays manual collection of information is error prone due to the limitations of human scouters given the volume and complexity of events as well as due to the non-handball-specific application that is used to collect the data.
METHODS: Definition of a software archicteture and implementation of software components.
RESULTS: To overcome the previously described problems to support coaches during matches, we are following an approach based on three components:
1. The scouting app: A tablet-based app which optimally supports comprehensive manual scouting of team handball matches from the point of view of one team.
2. The coaching app: Introducing a tablet-based app for coaches directly providing information regarding the performance of players as well as of a whole team. Furthermore, the current performance is evaluated based on previously collected data and analysis thereof. This evaluation is used to add indicators to the depiction of the raw values for the coach.
3. The data backend: Technically, the two apps are implemented based on the same backend application that uses a SQL database to store collected data as well as to provide data for visualization by the coaching app.
CONCLUSION: The backend has been designed such, that it can be run on an Android tablet and any other operating system that supports PHP and a SQL database (currently PostgreSQL). Hence, the whole infrastructure that is needed during a match consists of two Android tablets and any kind of WLAN to connect the two allowing the coaching app to access the backend (no Internet connectivity is needed). To avoid any network latency problems, it is advisable to co-locate the scouting app with the backend application on the same tablet. However, the system can also be set up such that both Apps access the backend remotely. For instance, if there is the option to have some IT infrastructure (WLAN and a larger computer for the backend database) permanently installed in the home arena. If sensors are used to automatically collect data, then the sensor systems communicate directly with the backend system - either on the scouting tablet or the centralized systems in the home arena. The backend system then merges the sensor events with the events generated by the scouting app which allows to seamlessly replace the manual information collection by an automated sensor based one.

ACCURACY AND PRECISION OF A WEARABLE INERTIA SENSOR DURING A FREE-WEIGHT BACK SQUAT

KAVALIAUSKAS, M.1, MORRISON, P.A.2, POTTS, N.3

1: EDINBURGH NAPIER UNIVERSITY, 2:ANGLIA RUSKIN UNIVERSITY, SPORT & EXERCISE SCIENCES, 3: SCOTTISH RUGBY

INTRODUCTION: Previous research investigating the validity and reliability of the PUSH™ (PUSH Inc., Toronto, Canada) wearable inertia sensor during a back squat exercise has produced conflicting results (Balsalobre-Fernández et al., 2016; Banyard et al., 2017). Therefore, the aim of this study was two-fold a) examine the error in all variables reported by the PUSH™ in comparison to a criterion method of two Kistler force platforms and 3D motion capture system during the free-weight back squat b) briefly discuss the suitability of the PUSH™ as a training monitoring tool in highly trained participants.
METHODS: Seven Scottish Rugby Union academy players (age 18.8±1.2 years; height 1.84±0.08 m; body mass 96.9±11.7 kg) were recruited. Participants performed a total of 134 free-weight back squat repetitions with a mean weight of 117.5 kg (±14.72) as part of their regular training sessions. All repetitions were simultaneously captured using the PUSH™ and two Kistler force platforms (Kistler Holding AG, Switzerland) synced with a 12 Oqus 300+ camera motion capture system (Qualisys, Sweden) sampling at 500Hz. PUSH™, Qualisys and Kistler data were then imported into Matlab (R2014a, The Mathworks Inc., Natick, MA, USA) for the analysis of six variables: mean and peak concentric velocity (MV and PV), mean and peak concentric vertical ground reaction force (MF and PF), and mean and peak concentric power (MP and PP). The accuracy and precision of the PUSH™ system were assessed in two ways. Bland-Altman plots were created for each variable for visual inspection. Then MANOVA and subsequent univariate tests were used to assess the difference between the systems. If a significant difference existed, then bias-corrected root mean square error (RMSE) was reported for that variable.
RESULTS: From the MANOVA there was a significant difference between the systems, $F(6,127) = 904.9$, $p<0.05$, partial $\eta 2 = 0.98$. The subsequent univariate tests also showed a significant difference between PUSH™ and Qualisys/Kistler for all six variables. MV and PV measured by the PUSH™ were underestimated by 0.01 m/s and 0.23 m/s, respectively. PUSH™ also underestimated MP by 219 W and PP by 554 W. In contrast, PUSH™ overestimated MF by 303 N and PF by 206 N. The bias-corrected RMSE were calculated for MV (±0.05 m/s), PV (±0.17 m/s), MF (±83 N), PF (±229 N), MP (±157 W) and PP (±432 N).
CONCLUSION: The accuracy and precision of MV and PV variables show that PUSH™ is unlikely to categorise the movement velocities appropriately. Similarly, high levels of error in MF, PF, MP and PP variables may prevent the PUSH™ from detecting small changes in resistance training adaptations accurately and reliably. This contrasts with previous studies that have suggested that PF (Banyard et al., 2017), MV and PV (Balsalobre-Fernández et al., 2016) in squatting could be measured reliably using the PUSH™. Overall, the PUSH™ band appears to lack the accuracy and precision to be used as a training monitoring tool in highly trained players.

COMPARISON OF DIFFERENT HEART RATE MEASURING METHODS DURING PERFORMANCE DIAGNOSTICS

SCHULZ, S.V.W., ENDERS, K., ROLSER, N., STEINACKER, J.M., LASZLO, R.

ULM UNIVERSITY HOSPITAL

INTRODUCTION: Treadmill ergometer testing with lactate measurement is frequently used in routine performance diagnostics. Here, different methods for heart rate (HR)-determination (ECG-based, heart rate monitor [HRM]) are used whereby little is known concerning their comparability. The aim of the study was to compare different HR measurement methods during performance diagnostics.
METHODS: 76 athletes (28.6 ± 14.7 years, 38% female; Vmax = 14.5 ± 1.9km / h) performed a lactate threshold test (4-2-3) on treadmill ergometer. HR during testing was simultaneously assessed by manual analysis of a 12-lead electrocardiogram (ECG) and a HRM (Polar FT1). ECGs were independently analyzed by two diagnosticians. Concerning potential faulty measurements, HRM values were also evaluated by these physicians. Single measurements were discarded from consecutive creation of heart rate curve of an individual athlete if a measurement was consistently judged as faulty/ artifact. In case of a mismatch, a third physician was consulted for a final decision. Finally, two different HR curves (ECG, HRM) and a lactate curve for each athlete were generated by using Ergonizer® software if ≥4 usable measurement points during exercise were still available after above-mentioned evaluation procedure. Thus, heart rates at different times important for the training control were compared between the two measurement methods.
RESULTS: ECG-based HR detection revealed excellent reproducibility and reliability. Concerning HRM, one or more faulty measurements were detected in 14.5% of all athletes. However, constructions of HR/ lactate curves were still possible in 84.6% of all athletes. HR at different corresponding time points did not differ significantly between HRM and ECG (intraclass correlation coefficient >0.9 and coefficient of variation <5%). In Bland-Altman analysis, mean differences were usually low (3-5 beats). However, limits of agreement were relatively high: ±9 beats at the individual anaerobic threshold, ±18 beats on a regenerative and long jog, ±12 beats on medium endurance run, ±12 beats on speed endurance run and ±13 beats on extensive interval training.

CONCLUSION: Training areas defined by HRs detected by manual ECG evaluation as a gold standard during performance testing may be also used by the athletes for home training control with their own HRM as HRs detected with these two different methods were mostly comparable. If HRM measurements are used for the athlete's final lactate/ HR curves and training recommendations, determined HRs during exercise performance test should be always checked for plausibility and comparability with corresponding ECG measurements by physicians with appropriate expertise due to relevant differences in some athletes.

VALIDATION OF SHOE PADS EMBEDDED WITH TRI-AXIAL ACCELEROMETER IN MONITORING PHYSICAL ACTIVITY

WANG, B., HOU, B., REN, X., ZHAO, D.F., ZHAO, H.Y., YE, J.L., CHEN, Z.X., WANG, C.

SHANGHAI RESEARCH INSTITUTE OF SPORTS SCIENCE

INTRODUCTION: A new type of shoe pads embedded with accelerometer overcomes the challenge of placement issues of movement monitors. However, the accuracies of these pads in monitoring physical activity have not been validated. Therefore, the aim of this study was to validate them in estimating acceleration, steps and energy expenditure during stair climbing, walking, jogging and running.
METHODS: After 2-hour fasting, 20 professional female soccer players (17.4±0.2yrs) rested at standing position for 5 minutes. The lowest heart rate (HR) was recorded as resting HR. Thereafter, they performed 10-min climbing on an elliptical trainer (9.6 km/h) and walking (3.2 km/h) or running at four different speeds on treadmill (6.4, 9.6, 11.2 12.8 km/h). They were asked to rest between each two trials to allow their HR recover to resting level. Energy expenditure (EE) was assessed with a portable indirect calorimetry (IC). GT3X+ devices were worn on waist (GWaist) and both ankles (GAnkles), providing acceleration and steps. The shoe pads (Pads) were placed inside running shoes, providing acceleration, steps, and EE estimation. The Vector Magnitude (VM) sum of each axis of acceleration measured by GT3X+ or Pads was calculated for comparison. All data were collected in 10-second interval for paired t-test analysis.
RESULTS: The intra-individual correlations between VM calculated from GT3X+ and Pads were significant for all subjects (r=0.729-0.996, mean=0.975±0.004). However, Pads VM was significantly higher than GT3X+ VM at all trials, with GAnkles significantly higher than GWaist. Pads VM increased to a greater extent than GT3X+ VM with increasing speed, therefore, the difference between Pads and GT3X+ VM measures increased gradually when speed increased. The step counts obtained by Pads and GWaist were highly correlated without significant differences when climbing or running at four different speeds ($p>0.001$), which also happened between the comparison between Pads and GAnkles, except that they were significantly different when running at 6.4 km/h on treadmill. There were significant differences between Pads and GWaist/GAnkles steps when walking on treadmill, and between GWaist and GAnkles steps when walking or running at 6.4 km/h on treadmill ($p<0.001$). EE assessed by Pads was highly correlated with EE from IC, but Pads overestimated EE during walking and underestimated EE when climbing or running at four different speeds ($p<0.001$).
CONCLUSION: The shoe pads embedded with tri-axial accelerometer appear to measure physical activity at moderate intensities most accurately. Modifications should be given to improve accuracies in measuring low or high intensity physical activities.

Sports Medicine and Orthopedics

THE EFFECTS OF CORE STABILITY EXERCISE USING THE FLEXI-BAR ON PATIENTS WITH NON-SPECIFIC LOW BACK PAIN

KUO, H.Y., TSENG, S.C., CHEN, H.S., GUO, L.Y., HSIAO, C.E.

KAOHSIUNG MEDICAL UNIVERSITY, KAOHSIUNG AMERICAN SCHOOL

INTRODUCTION: About 60 to 80 % of the general population has the burden of non-specific low back pain (NSLBP) and this leads to a limited range of activities in their daily lives, poor work efficiency as well as poor sleep and quality of life. Symptoms of mild NSLBP can be alleviated temporarily by medicine and electrical modality, but exercise therapy and health education are recommended to correct the posture, improve the symptoms and decrease the recurrence rate. Core stability exercise with the flexi-bar providing vibration stimulation helps to activate core muscles and muscle groups in proximal lower limbs, and to maintain trunk stability. The purpose of this study was to investigate whether core stability exercise using the flexi-bar is effective in reducing the burden of patients with NSLBP and if it improves quality of life.
METHODS: This experiment was conducted at a local hospital in Southern Taiwan on 20 patients with NSLBP between the ages of 25-55 years old. The duration of the experiment lasted 8 weeks, 2 sessions a week, 30 minutes a session. This core stability exercise with the flexi-bar can be divided into 3 phases: the first phase was a 5- minute warm-up with the flexi-bar; the second phase had the patient to perform 20-minute core stability exercise using the flexi-bar in the quadruped, plank, side-plank, reverse-plank and bridge positions; the third phase was a 5-minute cool down exercise without the flexi-bar.(1) Use the 36-Item Short Form Survey (SF-36) to access quality of life, and the Oswestry Disability Index (ODI) and the Visual Analog Scale (VAS) to access the how the patient feels.
RESULTS: A total of 18 patients completed the full experiment. And they showed a statistically significant improvement in both their quality of life and pain relief after performing the flexi-bar exercise regimen.
CONCLUSION: The results of this study suggest that an 8-week core stability exercise training using the flexi-bar is effective in reducing the burden of patients with NSLBP and improving their overall quality of life.

EFFECTIVENESS OF HIGH-INTENSITY INTERVAL TRAINING ON GLYCEMIC CONTROL AND CARDIORESPIRATORY FITNESS IN PATIENTS WITH TYPE 2 DIABETES: A SYSTEMATIC REVIEW AND META-ANALYSIS

ZHU, L., LIU, J.X., LI, P.J.

GUANGZHOU SPORT UNIVERSITY

INTRODUCTION: The effects of high-intensity interval training as compared with moderate-intensity continuous training on glycemic control and cardiorespiratory fitness in patients with type 2 diabetes have been examined by numerous randomized controlled trials; however, due to these studies' largely inconclusive results [1-3], a meta-analysis was performed to better elucidate their findings.
METHODS: Relevant articles were sourced from PubMed, Embase, the Web of Science, EBSCO, and the Cochrane Library. Randomized controlled trials investigating the effects of high-intensity interval training on glycemic control and cardiorespiratory fitness versus the effects of moderate-intensity continuous or control (no exercise or usual care) regimens were included. Studies were selected according to specified inclusion and exclusion criteria.
RESULTS: Twelve clinical randomized controlled trials involving 367 patients were finally identified. There was a statistically significant change in hemoglobin A1c (mean difference (MD): -0.29, 95% confidence interval (CI): -0.56 to -0.01, P=0.05); fasting insulin (standardized MD: -0.54, 95% CI: -0.94 to -0.14, P=0.008); relative VO2peak (MD: 4.57 ml/kg/min, 95% CI: 2.62 to 6.53, P<0.0001); and absolute VO2peak (MD: 0.33 L/min, 95% CI: 0.13 to 0.54, P=0.001) for patients in the high-intensity interval training group as compared with base-

line. And high-intensity interval training had a greater improvement (MD: -0.39%, 95% CI: -0.58 to -0.20, P < 0.0001) than did moderate-intensity continuous training. Similar results were also found with respect to relative VO2peak (MD: 3.34 ml/kg/min, 95% CI: 1.69 to 4.99, P < 0.0001); and absolute VO2peak (MD: 0.29 L/min, 95% CI: 0.12 to 0.46, P = 0.0002).
CONCLUSION: High-intensity interval training appears to be an effective strategy to improve cardiopulmonary fitness and glycemic control in individuals with type 2 diabetes.More multicenter, randomized controlled trials with large samples and longer-term durations must be conducted to confirm these results.

PREVALENCE AND CHARACTERISTICS OF OSTEOCHONDRITIS DISSECANS OF THE HUMERAL CAPITELLUM AMONG YOUNG BASEBALL PLAYERS

HOJO, T.1, MORIHARA, T.2, KIDA, Y.2, KOTOURA, Y.2, TACHIIRI, H.2, SUKENARI, T.2, FURUKAWA, R.2, NAKAMURA, M.4, IGUCHI, J.3, KUBO, T.2

1>DOSHISHA UNIVERSITY, 2>KYOTO PREFECTURAL UNIVERSITY OF MEDICINE, 3>KYOTOGAKUEN UNIVERSITY, 4>NIIGATA UNIVERSITY OF HEALTH AND WELFARE

INTRODUCTION: Osteochondritis dissecans of the humeral capitellum (OCD) is primarily a condition of adolescent overhead athletes. Baseball is one of the high-risk sports, which induces OCD. Many players start playing baseball during elementary school. Recently, medical check-ups for OCD in young baseball players utilizing ultrasonography are becoming more popular. The aim of this study was to investigate the frequency and clinical characteristics of OCD among young baseball players.
METHODS: The subjects were 4099 young baseball players from 7 to 17 years (mean, 13.2 years) who participated in medical check-ups for OCD. All players completed a questionnaire asking about the age, present and past elbow pain when throwing and the duration of competitive play. The elbow of each subject's throwing arm was assessed using ultrasonography. Subjects with abnormal results on ultrasonography were further examined through radiographic study. OCD lesions were classified into stages based on radiographic results. We compare the differences of demographic data between OCD players and non-OCD players.
RESULTS: OCD was detected in 119 (2.9%) of 4099 elbows by ultrasonography. One hundred-five of the 119 OCD players underwent further radiographic examination. Twelve of them (11.4%) were stage S (superficial stage, Figure), 21 (20.0%) were stage I (radiolucent stage), 35 (33.3%) were stage II (fragmentation stage), and 11 (10.5%) were stage III (loose body stage). And additional 11 (10.5%) players were stage IV (residual stage), and 15 (14.3%) were stage V (postoperative stage). The mean age of each stage was 9.8, 11.9, 13.5, 15.4, 15.8, and 15.8 years old, respectively. There was no significant difference on the age (p = 0.99) and the duration of competitive play (p = 0.99). They also had present (p = 0.001) and past elbow pain (p < 0.001) compared to non-OCD players, however sixty-eight OCD players in early stage (S, I and II, before loose body stage) had no significant differences on the present elbow pain.
CONCLUSION: The prevalence of OCD was 2.9% among young baseball players. Players with OCD had present elbow pain, but players in early stage do not have significant present elbow pain compared to non-OCD players. The stage of OCD has progressed with age. Medical check-ups of young baseball players who are 10 years old before and after, utilizing ultrasonography are useful for detecting OCD with no associated elbow pain.

COMPARISON OF EFFECTS OF VARIOUS ELECTRICAL STIMULATING METHODS ON FEMORAL BONE STRUCTURES IN RATS.

NAKAI, S., OHSAKO, M.

TOYO UNIVERSITY

INTRODUCTION: We had already recognized that an invasive acupuncture-electrical-stimulation showed an inhibitory effects on a bone loss by decease in mechanical stress. However, the effect of non-invasive transdermal-electrical-stimulation hadn't been reported. A purpose of this study was, using hindlimb-immobilized rats, to compare and investigate effects of the electrical-acupuncture-simulations and the transdermal-electrical-stimulation on bone loss. Furthermore, as for latter, differences of the effects of direct and alternating current was also investigated.
METHODS: Fifty male rats (wistar strain, seven-week-old) were used as materials and were divided into three groups randomly: an immobilized group (IM), an immobilized and acupuncture-electrical-stimulated group (EA), an immobilized and transdermal-electrical-stimulated group (TE), and a control group (CO). Moreover, TE was divided into two subgroups, that is, a group stimulated by a direct electrical current (DC) and a group stimulated by an alternating electrical current (AC). Hindlimbs of rats of each group, except for CO, were immobilized for two weeks, using jacket-type immobilizing apparatus. An acupuncture was inserted until a periosteum in EA and electrodes were put on the surface of skin in TE (DC and AC). EA and AC were stimulated by the alternating electric current (250μsec, 50Hz, 0.02mA) and DC was stimulated by the direct electric current (200μsec, 31Hz, 60V). Those stimulations were performed for 10minuites per day in everyday through the experimental period.
RESULTS: Thickness of a cortical bone and sizes of osteocytic lacunae decreased and a bone strength also declined in IM, but those structural changes inhibited in EA and DC. Many TRAP-reaction positive cells were observed at the wide extent in IM, but the intent was narrow in EA and DC.
CONCLUSION: It was suggested that the bone resorption was inhibited by acupuncture and transdermal electrical stimulations during the hind-limb immobilization. Furthermore, it was understood that those effects appeared notably by invasive acupuncture electrical stimulation and non-invasive transdermal direct-current electrical stimulation.

PREVALENCE OF ABNORMAL ELECTROCARDIOGRAMS IN CZECH ATHLETES DETECTED WITH THE SEATTLE CRITERIA – A ONE-CENTER EXPERIENCE

SOVOVA, M., FILICKA, M., SOVOVA, E., POKORNA, T., MASNY, O., MORAVCOVA, K., STEGNEROVA, L.

FACULTY OF MEDICINE AND DENTISTRY

INTRODUCTION: Sudden cardiac arrest in athletes is a dramatic event. A routine electrocardiogram (ECG) during preparticipation screening can help to reveal cardiovascular diseases and decrease the mortality rate. In 2013, new criteria of ECG assement – the Seattle criteria – were published. Using this criteria can decrease the number of false-positive findings.
METHODS: We analysed the 12-lead resting ECG of consecutive athletes (5-76 years) recorded in the Department of Sports Medicine in Olomouc, the Czech republic, between October 2015 and October 2017. We used the Seattle criteria for assessing the findings.

RESULTS: The ECGs of 3413 athletes were analysed. 47 ECGs (1.3%) were classified as abnormal – one athlet had prolonged QT interval, 12 athletes had premature ventricular contractions, 14 athletes showed signs of left or right ventricular hypertrophy, one athlete had ventricular preexcitation and there were 19 athletes with other pathological findings. After cardiac examination, we detected undelying structural heart disease in 12 athletes (0.3%). In 6 athletes, the heart disease lead to short elimination of sport activities (myocarditis – 2 cases, paroxysmal atrial fibrillation, AVNRT and WPW syndrome).
CONCLUSION: In the analysed group of athletes, the prevalence of pathological ECG is very low.

ELECTROACUPUNCTURE STIMULATION AND THE ABILITY USING THE STRETCH-SHORTENING CYCLE MOVEMENT IN THE LOWER LIMBS

TERADA, K., NAKATANI, T.

TENRI UNIVERSITY

INTRODUCTION: The stretch reflex plays a certain role during movements utilizing the stretch-shortening cycle (SSC) (Aura, 1986). On the other hand, acupuncture or electroacupuncture is one of the most popular types of complementary and alternative health approaches that athletes use to help control pain, treat injury, and hasten recovery (Ahmedov, 2010). Acupuncture or electroacupuncture stimulation suppresses some proprioceptive reflexes (Homma, 1985), such as the stretch reflex (Milne, 1985). This study evaluated the degree to which electroacupuncture stimulation impacts the ability to perform SSC movements.
METHODS: The subjects were 11 young males (age: 21.9 ± 0.8 yrs, height: 173.8 ± 5.2 cm, weight: 67.2 ± 5.6 kg) who were subjected to low-frequency electroacupuncture (2 Hz, 15 min.) of the triceps surae muscle, randomly selecting between the left and the right side. Immediately before, immediately after, and 1, 24, 48, and 72 hours after, the subjects performed five single-legged rebound jumps (RJ), and we calculated an RJ-index (jump height/ground contact time). At the same time, we also measured the range of ankle dorsiflexion, the muscle stiffness of the medial and lateral head gastrocnemius muscles (medial and lateral muscle stiffness), and subjective sensations according to a visual analogue scale (VAS). The measurements were performed bilaterally stimulated side (SS) and non-stimulated side (NS).
RESULTS: In any of the measured variables, no interaction was observed between which side was stimulated and the measurement opportunity. We performed Dunnett's method of multiple comparisons for the SS and the NS. As a result, on the SS we found a significant decrease immediately before and immediately after stimulation in the RJ-index (SS: -17.9%, $p<0.05$, NS: -10.1%, ns) and the medial (SS: -6.8%, $p<0.01$, NS: -6.7%, $p<0.05$) and lateral (SS: -6.2%, $p<0.05$, NS: -3.1%, ns) muscle stiffness. In addition, we found a similarly significant increase in the sense of discomfort according to a VAS (SS: -29.2% to -20.0%, $p<0.05$, NS: -17.4% to -1.7%, ns). On the NS, we found a similar difference only in the medial muscle stiffness.
CONCLUSION: Consequently, these results suggested that the timing of clinical implementation of electroacupuncture therapy requires consideration.
REFERENCES:
Ahmedov S. Ergogenic effect of acupuncture in sport and exercise: a brief review. J Strength Cond Res, 24(5), 1421-1427, 2010.
Aura O, Komi PV. Effects of prestretch intensity on mechanical efficiency of positive work and on elastic behavior of skeletal muscle in stretch-shortening cycle exercise. Int J Sports Med, 7(3), 137-143, 1986.
Homma S, Nakajima Y, Toma S. Inhibitory effect of acupuncture on the vibration-induced finger flexion reflex in man. Electroencephalogr Clin Neurophysiol, 61(2), 150-156, 1985.
Milne RJ, Dawson NJ, Butler MJ, Lippold OC. Intramuscular acupuncture-like electrical stimulation inhibits stretch reflexes in contralateral finger extensor muscles. Exp Neurol, 90(1), 96-107, 1985.

EFFECTS OF INTERMITTENT COLD AND HYPOBARIC HYPOXIA ON MUSCLE STRUCTURE AND FUNCTION: IMPLICATIONS TO IMPROVE RECOVERY AFTER INJURIES

VISCOR, G., SANTOCILDES, G., CABRERA-AGUILERA, I., LARA, S., RIZO-ROCA, D., PAGÈS, T., TORRELLA, J.R.

UNIVERSITAT DE BARCELONA

INTRODUCTION: Mechanical and metabolic properties of mammal muscle fibres can change in response to different environmental stimuli such as altitude exposure, which involves hypoxic and cold stress. The aim of this study was to identify the effects of simultaneous intermittent exposure to cold and hypobaric hypoxia on fibre types, capillarization and fibre morphometry of the rat gastrocnemius, and its usefulness to improve recovery after muscle injury.
METHODS: After inducing injury in the rat gastrocnemius, two groups of animals (n=6) were considered: COHY, submitted to a programme of simultaneous intermittent cold (4ºC) and hypobaric hypoxia (4,500 m) for 21 days; and CTRL, normoxic at 27°C. Histological slides were stained for demonstrating the oxidative and contractile properties of the fibres, classified as slow oxidative (SO), fast oxidative glycolytic (FOG), fast intermediate glycolytic (FIG) and fast glycolytic (FG). Capillary density (CD), fibre capillarization (CCA) and fibre cross-sectional area (FCSA) were measured after ATPase staining. Force properties of contralateral injured and healthy gastrocnemius were registered by electrical stimulation of sciatic nerve. Peak (PF in mN/g) and tetanic force (TF in mN/g), contraction (CT) and half relaxation times (HRT), and fatigue properties at low frequency (30 Hz) were measured.
RESULTS: The protocol did not induce significant alterations in fibre type composition. However, a significant reduction in FCSA of the oxidative fibres and a significant increase in CD was evident. Injured leg from the CTRL group registered significant lower values than the healthy leg in PF (37±9 vs 44±5, $p=0.048$), TF (110±40 vs 148±22, $p=0.016$), and showed lower resistance to fatigue. Simultaneous cold and hypoxic exposure recovered TF (but with lower values for injured leg: 165±19 vs 174±11, $p=0.184$) and resistance to fatigue, but did not show a total recovery in PF (45±6 vs 49±6, $p=0.042$). No alterations were registered neither for CT nor HRT in any group.
CONCLUSION: Oxidative fibres reduced FCSA and increased CCA to maintain their functionality in response to simultaneous exposure to cold and hypoxia, without showing muscle fibre type transitions. It is possible that it would be necessary more time than 21 days to induce changes in metabolic and contractile fibre characteristics. This protocol induced a growth of new capillaries (increased CD), which would have supplied more oxygen, growth factors and nutrients to the satellite cells, favouring their proliferation, differentiation and posterior maturation into myofibre, thus helping the regeneration processes from injury and accelerating to some extent the muscular force recovery.

INVESTIGATION THE RELEVANCE BETWEEN ORAL CONTRACEPTIVES AND SERUM RELAXIN-2 FOR ANTERIOR CRUCIATE LIGAMENT INJURIES IN ELITE FEMALE ATHLETES

NOSE, S.

THE UNIVERSITY OF TOKYO

INTRODUCTION: Anterior cruciate ligament (ACL) injuries occur two to nine times more frequently in female athletes than in male athletes. It was reported that female athletes with ACL injuries have higher serum relaxin-2 concentrations during the luteal phase, and that athletes with serum relaxin-2 levels > 6.0 pg/mL show a more than four-fold increase in the risk of ACL injuries. Relaxin-2 concentrations were reported to be significantly lower in subjects taking oral contraceptives (OC) than in non-OC users. However, it is uncertain whether OC therapy may decrease relaxin-2 levels in female athletes. The purpose of this study was to investigate changes of relaxin-2 levels in athletes taking OC.
METHODS: Levels of relaxin-2, estradiol, progesterone, luteinizing hormone and follicle-stimulating hormone were measured in serum samples (n = 183) from 106 elite female athletes. The participants included 77 eumenorrheic athletes, 13 athletes with amenorrhea and 16 athletes taking OC. In these 77 athletes with eumenorrheic athletes, blood samples were obtained during the follicular (72 samples), ovulatory (25) and luteal (57) phases of the menstrual cycle. Out of 77 eumenorrheic athletes, 5 athletes, whose serum relaxin-2 concentrations were > 6 pg/mL during the luteal phase began to take one OC tablet (norethisterone 1.0 mg/ ethinylestradiol 0.02 mg; LUNABELL tablets ULD) every night from the first day of menstruation, and serum relaxin-2 levels were examined during the second cycle of OC therapy.
RESULTS: Serum relaxin-2 concentrations were significantly higher during the luteal phase (n = 57) than in the follicular phase (n = 72), or in athletes on OC therapy (n = 10) ($p < 0.001$, $p < 0.001$ and $p < 0.05$, respectively). In the luteal phase, 36.8% (21/57) of the athletes had relaxin-2 levels > 6 pg/mL. In 23 athletes, serum relaxin-2 concentrations were measured during both the follicular and luteal phases, revealing that relaxin-2 levels were significantly higher in the luteal phase compared with the follicular phase. In 5 athletes who began to take OC, serum relaxin-2 concentrations decreased dramatically to below the detection limit (0.26 pg/mL) following OC administration.
CONCLUSION: Female athletes that have serum relaxin-2 levels> 6.0 pg/mL might be recommended to initiate OC therapy because it is useful to decrease the risk of ACL injury.

TOTAL HAEMOGLOBIN REACTIVITY CHANGES IN RESPONSE TO A BAROREFLEX MANOEUVER FOLLOWING SPORT-CONCUSSION

SINGH, J., SIRANT, L., DECH, R., NEARY, J.P.

UNIVERSITY OF REGINA, REGINA, SASKATCHEWAN, CANADA, S4S 0A2

INTRODUCTION: Previous research has shown that concussion can alter cardiac function by influencing changes in mean arterial blood pressure (MAP) (Bisop et al., 2017), as well as affect neurological autoregulation by influencing changes in total blood volume (tHb) (Christian et al., 2010). What has not been shown is whether the change in the relationship of blood pressure and total blood volume (tHb/MAP), known as total haemoglobin reactivity (THx), pre-concussion to post-concussion using a non-invasive near-infrared technology (NIRS) when initiating a baroreflex manoeuvre. Therefore, the aim of this study was to compare the THx of individuals in healthy vs concussion groups, by measuring the cardiovascular metrics under baroreflex conditions using a squat-stand manoeuvre.
METHODS: 14 participants (n=7 female) who sustained a sport concussion, were tested within 72-hours post-injury. Participant's blood pressure (finger plethysmography, Finapres) data was collected during 5 minutes of seated rest and 5 minutes of 10-second squat-stands (0.05 Hz), along with tHb (μM) changes using NIRS located over the prefrontal cortex. Participants were given a 3 second count instructing them to squat down and a 3 second count instructing them to stand up. THx data was analysed in the 1-6, 4-7 and 6-10 seconds periods of squatting and the 10 seconds of standing. Paired sample t-tests were used for pre- and post-injury data comparison.
RESULTS: For both female and male participants, significant changes were found in the 1-6, 4-7, 6-10 seconds of squatting and the 10 second standing periods ($p<0.05$). For males, THx was increased for the 1-6, 4-7, 6-10 and 10 second standing periods by 229.7%, 105.8%, 105.6%, and 72.4%, respectively, post-injury, due to increases in MAP (10.7%, 16.7%, 17.6% and 9.0%, respectively) and changes in tHb (225.5%, 157.2%, -153.6% and 92.1%, respectively). For females, THx was actually decreased by 44.3%, 24.0%, 30.3% and 142.0%, respectively, with respect to the mentioned intervals. This was due to changes in MAP (-4.8%, -3.7%, 0.6%, and -0.3%, respectively) and tHb (-41.9%, -26.9%, -29.7% and, -49.6%, respectively).
CONCLUSION: Our squat-stand manoeuver while monitoring THx provides an objective test to assess the pathophysiology of concussion. Changes in THx during the squat-stand suggests that autonomic dysregulation occurs following concussion within the initial 72 hours of injury. A larger sample size is required for validity and more research is required to assess the differences between males and females.

MEASUREMENT ERROR OF TOE PLANTAR FLEXION DUE TO DIFFERENCE IN METHOD - PROPOSAL OF A LIGHT AND EASY-TO-HANDLE BRACE

KOMURO, Y.

OCHANOMIZU UNIVERSITY

INTRODUCTION: According to previous studies, there was a correlation between strength of toe plantar flexion (STPF) and fall history (Mickle et al. 2009), and there was a significant difference in STPF between young people and the elderly (Endo et al. 2002). It was reported that walking speed, swing time and stride were correlated with walking speed (Misu et al. 2014). Knowing and managing our own STPF is important to prevent falls and maintain walking ability. However, the equipment that measures STPF was usually large and difficult to move (Goldmann et al 2013; Allen et al 2014; Senda et al. 1999). Therefore, we made a simple brace that is lightweight, easy to carry and that can be worn easily by oneself. The main muscles of the toe plantar flexion (TPF) are flexor hallucis longus (FHL), flexor hallucis brevis, flexor digitorum longus (FDL), and flexor digitorum brevis. FHL and FL work to flex not only the toes but also the ankle joints. In order to measure STPF in the state of sitting, we had to minimize the influence of ankle joint flexion. we thought that it would be natural to measure the STPF in a state where the ankle was plantar flexed. We hypothesized that large STPF could be obtained with less error in the new method than measurement at the sitting position. The purpose of this study was to compare the data obtained by the new STPF measurement method and measurement method by sitting position.
METHODS: Subjects were 12 young females (average 24.42, SD 4.33 years). In the new measuring method, the brace with the sensor (F-scan II, Nitta Corporation, Japan) was attached to the right foot. Subjects raised their right legs slightly from the floor and allowed the ankle and toes to plantar flex for 5 seconds. The foot was raised back to their original position. There was 5 seconds rest until the next

measurement started. A set of the plantar flexion and rest was repeated 5 times. In the measurement of sitting position, a sensor attached to the right foot was placed on the floor and a set of 5 seconds plantar flexion and 5 seconds rest was repeated five times. The acquired data was analyzed by a single regression analysis of IBMs SPSS version 24.
RESULTS: Three out of five TPF data were analyzed. The value of TPF obtained with the new measuring method was 61.16, SD23.48 N and the value obtained by sitting was 50.36, SD 33.63 N. The regression equation was y = 22.18 + 0.46 x (y = value obtained at the sitting position, x = value obtained by the new measurement method).
CONCLUSION: The value of the STPF obtained by the new measurement method was larger than the value at the sitting position. This result supported our hypothesis. It seems that the subjects could sufficiently contract FHL and FDL. Also, the value of standard deviation was smaller than the value at the sitting position. It can be said that the data obtained by the new method was more accurate.

GENDER DIFFERENCE IN MUSCLE ACTIVATION DURING DROP JUMP AND CUTTING MANEUVER IN PRE-PUBESCENT ATHLETES

SVEINSSON, T., JONSDOTTIR, U.S., BRIEM, K.
UNIVERSITY OF ICELAND

INTRODUCTION: Movement patterns and neuromuscular activation of muscles in the lower extremities may contribute to risks for ACL injuries. For some muscles in pre- and post-pubescent female and male athletes, these have been studied. Although gluteus medius (GM) muscle activity may be important during dynamic activities, its activation patterns have not been much studied. The aim of the study is to identify gender differences in GM activation during drop jump and cutting maneuver among 11 and 12 years old football and team handball players.
METHODS: The design was cross-sectional laboratory trial Players were recruited from local sports clubs, 9 boys and 36 girls. Surface electrodes were used to collect EMG activity from GM during the two dynamic tasks, before and after a standard fatigue protocol. AMTI force plates were used to identify stance phase duration. Stance duration, timing of peak muscle activation and activation levels at initial contact, normalized to peak activation, were analyzed pre- and post-fatigue between genders for each task and were the main outcome measures.
RESULTS: During the drop jump, shorter stance duration ($p=0.03$) and greater activation at initial contact ($p=0.02$) were observed for girls than for boys. Furthermore, peak activation occurred earlier in girls than boys ($p<0.01$). Moreover, GM activation levels at initial contact were overall significantly greater after a fatigue protocol than before ($p<0.01$) and peaked earlier ($p<0.01$). During cutting manuever, a significant main effect of fatigue on activation levels at initial contact ($p<0.01$) was observed. Also, a significant interaction between gender and fatigue was observed for their effects on stance duration ($p<0.01$), where stance duration was increased for boys while it was deceased for girls.
CONCLUSION: Gender differences were identified in activation patterns of GM and duration of stance phase in the current study. To some extent, this may reflect different kinematic strategies during these dynamic tasks or gender biased training methods. Further investigation into muscle activation patterns and lower extremity kinematics are important in the context of injury prevention.

FUNCTIONAL MOVEMENT PERFORMANCE ABILITY IN MARTIAL ARTS AND TEAM SPORT YOUNG MALE ATHLETES

PEDAK, K., RANNAMA, I., BAZANOV, B.
TALLINN UNIVERSITY

INTRODUCTION: The Functional Movement Screen (FMSTM) is widely used in training science and sport medicine and estabilshed as a standard tool to assess functional movement abilites (Kraus et al.,2014). This study aim was to compare the functional movement performance ability of athletes from two different sports groups – team sport (basketball, handball,volleyball) and martial arts (judo, taekwondo, karate).
METHODS: Fourty-five team sport (age =16,27 ± 1,7 years; height=183,2± 6,6 cm and KMI=23,5 ± 3,8) and twenty-seven martial arts athletes (16,7±3,8 years; height=178,7cm and KMI=20,5±3,5) were screened by Functional Movement Screent (FMS) using a 100-point grading scale (Butler et al.,2010).
All participants were free from injury last 6 months. Participants were screened using the functional movement screen protocol that comprised the FMS seven movement patterns: deep squat, hurdle step, in-line lunge, , active straight-leg raise, trunk stability push-up, shoulder mobility and rotary stability. Each participant was videotaped performing the 7 movements of the FMS and scores were obtained. The videos were then analyzed using FMS 100-point scale (viide). Participants were given three trials of each movement pattern. Before testing procedures participants completed a 10-min dynamic warm-up.
All analyses were computed via SPSS® V.21 for Windows. One-way ANOVA was used to compare differences. , and the level of significance for all tests was set at alpha level $p < 0.05$.
RESULTS: We found statistically significant difference between FMS total score of martial art athletes. The mean composite FMS 100-point scale was 55,1±9,3 and team sports athletes 45,0±6,4. Martial arts athletes shows statistically significantly higher score in active straight-leg raise 4,4±3,1 vs 7,9±3,9 ($p<0,05$) and trunk stability push-up test 4,4±3,5 vs 7,1±4,5 ($p<0,001$). There was not statistically significant difference between other five tests.
CONCLUSION: The results of the present study indicate that low FMS 100-point scale in both groups, which increase the risk of injuries. Results of the active leg test show, that team sport athletes have more problems with muscles of the hamstring and gastric-soleus flexibility than martial artists. In addition to this, team sport athletes have more problems with performance of trunk muscles stabilizing, according to the trunk stability push-up test. The results of the test indicate problems specific to the sport. Future studies should also determine the effects of specific movement compensations as defined by the FMS on athletic performance to indicate sport-specific problems.
References: Butler R.J, Plisky P.J, Kiesel K.(2010). Reliability of the Functional Movement Screen Using a 100-point Grading Scale:1765. Medicine & Science in Sport & Exercise.
Kraus K., Schütz E., Taylor W. R., & Doyscher R.(2014). Efficacy of the functional movement screen: a review. The Journal of Strength & Conditioning Research, 28(12), 3571-3584.

EXPLORATION OF BLOOD PRESSURE, ARTERIAL STIFFNESS, AND HEART RATE VARIABILITY IN TRIATHLETES

LEE, P.H.1, LIN, Y.Y.2, SU, C.T.3, LIN, C.H.1, YANG, A.L.1

1: UNIVERSITY OF TAIPEI ; 2: CHINA MEDICAL UNIVERSITY ; 3: FU JEN CATHOLIC UNIVERSITY

INTRODUCTION: Regular exercise is known to improve cardiovascular function and exercise performance. However, high blood pressure is one of the common cardiovascular conditions in athletes. Until now, there is little information regarding the cardiovascular characteristics in the triathlon, which is an endurance sport and needs sufficient aerobic capacity (Leischik et al., 2014; Suriano et al., 2010). Therefore, the purpose of this study was to explore the blood pressure, arterial stiffness, and heart rate variability (HRV) in the triathletes.
METHODS: Twelve male elite triathletes and ten non-athlete control subjects (aged 20-25 years old) participated in this study. The resting and maximal blood pressure during exhaustive exercise were measured, including systolic and diastolic blood pressure (SBP and DBP), and pulse pressure (PP). Also, the arterial stiffness index (ASI) and HRV at rest were analyzed non-invasively and compared in both groups.
RESULTS: We found that resting SBP in the triathlete group was significantly ($p < 0.05$) higher than that in the control group. However, there was no significant difference in resting DBP, PP, and maximal SBP and DBP between the triathlete and control groups. Moreover, the ASI values showed no significant difference between the two groups. Regarding the HRV, the triathlete group had significantly ($p < 0.05$) lower heart rate and better R-R interval (inter-beat interval) and high frequency (HF) power compared with the control group.
CONCLUSION: This study indicated that, compared with the control group, the triathletes had higher SBP and better R-R interval. However, similar ASI values were found between the two groups. It may provide some useful information for the health and exercise performance in the triathletes.
Reference
Leischik R, Spelsberg N, Littwitz H, Dworrak B. (2014). Am J Sports Sci, 2(2), 41-47.
Suriano, R, Bishop D. (2010). J Sci Med Sport, 13(3), 340-347.
Contact: golden156165@yahoo.com.tw; yangailun@gmail.com

FACTORS INFLUENCING DIFFERENCE IN ANKLE JOINT FLEXIBILITY BETWEEN MALES AND FEMALES

KATO, E.

KYOTO SANGYO UNIVERSITY

INTRODUCTION: The methods are used to evaluate flexibility by measuring length and angle. However, as the influence of resistance to a pain cannot be excluded, both these measurements cannot be objective. Stiffness is a mechanical index to assess joint flexibility, and can be measured using evaluating the passive torque of a joint involving a group of muscles that are elongated when the joint is moved. Because it is not affected by resistance to pain, it is thought that stiffness can be used to evaluate joint flexibility more objectively than can be done by measuring length and angle. Although it is known that there is a significant sex difference in flexibility, the responsible factors remain unclear. In this study, we aimed to elucidate how stiffness can be measured in ankle joint, as well as to determine the factors influencing stiffness measurement and how they relate to the sex differences in flexibility.
METHODS: Passive ankle joint dorsiflexion was performed in 27 healthy adults. Subjects took a seated position on a dynamometer and fixed their foot to a foot-plate that recorded passive torques generated by the plantar flexor muscle group from 30˚ of plantar flexion to 20˚ of dorsiflexion. We calculated ankle joint stiffness using linear regression between the ankle joint angle and passive torque. Muscle thickness of the anterior and posterior of shank was measured as an index of muscle volume, and B-mode ultrasound was used to quantify changes in the muscle architecture of the gastrocnemius medialis accompanying a change in the joint angle. In addition, to determine muscle stiffness at each ankle joint angle, the muscle belly of the gastrocnemius medialis was assessed with ultrasound shear wave imaging. Subjects performed isometric maximum voluntary contraction for plantar flexion and dorsiflexion. Furthermore, subjects exerted maximal plantar flexion as fast as possible, and the rate of torque development was calculated. Multiple regression analysis was performed using a stepwise method, with ankle joint stiffness as dependent variables and all the measurement parameters as independent variables.
RESULTS: As morphological parameters, significant sex differences were observed in height, body mass, shank length, muscle thickness in the anterior of the shank and subcutaneous adipose thickness in the anterior and posterior of the shank. There was no significant sex difference in passive torque at each ankle joint angle, but a significant sex difference was found in ankle joint stiffness. With passive torque, the muscle stiffness and fascicle length at each ankle joint angle showed no significant interaction between the ankle joint angle and sex difference, but a significant interaction and a main effect were seen in the pennation angle.
CONCLUSION: Passive torque and stiffness were used to objectively determined joint flexibility. A significant sex difference was found in ankle joint stiffness, with effects on muscle volume, muscular strength, and muscle architecture.

ADAPTIVE IMPLICATIONS OF VITAMIN D CONCENTRATIONS IN SOUTHERN HEMISPHERE NATIONAL RUGBY LEAGUE PLAYERS

ROBERTS, L.A.1, SCOTT, T.2,3, KELLY, V.G.2,3

1; GRIFFITH UNIVERSITY AND MENZIES HEALTH INSTITUTE QUEENSLAND , 2; BRISBANE BRONCOS RUGBY LEAGUE CLUB , 3; UNIVERSITY OF QUEENSLAND

INTRODUCTION: Recent data supports individuals needs for optimal 25(OH)D (Vitamin D; VitD) concentrations to support muscle adaptation. Additional performance adaptations may also occur from VitD supplementation; by promoting or maintaining optimal VitD concentrations, or in e.g. Northern Hemisphere individuals and athletes where deficiencies are common. However, a paucity of data exists relating to VitD status in Southern Hemisphere elite athletes, and particularly any potential associations with immunological and performance adaptation parameters in response to training.
METHODS: Thirty-one elite Southern Hemisphere National Rugby League players (22 +/- 3.57 yr, 1.78 +/- 0.31 m, 99.38 +/- 12.14 Kg), and thirty-one recreationally active Males (Controls; 26.23 +/- 4.12 yr, 1.79 +/- 0.65 m, 83.10 +/- 7.70 Kg), matched for skin pigmentation-type; volunteered to participate in the study. Blood samples were collected from the players before (Pre), half way through (Mid), and after (Post) a 3-week pre-season training block (January, Summer). Blood samples were collected from Controls coinciding with Post. Pre and Post training, concentrations of VitD were measured from all participants, and performance indicators were measured from players. A full blood count was also measured from players Pre, Mid and Post.

RESULTS: All players had adequate, above 50 Nmol.l VitD concentrations at Pre, with 24 players having optimal, above 100 Nmol.l concentrations. Concentrations increased from Pre-Post training (p = < 0.001; d 0.33 (95% CI 4.85 - 9.24 Nmol.l), including two players increasing their rating from adequate to optimal. Concentrations were higher in players compared with Controls (p = < 0.001; d 2.5 (95% CI 35.66 - 65.16 Nmol.l), along with their mean weekly time spent outdoors from 0600 to 1800 over the previous month (4.59 +/- 1.71 Vs 1.00 +/- 0.76 hrs; p = < 0.0001; d 2.7 (95% CI 2.92 - 4.27 hr). VitD concentrations also correlated negatively with skinfold thickness (p = 0.006; r -0.36 (95% CI -0.11 - -0.56)) and tended to correlate positively with estimated maximal oxygen uptake (p = 0.059; r 0.27 (95% CI -0.01 - 0.50)). Leukocyte derivatives including total leukocytes, lymphocytes, monocytes and basophils; and erythrocyte counts, decreased from Pre-Post training (p = 0.001 - 0.031; d 0.58 - 1.13). VitD concentrations tended to positively correlate with monophil, eosophil and basophil counts (p = 0.008 - 0.082; r 0.24 - 0.36), and negatively with measures of platelet architecture (p = 0.004 - 0.077; r -0.35 - -0.53).
CONCLUSION: Players had higher VitD concentrations compared to the Controls, most likely as a result of their increased sun exposure. The players concentrations could also be increased by short-term ambient sun exposure, despite starting concentrations. Immunological markers were decreased by training, and associated with absolute, or changes in VitD concentrations. However, the mechanisms underpinning these associations require further investigation in elite athletes.

EXERCISE-INDUCED LACTATE RESPONSES IN MULTIPLE SCLEROSIS.

OP T EIJNDE, B.

HASSELT UNIVERSITY

INTRODUCTION: Multiple Sclerosis (MS) patients show elevated resting serum lactate concentrations compared to healthy controls (HC). Whether they also exhibit higher lactate concentrations during acute exercise and/or following training (repeated exercise) is unknown.
METHODS: In this retrospective study, blood lactate concentrations (mmol/l) during submaximal (HC, n=11; MS, n=32) and maximal (HC, n=20; MS, n=24) exercise testing (ergospirometry) were analyzed. Submaximal (lactaterest, lactatebout1, lactatebout2) and maximal (lactatestart, lactatemax) lactate concentrations were adjusted to lean tissue mass (/LTM). Hereafter, a portion of both MS groups were enrolled in a 24 week mild to moderate intensity (MSsubmax, n=12) or 12 week high intensity interval (MSmax, n=13) exercise intervention program and hereafter performed POST exercise submaximal and maximal exercise tests.
RESULTS: Under submaximal exercise conditions in MS and compared to HC, lactaterest (MS: 2.7±0.6 vs HC: 2.3±0.7), lactaterest/LTM (6.9±2.1 vs 5.2±1.9) and lactatebout2/LTM (7.7±2.5 vs 5.8±2.8) were significantly ($p<0.05$) elevated in MS. After 24 weeks of mild-to-moderate-intensity exercise training and compared to PRE values, lactatebout2 (2.5±0.7 vs 3.4±1.1) and lactatebout2/LTM (6.3±2.1 vs 8.4±2.7) significantly ($p<0.05$) decreased during submaximal testing in MSsubmax. Under maximal conditions, lactatestart (2.3±1.0 vs 1.7±0.9) and lactatestart/LTM (5.5±2.9 vs 3.9±2.6) were significantly ($p>0.05$) elevated in MS. Twelve weeks of high intensity interval training did not improve this ($p>0.05$).
CONCLUSION: Under the conditions of the present study we conclude that MS patients have higher resting lactate concentrations but during acute submaximal and maximal exercise, lactate responses appear to be similar compared to healthy controls. Moderate intensity exercise therapy (24w) probably improves lactate accumulation but high intensity exercise therapy (12w) did not.

Training and Testing

FUNCTIONAL ABILITY OF THE ANKLE AND FOOT IN FEMALE ATHLETES WITH LONG TERM SPORT PERFORMACE IN THE WATER

CHATZIILIAS, V.1, ATHANASOPOULOS, S.1, MANDALIDIS, D.1

NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS

INTRODUCTION: Aquatic sports that performed in the water require athletes to stay for prolonged periods of time in weightlessness environments such as a pool or the seawater in order to achieve a high level of competitiveness. Other individuals utilize similar environments both for therapeutic and leisure purposes, mainly due to the reduced gravitational loads that act on the human body (Becker, 2009; Matsuda et al., 2008). The effects of these environments on the weight bearing joints of the lower limbs remain unknown. The aim of this study was to examine the effect of prolonged participation in aquatic activities that performed in the water on the functional ability of the ankle and foot.
METHODS: The functional ability of the ankle and foot was assessed in 28 healthy female athletes who were involved for more than 10 years in aquatic sporting activities (AS) that performed in the water, such as water polo and swimming (n=14) and field sporting (FS) activities, such as basketball and handball (n=14). Fifteen healthy females without regular participation in any kind of sport, served as control (CO). The functional ability of the ankle and foot was determined based on (i) the isometric strength of the plantarflexors/dorsiflexors of the ankle joint and the evertors/invertors of the subtalar joint, (ii) the range of motion of the ankle and midtarsal joints and (iii) the reaction time of the peroneus longus muscle. The static and dynamic body balance was also assessed by measuring the displacement of the center of pressure during single-leg-standing tests and the reaching distance during Y-balance test, respectively.
RESULTS: The isometric strength of the dorsiflexors, evertors and invertors muscles was significantly higher in AS athletes ($P<0.05$) compared to FS athletes and the C group. The differences between groups regarding the range of motion of the ankle and midtarsal joints, the reaction time of peroneous longus as well as the static dynamic balance measurements, were not significant.
CONCLUSION: Our findings revealed that functional ability of the ankle and foot as well as body balance was not diminished by long term participation in aquatic activities that performed in the water. Further study is required to determine the functional ability of other weight bearing joints of the lower limb and the trunk.
References: Becker, BE. (2009). PM&R, 1(9), 859-872.
Matsuda, S., Demura, S., & Uchiyama, M. (2008). Journal of Sports Sciences, 26(7), 775-779.
Contact: bxatziilias@yahoo.com

CHANGES IN RPE, ENERGY EXPENDITURE, ACTIVITY AND FATIGUE OF VASTUS LATERALIS MUSCLE IN SLOPED WALKING.

LEE, S.Y.1, LEE, J.H.1, KIM, Y.H.1, LEE, H.S.1

DANKOOK UNIVERSITY GRADUATE SCHOOL

INTRODUCTION: The task demands for sloped (uphill/downhill) walking result in changes in kinematics and kinetics (Kuster et al., 1995) and electromyography (Lay et al., 2007) in comparison to level walking. Moreover, muscle functional roles likely change in response to

the biomechanical demands of sloped walking (Nathaniel et al., 2016). This study tested the hypothesis that rate of perceived exertion (RPE) and energy expenditure (EE) would increase in uphill treadmill walking (UH) compared with downhill (DH) and level treadmill walking (LV), and increases in activity and fatigue of vastus lateralis muscle (VL) would production in DH compared with LV.
METHODS: 12 healthy adult aged 22 to 29 years, completed on a treadmill in a randomized crossover order 3 walking trials for 30 min at 1.2 m/s walking speed, with three incline (LV, UH and DH with a slope of 10%). RPE and EE were measured continuously during the 30 min of each 5 min interval (T1~T6). Activity and fatigue of VL were collected from electromyography at the all slope session, +0~1 min (T1), +9~10 min (T2), +19~20 min (T3) and +29~30 min (T4) during 30 min treadmill walking.
RESULTS: The changes in RPE and EE were significantly increased (p=0.001, respectively) T1 to T6 in UH as compared to LV. The changes in VL activity were significantly increased (p=0.001, respectively) T1 to T4 in DH as compared to LV, but the changes in VL fatigue were not significantly different between groups and times.
CONCLUSION: It has been reported that uphill exercise increases the RPE and EE as compared to LV (Hagiwara and Yamamoto, 2011), and confirmed the findings of the present study showing that changes in RPE and EE were more due to a cardiorespiratory ability rather than to muscle damage. Eston et al. showed that muscle activity was significantly increased at DH than that at LV. It seems that changes in VL activity are influenced by performing eccentric contractions during DH. However, no significant changes in VL fatigue were evident, it is possible that the magnitude of muscle fatigue was due to a lesser in VL, and thus this warrants further study.

BLOW-OUT 2 HOURS BEFORE THE START OF COMPETITION IN INTERNATIONAL RUGBY-7S PLAYERS: BENEFICIAL OR DETRIMENTAL?

MARRIER, B.

FEDERATION FRANÇAISE DE RUGBY

INTRODUCTION: Preconditioning strategies are considered as opportunities to optimize performance on competition day. However, there is little scientific information available in team sports. The aim of this study was to monitor the changes in physical and psychophysiological indicators among international Rugby-7s players after a priming exercise.
METHODS: In a randomized crossover design, fourteen under 18 international Rugby-7s players completed, at 8:00 am, a pre-loading session consisting of a warm-up followed by small-side games (4 vs. 3), skills and 2 x 50-m maximal sprints (Experimental) or no pre-loading session (Control). Following a 2-hour break, the players performed a set of six 30-m sprints and a Rugby-7s match. Recovery-stress state, salivary cortisol and alpha-amylase (sAA) levels were assessed before the preloading session (Pre), immediately after (Post-1), before the testing session (Post-2) and after (Post-3).
RESULTS: Experimental - Control differences in repeated sprint performance were very likely trivial (+0.2 +/-0.7%, 3/97/1%). During the first half of Rugby-7s match, the sprint distance covered and the accelerations number were almost certainly moderately lower in Experimental than in Control and the accelerations number was likely higher (small) during the second half in Experimental compared to Control. At Post-2, the perceived recovery-stress state was better (small difference) in Experimental compared with Control. No difference was observed for salivary cortisol responses while the preloading session induced a higher stimulation of sAA activity.
CONCLUSION: The priming exercise has no substantial effect on physical performance during a simulated Rugby-7s match, however potential benefits have been reported for psychophysiological indicators.

A LONGITUDINAL STUDY ABOUT THE BODY COMPOSITION OF COLLEGIATE JUDOIST USING DXA

MAEMICHI, T., TORII, S., IIZUKA, S.

WASEDA UNIVERSITY

INTRODUCTION: Body composition is one of the most important factors of motor quality for athletic performance. Exercise prescription based on the results of regional body composition such as side-to-side difference of extremities is expected to improve athletic performance. It is also suggested that participating in athletic training for a long time would change the body composition of athletes as to fit the nature of the sport. Therefore, the purpose of this study was to investigate the effect of continuing judo training during college years on body composition such as bone, muscle and fat.
METHODS: Subjects were 16 male and 7 female collegiate judoists. All subjects were participating in judo training before college admission. Also, they lived the judoist club dormitory. Body composition was measured using dual energy X-ray absorptiometry (DXA) from the first to fourth grade in each year. The values of fat free mass (muscle mass), fat mass, body fat percentage, bone mineral content (BMC), and bone mineral density (BMD) were compared between those at first grade and those at fourth grade.
RESULTS: Body weight and body fat percentage didn't increase between first grade and fourth grade. Bone mineral content and bone mineral density significantly increased in all body regions in male collegiate judoist players. Also, Bone mineral content and bone mineral density significantly increased in several (not all) body regions in female collegiate judoists.
CONCLUSION: Judo is one of the material arts, and makes large mechanical stress on the body, resulting in increase of bone mineral. The authors consider that the reason of sex difference in bone mineral change would account the sex difference of the growth period. Continuing judo training during college years increases bone mineral content and bone mineral density.

INFLUENCE OF THE PLAYER'S PERSONAL CHARACTERISTICS ON THE PHYSICAL DEMANDS OF ELITE JAPAN RUGBY UNION MATCH PLAY

YAMAMOTO, H., TAKEMURA, M., TACHIBANA, M., HASHII, Y., NISHITSUJI, Y,. TSUJITA, J., HOJO, T.

DOSHISHA UNIVERSITY

INTRODUCTION: Physical demands of Rugby union have been analyzed and the characteristics of each position reported (Yamamoto et al., 2017). However, data may be influenced by the match result (won/lost, score margin) or influence of the players personal characteristics, and it is necessary to consider whether the characteristics of each position are indicated appropriately. Therefore, the aim of this study was to analyse the variation among player's in the same position, which is one piece of information required when considering whether physical demands correctly report the characteristics of each position.
METHODS: Subjects were players who participated fully (80 minutes) for more than seven matches in official matches of the 2013 - 2015 season of Japan rugby top league. The number of player by Position were Lock (n = 3), Flanker (n = 3), Fly Half (n = 2), Center (n = 3), Wing (n = 2). Physical demands were recorded by a SPI Pro XII (GPSPORT, Australia) sampling at 5 Hz. Data were categorized into (1)Total distance(TD), (2)movement speed zone, corresponding to low(LSR;0-5m・s-1) and High(HSR;≧5m・s-1), (3)total and high accelerations(TA

and HA;≧2.5 m・s-2), (4)total and heavy impacts(TI and HI;≧10G). Bartletts test for analysis of variance, ANOVA was used for the test when equal variance was confirmed.
RESULTS: With Wings, there was a significant difference between players at TD (p<.01, ES = 0.7). Significant differences were also observed in LSR, HSR, TA, HA, TI, HI (p<. 01, ES = 0.5 – 1.1). Other positions also showed the same result as Wings.
CONCLUSION: A significant difference was found among players in the same position with each parameter, and it became clear that physical demands were influenced by players even in the same position. On the other hand, from results of the Bartletts test, uniformity of variance was confirmed among players at each position. Thus, it was suggested that Physical demands adequately show the characteristics of each position.
References: Yamamoto H, Takemura M, Kaya M, Tsujita J. (2017). Physical Demands of Elite Rugby Union Match-play Using Global Positioning System. Football Science, 14, 15-23. http://www.jssf.net/home.html.
Contact: trainer_life_22@yahoo.co.jp

RELATIONSHIP BETWEEN UPPER LIMB POWER IN BENCH PRESS AND THROWING SPEED IN CHEST PASS

MURAOKA, Y.1, TAGUCHI, T.1, KUSAYANAGI, K.1, YASUDA, T.2

1: MEISEI UNIV. , 2: NIIGATA UNIV. OF MANAGEMENT

INTRODUCTION: The movement pattern of the chest pass in basketball is similar to that of bench press. The purpose of this study was to examine the throw speed in chest pass and its association with the upper limb power in bench press and to clarify the relationship between upper limb power and throwing performance in chest pass.
METHODS: Nine male basketball players (mean+/-SD: age, 18.8+/-1.1 years; height, 170.6+/-6.1 cm; weight, 65.9+/-7.4 kg; years of basketball experience, 8.2+/-0.8 years) from a university basketball team were tested for maximal throwing speed in chest pass and upper limb power in bench press. The throwing speed in chest pass was measured using a speed radar gun (Bushnell). The subjects were asked to perform a quick and strong chest pass by using a basketball (FIBA approved, category 7) from a distance of 7 m to the tester, throwing 3 to 5 times. One repetition of the maximum (1RM) bench press was measured after warming up. The subjects performed the ballistic bench press with loads corresponding to 30%, 50%, and 70% of 1RM. A linear position transducer (Gymaware, S&C) was attached to the barbell shaft to determine the maximum velocity. Quadratic polynomial regression was calculated from the load and power in bench press, and the maximum power output was determined. Then, power in chest pass was calculated. The relationship between the maximum power in bench press and that in chest pass was examined.
RESULTS: As the load on bench press increased, the velocity decreased linearly. A significant correlation was observed between the maximum velocity of chest pass and the maximum velocity of bench press in 30% of 1RM ($r = 0.77$, $P < 0.05$). In this study, the maximum power in bench press was observed in approximately 50% of 1RM. It was different from that in a previous report (about 30% of 1RM, Kaneko, 1970). In addition, a significant correlation was not observed between the power in chest pass and the maximum power in bench press.
CONCLUSION: In the power output of multiple joints of the upper limbs, the maximum power was not necessarily shown in 30% of 1RM. As the significant correlation was acceptable between the maximum velocity of chest pass and the maximum velocity of bench press in 30% of 1RM, we suggest that for the improvement of the throwing speed in chest pass, lower load should be applied on bench press.
REFERENCES: Kaneko M (1970) The relation between force, velocity and mechanical power in human muscle. Res J Physical Ed 14: 143-147

GROUP AND INDIVIDUAL RESPONSES TO A 4-WEEK HEAVY SLED INTERVENTION IN YOUNG PROFESSIONAL RUGBY UNION PLAYERS

ROE, G., MCLAREN, S.J., DARRALL-JONES, J., JONES, B.

LEEDS BECKETT UNIVERSITY

INTRODUCTION: Eight weeks of heavy sled training is effective for improving sprint performance in team sport athletes (Morin et al., 2017). Shorter duration interventions, more suitable to preseason training blocks have yet to be investigated. We therefore aimed to assess the group and individual responses to a 4-week heavy sled intervention in rugby union players during a preseason training block.
Ten young male professional rugby union players (age 19.1 ± 1.2 years, body mass (BM) 98.1 ± 15.4 kg, height 184 ± 5 cm) completed a 4-week heavy sled programme in addition to their normal training. Data from the previous preseason exclusive of any sled training was used as a control (including the same (n=5) and different (n = 6) players to intervention (age 18.9 ± 1.3 years, BM 97.6 ± 14.5 kg, height 183 ± 6 cm). Individual sled loads were determined at the beginning of preseason via sprint force-velocity-power profiling, using 0% (40-m), 60% (30-m) and 120% (20-m) BM as external loads and methods similar to previous research (Cross et al., 2017). Subsequently, players completed 2 sets of 4 (week 1), 5 (weeks 2-3) or 6 (week 4) 20-m heavy sled sprints (75-87% BM) on 2 non-consecutive days. Between-sprint and set rests were 3 and 5 min respectively. Linear mixed models with random effects were used to examine the pre-post intervention-control differences in linear sprint times (10-, 20-, 30- and 40-m, unloaded) whilst adjusting for baseline value and training load (derived from session ratings of perceived exertion) accumulated outside the intervention sessions. Standard deviations (SDs) for individual differences in response to the intervention (vs control) were also estimated along with the number of true responders to the intervention (≥ 75% probability that the observed change > control group pre-post typical error and smallest worthwhile change [SWC]).
10-m time was likely faster (> SWC) following the intervention compared to the control period (-2.4%; 90% confidence limits ±1.8%). The pre-post intervention-control difference was unclear for 20- (-0.4; ±1.7) and 30-m times (-0.6; ±1.6), and possibly trivial for 40-m time (0.6; ±1.6). Individual response SDs were moderate for 10-m (3.3%; ±4.0%) and trivial for 20- (-1.3; ±3.6), 30- (-1.7; ±3.5), and 40-m (-3.9; ±2.1). The number of true and substantial responders to the intervention were 5, 1, 2 and 0 for 10-, 20-, 30- and 40-m times.
Four weeks of heavy sled training improves 10-m sprint time in rugby union players, with substantial individual responses apparent. No substantial effects were evident for sprint times greater than 10-m -a finding that may be explained by the specificity of training-induced adaptations. Whether these improvements are maintained beyond the intervention period and to what extent non-responders can be explained requires further investigation.
Cross et al. (2017) Int J Sports Phys Perform, 12(8), 1069-1077
Morin et al. (2017). Int J Sports Phys Perform, 12(6), 840-844

METHODS: RESULTS: CONCLUSION: HIGH VS. LOW FREQUENCY RESISTANCE TRAINING: AN ANALYSIS OF INDIVIDUAL MUSCLE HYPERTROPHY

LIBARDI, C.A., BARCELOS, C., DAMAS, F., NÓBREGA, S.R., LIXANDRÃO, M.E., SANTOS, L.M.E., UGRINOWITSCH, C.
FEDERAL UNIVERSITY OF SÃO CARLOS

INTRODUCTION: Higher resistance training (RT) frequencies can result in greater weekly total training volume (TTV, sets × repetitions × load) and RT-related outcomes (Schoenfeld, Ogborn, Krieger, 2017). On the contrary, it is reasonable to assume that very high training frequencies (e.g. five times per week) may not be beneficial to RT-related outcomes as one could expect a level of residual fatigue between training sessions that could negatively impact exercise performance. The aim of the present study was to compare the effect of high (HF) or low frequencies (LF) RT on muscle hypertrophy in untrained young men. Additionally, we analysed the hypertrophic responses of each individual at high and low frequency.
METHODS: We used a within-subjects design in which 20 untrained men had one leg randomly assigned to HF (five times per week) and the other to LF (two or three times a week). Vastus lateralis muscle cross-sectional area (CSA) was measured at baseline and after eight RT weeks. Total training volume (TTV) was calculated as sets×repetitions×load.
RESULTS: HF resulted in greater TTV than LF ($P<0.05$). Similar changes were found in muscle CSA comparing legs that trained at HFvsLF (15% and 14%, respectively; $P<0.05$). However, it is interesting to note that some individuals depict larger increases in muscle hypertrophy performing HF, while others had greater gains with LF.
CONCLUSION: In the present study, the LF protocol performed 6-9 weekly sets, while the HF executed 15 sets per week. Thus, our findings suggest that there may be a 'ceiling effect' for muscle hypertrophy on the dose-response relationship of the weekly sets, at least in untrained individuals. It should be noted that the results of muscular hypertrophy were based on group analyses. Thus, it is also interesting to analyse individual responsiveness to HF vs. LF. This analysis showed that some individuals increased more muscle CSA values in response to a HF and consequently greater TTV. We suggest that some individuals might be 'less sensitive' to RT stimulus, requiring HF. Interestingly, some subjects in the present study were more sensitive to lower RT frequencies and TTV. The reason for that is still very speculative, but it may be possible that they require a longer recovery time between sessions in order to maximize RT-related outcomes gains.

EFFECT OF DIFFERENT TYPES OF JUMPING EXERCISE TRAINING ON LOWER-LIMB MOTOR COORDINATION AND MUSCLE POWER IN OLDER ADULTS

NAKATANI, T.1,2, KINO, K.2, YAMAMOTO, H.2, TERADA, K.1,2, SHIRAISHI, A.1,2, NADAMOTO, M.3, MIURA, S.4
HUMAN PERFORMANCE LABORATORY

INTRODUCTION: Age-associated impairment of physical functions may lead to a failure in completing daily tasks (Gralnik et al. 2000). Physical training improves motor performance, and enhanced fitness delays the onset of frailty. This may improve the quality of life in older adults. However, insufficient knowledge about the effects of jumping training on lower-leg muscular coordination, agility and power in older adults is available. The current study investigated the effects of training in different types of jumping exercise on lower-limb motor coordination and muscle power in older adults.
METHODS: Twenty-nine healthy men and women aged 63–80 years participated in this study. Participants were randomly assigned to either a forward jumping (FJ) (n = 16) or in-place jumping (IJ) (n = 13) exercise group. Both groups performed 1 jump per second until they reached a rating of perceived muscle exertion of 15 on the Borg Rating of Perceived Exertion Scale (Borg 1982). The FJ group jumped slightly forward, and the IJ group jumped in place. Both groups trained 3 times a week for 12 weeks. They also participated in 60 min of supervised group exercise once every 2 weeks at a local centre. Outcome measures included right lateral walk (RLW) and left lateral walk (LLW), the four-square step (4SS), foot stepping (FS), two-step stride length (2SL) and chair stand power (CSP).
RESULTS: Repeated measures analysis of variance showed a significant effect of the interaction between exercise and time for CSP, and a significant main effect of time of measurement for RLW and LLW, 4SS and FS in the both groups. In the FJ group, CSP improved significantly after the 12-week intervention (10.3 ± 1.2 vs. 11.6 ± 1.4 kgf/s/kg, $P < 0.05$). FS in the FJ group also showed significant improvement after the 12-week intervention (79.5 ± 14.7 vs. 84.5 ± 10.5 times, $P < 0.05$). The IJ group did not show any significant improvement for CSP or FS.
CONCLUSION: The results of this study suggest that the jumping exercise with slightly forward movement is more effective than in-place movement in improving agility and leg muscle power in older adults. The jumping exercise is simple, can be done at home and is safe. It is a beneficial technique for improving lower-limb muscle strength and power.
References: Borg G (1982) Med Sci Sports Med, 14: 377-381.
Guralnik JM, Ferrucci L, Pieper CF, Leveille SG, Markides KS, Ostir GV, Studenski S, Berkman LF, Wallace RB (2000) J Gerontol A Biol Sci Med Sci, 55(4): M221-M231.
Contact: toshiaki@sta.tenri-u.ac.jp

CORRELATION OF STRENGTH AND SWIM ERGOMETER PERFORMANCE WITH MAXIMAL SHORT COURSE SWIMMING

PETERSEN, C.1, MASON, T.2, PORTER, C.2
1. UNIVERSITY OF CANTERBURY, 2. SWIMMING CANTERBURY

INTRODUCTION: Minimising drag and maximising propulsive force are key factors in competitive swimming performance, with explosive strength also important for start and turns. Identifying factors that highly correlate with performance may help prioritise strength and conditioning practices. Therefore, our aim was to analyse correlations of several strength variables to 100m short-course swimming performance in adolescent swimmers.
METHODS: Twenty competitive swimmers, 10 male (age: 15.6 ± 3.5 years; mass: 67.0 ± 15.9 kg; height: 170.2 ± 10.1 cm) and 10 female (age: 16.0 ± 1.8 years; mass: 60.3 ± 4.1 kg; height: 165.0 ± 6.4 cm) volunteered to take part in the investigation. Recent 100-m short-course personal best (PB) swim performances in freestyle (Free) (64.58 ± 5.10 s :mean +sd), backstroke (Back) (73.07 ± 7.06 s) breaststroke (Breast) (87.46 ± 7.70 s), butterfly (Fly) (74.67 ± 9.54 s) and individual medley (IM) (74.28 ± 5.31 s) were correlated with swimmers' explosive strength (countermovement vertical jump (CMJ) and broad jump), swimfast ergometer (Kayackpro, USA) arm and leg tests as well as pool kick testing. Spearman's rank order correlation analysis was used to assess correlations between variables and PB swim performances.
RESULTS: Very large correlations were found with; 100m pool kick (96.94 ± 13.64 s) and both Free ($rs = 0.75$; $p<0.001$) and Back ($rs = 0.74$, $p<0.001$), and with CMJ (36 ± 11 cm) and Fly ($rs = -0.75$, $p<0.001$). Pool kick was also largely correlated with IM ($rs = 0.68$, $p=0.001$) and Fly ($rs = 0.53$, $p<0.02$). Large correlations ($rs = -0.54$ to -0.69, $p<0.01$) were found with CMJ and all other swim strokes, while broad jump (183

± 26 cm) was largely correlated with all strokes (rs = -0.52 to -0.53, p<0.02) except Breast (rs = -0.38, p = 0.07). The 100m ergometer arm test (60.06 ± 17.89 s) was largely correlated with performance across all strokes (rs = 0.51 to 0.62, p<0.02); the ergometer leg test (80.37 ± 31.08 s) was largely correlated with Free performance (rs = 0.68, p=0.001), moderated correlated with Back, Fly and IM, (rs = 0.45 to 0.47, p<0.05) but insubstantial correlated to Breast.
CONCLUSION: To improve swimmers training programmes it is useful to understand the correlation between power output in dryland and in-water exercises and actual swimming performance by specific strokes. The current assessment has highlighted useful stroke specific correlations for 100m short-course swimming performance and the importance of power output for these adolescent swimmers. A limitation of the current study was only using a Free kick on the ergometer, future studies should employ a stroke specific kick on the ergometer which will more closely resemble the specificity of leg movement used to produce propulsion in the water.

THE EFFECT OF TOE GRASP STRENGTH TRAINING ON AGILITY CAPABILITY

KUDO, H., SAITO, S.

MEJIRO UNIVERSITY

INTRODUCTION: Agility capability is the ability to perform quick action with acceleration and deceleration in various directions such as abrupt stop and turn.
It is essential that athletes increase agility capability.
On the other hand, the relationship between the toe function and the athletic ability has also been pointed out, and it has been reported that toe training such as towel gather training improves the muscular strength of toe grasp, repeated lateral jump, standing width jump and vertical jump. (Ihara. H, Miwa. M, Ishibashi. T, et. al., 1997)
METHODS: This study comprised 26 healthy male volunteers (13 toe grasp training group and 13 control). The toe grasp training group volunteers performed 8 weeks of towel gather training as the toe grasp training. We conducted an 8-weeks towel gather training at the toe grasp training group s volunteer, measured toe grasp muscle strength and pro-agility test before and after the training , and compared with the control. In the pro-agility test, also the direction turning time were measured.
RESULTS: The toe grasp muscle strength of the toe grasp training group was significantly improved at 0.24 kg / kg before training and at 0.43 kg / kg after training.
This result is an improvement of 181.2%.
As a result of the pro agility test in the toe grasp trainig group, the test time was shortened to 96.6%, the turn time to the left was 79.3%, and the turn time to the right was 83.6% respectively. All of these results were statistically significant results.
CONCLUSION: Discussion: From the results of this study, it was suggested that the toe grasp strength training could be one of the promising training method to improve agility capability, especially direction turning ability.
Furthermore, by adding toe grasp strength training to agility training it may be able to improve agility capability more effectively.
Although we performed kinetic analysis in this study, but it seems that kinematic analysis is necessary from now on.
Reference
Ihara. H, Miwa. M, Ishibashi. T., et. al. Maintenance of Effects after Stopping Toe Exercises. West-Japanese Society of Orthopedics & Traumatology. 1997, 46(2) ; 393-397.

RELATIVE INDEX OF JUDO-SPECIFIC TEST DISCRIMINATES ATHLETES OF DIFFERENT WEIGHT CATEGORIES

DETANICO, D., KONS, R.L.

FEDERAL UNIVERSITY OF SANTA CATARINA

INTRODUCTION: Specific tests may be used to assess and monitor physical capacities, allowing performance improvements. A specific test widely used in judo athletes is the Special Judo Fitness test (SJFT) that provides an absolute performance index, based in the number of throws (marker of anaerobic capacity) and heart rate (marker of aerobic capacity) (Franchini et al., 2009). However, it seems that relative SJFT index (normalized by body mass) better discriminates the performance of judo athletes in different weight categories (Isik et al., 2017). Thus, this study aimed to analyze the SJFT performance in judo athletes of different weight categories.
METHODS: Twenty eight male judo athletes participated of this study (20.3±3.3 years), divided in two weight categories: Lightweight category (LW) (n=18, 55-73 kg, body mass = 67.2±6.9 kg) and heavyweight category (HW) (n=10, 74-100 kg, body mass = 90.1±9.9 kg). Athletes performed the SJFT that is composed of three sets of 15, 30, and 30 seconds, with 10-s rest interval between each set. During test, athletes performed the maximum number of throws in two participants separated by 3 meters. Number of throws was identified, heart rate immediately after the test and 1 minute after the test were also computed. Absolute SJFT index was calculated through the sum of heart rate (after the test and 1 minute after) divided by the number of throws, while relative SJFT index was calculate by the absolute SJFT divided by the body mass. A t-test was used with level of significance set at p<0.05.
RESULTS: No significant differences were found for number of throws (LW 28±2, HW 27±4, p=0.65), heart rate after the test (LW 176±12 bpm, HW 177±5 bpm, p=0.79), heart rate 1 minute after the test (LW 149±19 bpm, HW 148±8 bpm, p=0.78) and absolute index (LW 11.8±1.5, HW 12.2±1.7, p=0.55); however significant difference was reported for relative index, showing better values in the HW athletes compared to LW (LW 0.18±0.02, HW 0.14±0.02, p<0.001).
CONCLUSION: According to Casals et al. (2017), body mass should be considered in the SJFT interpretation, ratifying our results, that showed only the relative index was able to discriminates heavier and lighter athletes. Although lighter judo athletes generally achieve higher relative power outputs than heavier ones (due to lower body fat) (Isik et al., 2007), in this study they did not present better relative SJFT index, indicating lower performance compared to heavier athletes. We concluded that relative SJFT index discriminated judo athletes of lightweight and heavyweight categories, and it can be used instead of absolute SJFT index for comparison of judo athletes in different weight categories.
References: Casals C, et al. (2017). J Strength Cond Res, 31:1229-1235.
Isik O, et al. (2017). J Human Sci, 14:4219-4225.
Franchini E, et al. (2009). Arch Budo, 5:127-129
Contact: d.detanico@ufsc.br

EFFECTS OF EQUAL-VOLUME RESISTANCE TRAINING WITH DIFFERENT TRAINING FREQUENCIES IN MUSCLE SIZE AND STRENGTH OF TRAINED MEN

GENTIL, P., FISHER, J., STEELE, J., CAMPOS, M., SILVA, M., PAOLI, A., GIESSING, J., BOTTARO, M.

UNIVERSIDADE FEDERAL DE GOIAS

INTRODUCTION: Training frequency has recently received increased attention 1. Considering that lack of time is a common barrier to exercise adoption 2, identifying the minimal frequency of RT to optimize adaptation is of importance. In this regard, condensing exercise sessions into fewer days, yet performing an equal volume, might be a promising strategy. If trained individuals can obtain similar results with lower training frequencies, this could be a valuable strategy for prescribing RT programs for people with time constraints. Therefore, this study would provide valuable information that might conserve training time and encourage participation whilst optimizing adaptation.
METHODS: Sixteen men with at least one year of RT experience were divided into two groups, G1 and G2, that trained each muscle group once and twice a week, respectively, for 10 weeks. Elbow flexors muscle thickness was measured using a B-Mode ultrasound and elbow extensors and flexors peak torque were assessed by an isokinetic dynamometer.
RESULTS: The results of ANOVA did not reveal group by time interactions for any variable, indicating no difference between groups for the changes in MT or PT of elbow flexors and extensors. Notwithstanding, elbow flexors MT increased significantly <3.1%, P < .05> only in G1. Elbow flexors and extensors PT did not increase significantly for any group.
CONCLUSION: There were no differences in performing RT one or two times a week with equal number of sets in trained men. Nonetheless, only the group that trained once per week significantly increased muscle thickness. The results of the present study seem to contradict the results of previous studies in trained men 3. There are studies reporting positive results in trained men training once a week 4 and this approach has been widely used by bodybuilders using split programs 5. As lack of time is the most frequently cited barrier to exercise adoption 2 using an exercise program that can be performed only once a week may improve adherence in periods where time constraint might be an obstacle to continue training. reducing training frequency in trained men can elicit muscle hypertrophy.

EFFECTS OF UPPER-BODY COMPLEX TRAINING WITH OPTIMAL INDIVIDUAL POST-ACTIVATION POTENTIATION TIME ON KAYAK PERFORMANCE AND INFLAMMATORY RESPONSES IN KAYAKERS

HSU, S.C., LEE, Y.H., LIN, S.C., LEE, M.M., CHAN, K.H.

NATIONAL TAIWAN SPORT UNIVERSITY

INTRODUCTION: Complex training is an effective training method for enhancing power output in athletes. An appropriate individual rest interval may be paramount to optimizing the effectiveness of complex training. Upper-body complex training has not received substantial attention compared with lower body complex training. Therefore, the aim of this study was to investigate the effects of 4-week upper-body complex training with optimal individual post-activation potentiation time on kayak performance and the inflammatory responses.
METHODS: Eight male high school canoeists volunteered to participate in this study. The maximal muscular strength (1-RM) of bench press and bench pull, 200 m kayak time trial, as well as the individual post-activation potentiation (PAP) period were determined before the study. Thereafter, subjects perform the complex training 3 times per week for 4 weeks. The training protocol consists 6 sets (2 min between sets) of 3-RM bench press/ 8 repetition medicine ball chest press and 3-RM bench pull/ 8 repetition medicine ball over head throw with the rest time of optimal individual PAP time. Venous blood were drawn before training, 1 and 3 hours after training to determine the concentrations of interleukin-6 (IL-6) and C-reactive protein (CRP) at the first and the last training session. After 4 weeks training, the 200 m kayak time trial were proceed again. Data were analyzed by paired t-test and one-way ANOVA with repeated measures.
RESULTS: After 4-week of complex training with the rest time of optimal individual PAP time, performance for 200 m kayak time trial significantly improved (55.90 ± 10.03 v.s. 57.65 ± 11.19 s, $p < 0.05$). There was no statistically significant difference in the concentrations of IL-6 and CRP within different time points before and after the complex training.
CONCLUSION: The physiological rationale behind complex training has been termed PAP. PAP refers to the phenomenon by which the acute contractile ability of a muscle is enhanced in response to a conditioning stimulus such as a HRE. Previous studies have reported different and contradictory results of PAP, which may due to PAP is an individualized phenomenon (Wang et al., 2016). Therefore, we used the optimal individual PAP time to be the rest time of the training program. Single bout of upper-body complex training had acute effect on power output of bench press throw (Liossis et al., 2013). This study indicated that the 4-week training program used in this study could enhance the kayak performance. Moreover, strenuous exercise induces increased levels in a number of inflammatory cytokines (Pedersen, 2000). The training program applied in this study would not induce the inflammatory responses.
References: Liossis, L. D., Forsyth, J., Liossis, C., Tsolakis, C. (2013). J Hum Kinet, 39, 167-175.
Pedersen, B. K. (2000). Immunol Cell Biol, 78, 532-535.
Wang C. C., Yang M. T., Lu K. H., Chan K. H. (2016). Nutrients, 8, 143.

THE RELATIONSHIPS BETWEEN KNEE MUSCLES STRENGTH BALANCE AND SOCCER EXPERIENCE AMONG PROFESSIONAL MALE PLAYERS

MISJUK, M., RANNAMA, I.

TALLINN UNIVERSITY

INTRODUCTION: The game of soccer involves frequent one-sided activities, which may lead to muscle strength asymmetries between two legs and between agonist-antagonist muscle groups (Maly et al.,2016, Dauty et al., 2003). Theoretical model of functional asymmetry in soccer demonstrates that soccer players training age could be one factor that affects formation of functional asymmetry (Fouseks et al., 2010). There is lack of studies that investigate relationships between knee muscular strength balance and soccer experience of soccer players.
The purpose of this study is to investigate relationships between knee muscles strength balance and soccer experience.
METHODS: The study is based on 102 male soccer players from Estonian Premium League teams (22.9±4.3yrs, 181.1±6,8cm, 76.6±8,1kg, soccer experience 15.6±4.2 yrs). Soccer players performed knee extensors and flexors test. Peak torque was measured with an isokinetic dynamometer Humac Norm (USA). Concentric actions were measured at angular velocity of 60, 300°/s, and eccentric actions at angular velocity of 60°/s. The study employs two types of muscular strength balance parameters: H/Q ratio and bilateral symmetry of extensors and flexors. Soccer experience was defined as a period since players started participating in soccer training. Pearson correlation analysis was used to estimating relationships between the variables.

RESULTS: Statistically significant relationships were found between knee muscle strength balance and soccer experience. The longer experience of soccer players was significantly related with higher extensors bilateral strength asymmetry ($p<0.01$) at angular velocity of 60°/s on concentric mode ($r=0.255$) and lower H/Q ratio of non-dominant leg ($p<0.05$) at angular speed 60°/s on eccentric mode ($r=-0.206$). No statistically significant relationships were found between strength balance at angular speed 300°/s and soccer experience.
CONCLUSION: Results of current study are not in line with previous study that found reduction of directional asymmetries of concentric knee flexors at 180°/s and 300°/s with professional training age (Fousekis et al., 2010). In contrast to the previous study, we found that when soccer experience is increasing then muscular balance problems (H/Q ratio and bilateral deficit) are also increasing. Earlier injuries are one possible explanation for it. It is well known that injury rate in professional soccer is high and lower extremity injuries are most common (Ekstrand et al., 2011). Longer the soccer career has lasted, more likely it is that players have had injuries that affected their strength balance of knee muscles.

THE COMPATIBILITY OF EVALUATION OF AEROBIC CAPACITY, BY MEANS OF THE YO-YO, AND BEEP TESTS, OF AMATEUR FOOTBALL PLAYERS

SZMATLAN-GABRYS, U.1, GARNYS, M.2, STANISZ, L.1, STANULA, A.3

1:STATE SCHOOL OF HIGHER EDUCATION IN , 2:4SPORTLAB , 3:UPE

INTRODUCTION: The aerobic capacity is vital in the preparation of amateur footballers when it comes to the safe participation in such a form of physical activity of people who participate in training sessions 4-5 times a week. The studies carried out by Helgerud, J., Engen L., Wisløff U., Hoff J. (2001) , confirmed the normativity of the running tests designed for footballers in order to evaluate their aerobic capacities. The aim of this study was to verify the compatibility of the evaluation of the aerobic capacity of amateur football players, carried out by means of the Yo- Yo, and Beep running tests with direct measurements of physiological indexes.
METHODS: The participants of the study were 41 amateur football players aged 27,5±3.9 years, height 175.7 ± 6.9 cm, body mass 76.4 ± 6.1 kg. All participants regularly took part in training sessions for 8-10 hours a week. The studies were carried out on a football pitch, in accordance with the Yo- Yo Test and Beep Test (Thomas A., Dawson B., Goodman C. 2006) procedures, separated by a 72 hour break. The physiological parameters VO2, VE, RF, and VO2HR were measured by means of the K4b2 analyzer (Cosmed, Italy), and the HR by Polar Team (Finland)
RESULTS: In the study group the mean values in the Beep Test, and in the Yo-Yo Test, respectively, for the particular indexes: VO2max 56,53±5,61 /53,51±2,26 ml/kg/min, VE 135±10,7/ 129±9,4 l/min; RF 56±6,4 b/min/ 59±2,8 b/min; HR 193±4 / 189±3 bp/min; VO2HR 22,3± 3,1 /21,4±1,4 ml/bpm. All the parameters, with the exception of the RF in the Yo-Yo Test, adopt lower maximum values. These differences are of the order of 2-5%.The statistically significant differences of the order of $p=0.05$, occurred among the values of VO2max, RF, and VO2HR. A correlation analysis of analogous indexes, showed a statistically significant relationship in just two cases: the HRmax ($r=.455$ $p=0,01$), and the VO2HR ($r=.311$ $p=0,05$)
CONCLUSION: The lack of a statistically significant correlation relationship among the aerobic capacity index values, recorded in two running field tests, indicates the need for carrying out further studies in this area, and explaining the causes of such a state of affairs. The evaluation of the competitor cannot differ depending on the applied testing tool. The Yo-Yo Test with its velocity increase structure, is more aggravating for an amateur football player, than the Beep Test. This is indicated by lower physiological parameters values, at which the physical effort undertaken in accordance with this program, is stopped. In the Yo-Yo Test, there is an earlier activation of anaerobic metabolism, which is indicated by a higher level of the respiratory frequency (RF), stimulated by the increase of the concentration of CO2 in the exhaled air.
References: Helgerud, J., Engen L., Wisløff U., Hoff J. (2001) Med. Sci. Sports Exerc., 33(11) :1925–1931
Thomas A., Dawson B., Goodman C. (2006) Int. J. Sports Physiol. Perfor.Exce, 1:137-149
Contact: ulagabrys1957@tlen.pl

POSITION-DEPENDENT PHYSIOLOGICAL AND SOMATIC PROFILE OF ELITE YOUNG FEMALE BASKETBALL PLAYERS.

MIKOLAJEC, K.1, STANULA, A.1, GABRYS, T.2, GRYKO, K.3

1: AWF , 2: AJD , 3: AWF

INTRODUCTION: Many features characterize physiological profile of team sports players. Considering basketball most important physical abilities are power (jumps and high intensity runs), aerobic endurance (recovering from intense actions) anaerobic endurance (up-tempo style of play), speed (1x1, fastbreak), agility (ball control, multi-directional movements) [2]. Previous investigations have reported that the level of those variables might depends on playing position [1].
Therefore, the purpose of this study was to investigate the relation between selected physical abilities and playing position of youth polish national teams female basketball players at different age levels.
METHODS: 42 elite female basketball players participated in the study (U-16, n=15; U-18, n=12; U-20, n=15). Testing took place during the preparation mezocycle before FIBA Youth European Championships. Players were grouped depends on playing position on guards (playing position 1, 2), forwards (position 3 and 4) and centres (position 5). 10 different tests were carried out including: anthropometric measurement, speed, power, aerobic and anaerobic endurance and agility. One-way ANOVA was used to investigate the mean differences in the tested features according to playing position and age category.
RESULTS: U-16. Results showed that guards were significantly faster than forwards and forwards than guards for 5 m sprint (1.16 s vs. 1.18 s; $p<0.01$ and 1.18 s vs. 1.18 s; $p<0.01$) and total time of RAST test (30.37 s vs. 32.85 s; $p<0.001$ and 32.85 s vs. 30.52 s; $p<0.001$ respectively).
A significant effect of playing position was observed in body height, body mass and FFM. No significant effect was recorded in VO2max and HRmax.
U-18. Results showed that centres are taller than forward and guards (196,0 cm vs 172.0 cm; $p<0.01$ and 182 cm vs 172.0 cm; $p<0.05$ respectively).
U-20. As expected significant effect was reported in body height between centers and guards (194.3 cm vs 173.7 cm; $p<0.001$) and forwards and guards (185.6 cm vs. 173.7 cm; $p<0.01$). Results also showed significant effect of playing position in 5 m sprint between guards and centers (1.09 s vs. 1.2 s; $p<0.05$) and total time of RAST test between guards and centers as well as center and forwards (30.31 s vs. 34.13 s; $p<0.001$ and 34.13 s vs. 31.21 s; $p<0.01$ respectively).
CONCLUSION: Discussion: The body height and body mass differences were mostly observed between centres and guards and centres and forwards which indicates that this position is very specific according to game requirements. Significant effect of playing position in speed ability and anaerobic endurance (RAST test) can be explained by greater number of high-intensity activities in guards and forwards

compared with centres during game performance. No significant difference in VO2max indicates that game requirements in this area are similar despite of the playing position.
References: 1. Delextrat A., Cohen D. Strength, power, speed, and agility of woman basketball players according to playing position. J Strength Cond Res, 23(7): 1974-81, 2009.
2. LaMonte MJ. et al. Comparison of physical and physiological variables for female college basketball players. J Strength Cond Res, 13: 264-270, 1999.
Contact: k.mikolajec@awf.katowice.pl

THE EFFECT OF TRAINING ON SIDE FOOT-KICK PERFORMANCE AMONG SWEDISH FIRST LEAGUE WOMEN'S SOCCER PLAYERS

CARLSSON, M.1, ISBERG, J.1, NILSSON, J.1, CARLSSON, T.1

DALARNA UNIVERSITY

INTRODUCTION: A high completion rate for passes is important for success in soccer, because longer passing sequences are related to more scored goals (Hughes & Franks, 2005). In a recent study, it was found that female players had a lower pass-completion rate than male players at the highest competitive standard of European soccer, which suggests that elite female players in general do not have the same technical characteristics as elite male players (Paul S. Bradley et al., 2014). The purpose of the study was investigate the effect of a 2-week training intervention on side foot-kick performance among Swedish first league women's soccer players.
METHODS: To investigate the effect of training on side foot-kick performance, a pre-post-intervention study was implemented where four side foot-kick tests were performed before and after a 2-week training period. The side foot-kick accuracy were investigated when kicking a stationary ball using match-relevant ball speed (SBRS) and maximal ball speed (SBMS) as well as subsequent to a 5-m run with the ball from different approach angles (0°, 30°, and 60°) to a predetermined position, where passing of the ball on the move was executed using match-relevant ball speed (RBRS). The fourth test comprised repeated side-foot kicks onto a rebound-box with continuously increasing passing distance (RRB).
Based on the results from the pre-tests, the players were assigned to either the intervention group (INT) or the control group (CON). The training intervention consisted of six 55-min training sessions. In each session, two rounds of five exercises focusing on improvement of side foot-kick accuracy were executed. Within-group and between-group differences were investigated using paired samples Student's t-tests and Mann-Whitney U tests, respectively.
RESULTS: Prior to the training intervention, there were no significant differences between the groups for any of the investigated test variables. The INT group improved RBRS ($P = 0.036$) and RRB ($P = 0.010$) during the training intervention, whereas no significant within-group changes were found for either SBRS or SBMS (both $P > 0.05$). No within-group differences were found for any of the test variables in the CON group (all $P > 0.05$). Significant between-group differences were found for RBRS ($P = 0.040$) and RRB ($P = 0.005$), whereas no differences were found for either SBRS or SBMS (both $P > 0.05$).
CONCLUSION: The fundamental soccer skill of passing a moving ball could be improved in elite women players by a 2-week training period focusing on improving side foot-kick performance.
REFERENCES:
Bradley PS, Carling C, Diaz AG, Hood P, Barnes C, Ade J, Boddy M, Krustrup P, Mohr M (2013) Hum Mov Sci, 32, 808-821.
Hughes M, Franks I (2005) J Sports Sci, 23, 509-514.

THE TRACKING PERFORMANCE IN THE TRAINING PERIOD WAS SIGNIFICANTLY BETTER THAN IN THE COMPETITION PERIOD IN ELITE BASEBALL PLAYERS

WU, S.K., CHEN, W.Y., CHIANG, C.H., YANG, H.H.

NATIONAL TAIWAN UNIVERSITY OF SPORT

INTRODUCTION: Baseball players have to track the moving balls, the running teammates and opponents at the same time in order to have a best defense. Baseball players had better performance of attentively tracking multiple moving targets than non-athletes was reported in past work. The purpose of the study is to examine whether the tracking performance is different in the competition period and the training period.
METHODS: Twenty-three baseball players and thirty non-athletes were recruited in this study. The tracking performance for all participants were measured with the modifying task by the Multiple Object Tracking Task . In our task, participants were asked to attentively track specific targets wandering around the computer monitor among some distractors for a few seconds, and they reported those targets in the end of trial. The task manipulated the object moving speeds <0.6, 0.9, 1.2, or 1.5deg/s> and manipulated the tracked target numbers <1 or 2 targets> to have 8 conditions. In addition, another condition was asked participants to simultaneously track one target in 0.6 deg/s and another target in 1.5 deg/s. All participants were run the task in the competition period and in the training period.
RESULTS: The tracking accuracy was significantly decreased as increasing the tracked numbers of targets and the tracking speeds for all participants in the competition period and the training period. An interesting finding was that at slow speeds <0.6 deg/s>, the tracking performance was similar for tracking two targets in the same speeds and in the different speeds. In contrast, at higher speeds <1.5 deg/s>, the tracking accuracy of two targets in the different speeds was significantly higher than two targets in the same speeds. In both periods, the tracking accuracy for baseball players was significantly better than non-athletes. Specially, the tracking performance for baseball players was significantly better in the training period than in the competition period, but non-athletes had similar tracking performance in both periods.
CONCLUSION: The study identified baseball players performed better than non-athletes in tracking performance. Baseball players in Multiple Object Tracking performance may show different results in different periods.

THE MODIFICATION OF THE YO-YO INTERMITTENT RECOVERY TEST LEVEL 1 FOR AMPUTEE SOCCER PLAYERS

MAEHANA, H., MIYAMOTO, A., WATARI, T., SUZUKI, K., WATANABE, T., KOSHIYAMA, K., YOSHIMURA, M.

JUNTENDO UNIVERSITY

INTRODUCTION: Amputee soccer is uniquely designed for the physically challenged, those who have undergone amputations, as well as those with extremity dysfunctions. All outfield players play on one leg using bilateral crutches without wearing an artificial leg during the match. In recent years, studies have been conducted with respect to amputee soccer. Maehana et al. (2017) has evaluated the match

performance and heart rate (HR) response of competitive match in Japanese amputee soccer. Their results demonstrated that the exercise intensity was high in amputee soccer. In particularly, it could be said to effective that improving maximum oxygen uptake in training. However, measurement method has not been established that considers the characteristics of amputee soccer that plays with clutches. Therefore, this study aimed to improve the Yo-Yo intermittent recovery test level 1 (YYIRT1) for amputee soccer players.
METHODS: Subjects were 10 non-disabled males who had experience of amputee soccer. The employed to measure aerobic performance was used YYIRT1. All subjects carried out normally YYIRT1 without carrying a clutch (Standard YYIRT1) and a clutch held (20m YYIRT1). Moreover, subjects carried out two improvement test with crutches that were shortened the setup distance from 20m to 10m (10m YYIRT1) and 15m (15m YYIRT1). The rest between each trial set more than 1 week. The sound source (beep) used in the test was unified to the default sound. Running performances data such as movement speed, acceleration, and deceleration were collected using a global positioning systems technology. HR was recorded using short-range radio telemetry. HR expressed as bpm and classified following categories: 50-150bpm, 150-160bpm, 160-170bpm, 170-180bpm, 180-190bpm and =190bpm.
RESULTS: The mean movement distance were as follows in respective test: Standard YYIRT1; 2115.5±273.1m, 20m YYIRT1; 210.0±20.0m, 15m YYIRT1; 1240±286.0m, 10m YYIRT1; 1820.0±0.0m. The mean HR were as follows in respective test: Standard YYIRT1; 173.9±7.6bpm, 20m YYIRT1; 137.5±10.4bpm, 15m YYIRT1; 171.1±10.6bpm, 10m YYIRT1; 182.0±5.7bpm. The HR categories spent a lot of time were as follows in respective test: Standard YYIRT1; 180-190bpm (25.5%), 20m YYIRT1; 50-150bpm (69.2%), 15m YYIRT1; 180-190bpm (31.6%), 10m YYIRT1; 180-190bpm (33.3%). There were significant correlations between Standard YYIRT1 and 15m YYIRT1 for movement distance ($r=0.73$; $p<0.05$).
CONCLUSION: Subjects in this study are non-disabled subjects but are training for amputee soccer. The 20m YYIRT1 was difficult to catch up with the sound source (beep) because of longer the setup distance. And, many subjects finished the test without HR reaching the target value. On the other hands, 10m YYIRT1 was too easy because all subjects completed the test. As a result of this study, it would be better improvement that reduce the setup distance to 15m. There was high relation between Standard YYIRT1 and 15m YYIRT1 in the movement distance. Therefore, it is necessary to further study the usefulness of 15m YYIRT1.

MONITORING OF HEALTH AND PERFORMANCE DATA FROM A PROFESSIONAL BASKETBALL TEAM DURING FOUR COMPETITIVE SEASONS.

GUERRERO, M.1, RODAS, G.2, FERNANDEZ, D.3, CADEFAU, J.1,4, SOLANAS, J.L.5, CUSSÓ, R.1
UNIVERSITY OF BARCELONA

INTRODUCTION: While winning is the primary goal in professional sport, training is often challenged by conflicting imperatives that of achieving optimal conditioning minimize injury and maximize availability to play. To measure the impact of training models on damage, injury and illness incidence, data of health and performance related variables must be integrated into all aspects of training and competition . Fast and Slow myosin's serum levels are internal indicators of muscle damage and are associated with the risk of injury . Control of the internal load induced by training and competition is a determining factor in the process of functional assessment of the athlete.
METHODS: 44 male professional basketball players from the FCB Basket unit participated in the experiment during four basket's season. Players were examined three times each season, using the periodic health examination protocol. Team followed Verkhosansky's model of contemporary training for high performance sport teams. Myosins were measured by ELISA .
RESULTS: They show that training protects both fibers of damage decreasing the myosin concentration in serum. However work exposition increase significantly the slow myosin in all seasons while fast myosin is significantly different between seasons , 11-12 and 12-13 , 12-13 and 13-14 . The increase in eccentric exercise correlated with an increase in fast myosin and a decrease in slow myosin . The best scored points are related with the lowest slow myosin.
CONCLUSION: The analysis of the four seasons together we observe the best results have been obtained during the 10-11 seasons and the worse during 12-13 and 13-14 seasons. Monitoring of fast and slow myosin as markers of both muscle fiber injuries is a very good option to test the muscular status of each player and make decisions to optimize the development of training during a competition season.

PHYSICAL AND PERFORMANCE CHARACTERISTICS OF JAPANESE DIVISION Ⅱ FEMALE COLLEGIATE BASKETBALL PLAYERS.

IGUCHI, J.1, AKIKO, S.1, HOJO, T.2, FUJISAWA, Y.2, KUZUHARA, K.3
1:KYOTO GAKUEN UNIVERSITY, 2: DOSHISHA UNIVERSITY 3:AICHI TOHO UNIVERSITY

INTRODUCTION: Several sports (e.g., American football, baseball and soccer, etc.) have invented some performance tests such as 1 Repetition Maximum (RM) bench press and squat, 40-yard sprint and Yo-Yo endurance test, which reflect competition time and physiological metabolism in each sport. Based on the studies which analyzed the results of those tests, it has been clear that power, muscular strength and body composition play important roles in deciding whether regular or non-regular player, teams win or loss. Regarding basketball, due to the rule changes in 2000(e.g., shortening of attack time from 30 seconds to 24 seconds) speeding up the progress of the game, players need more anaerobic capacity. In this study, we compared Japanese division 2 female collegiate basketball players with English national league division 2 female players in terms of body composition and physical performance. This research aims to verify whether the above findings apply to womens basketball by comparing between international countries.
METHODS: Twenty-two collegiate female basketball players(n=22, age=19.3±1.1 years) were recruited for this study. All subjects were classified by position: Center, Forward and Guard. Before participation, each subject was informed in detail of the study and provided written informed consent. All subjects were assessed for body composition (Height[cm], body weight[kg] and fat [%]) and performed several performance tests composed of vertical jump (VJ, [cm]), 20-m dash(s), Agility T-test(s), Suicide run(s) and Chest pass(m). Power (kg・s-1) was calculated based on each subjects VJ height and body weight. As data to be compared, we referred to the records collected by Delextrat and Cohen (2009). All comparisons were conducted using 1-sample t-test and the alpha level was set at $p \leqq 0.05$.
RESULTS: Significant differences were found in 25 of 36 comparisons. A significant difference was confirmed in all comparisons by team (table 1). As for the comparisons by position, 2 of 9, 9 of 9 and 5 of 9 comparisons showed a significant difference for center, forward and guard, respectively(table2-4).
CONCLUSION: As an overall trend, English players were taller, heavier, less fat, more power, faster in the 20-m dash than Japanese players. On the other hand, the comparison by center showed that there was no significant difference between the 2 teams except for height and body weight.

HIP ADDUCTOR MUSCLE STIFFNESS CHARACTERISTICS IN SOCCER PLAYERS

SAHO, Y.1, TANIGUCHI, K.2, KATO, T.3, KATAYOSE, M.2

1: TEIKYO UNIVERSITY , 2:SAPPORO MEDICAL UNIVERSITY , 4 OBIHIRO KYOKAI HOSPITAL

INTRODUCTION: Soccer is one of the sports with the most injuries. In particular, many muscle injuries occur in the lower limbs. Groin pain, including adductor muscle strain, is a typical injury among soccer players (Mosler et al. 2017). A better understanding of the mechanical properties of the lower leg muscles may help prevent muscle strain. We sought to investigate stiffness in the lower leg muscles of soccer players.
METHODS: Overall, 78 collegiate male soccer players (age: 19.4±1.0 year) participated in the study. The shear modulus in the hip adductor longus, biceps femoris, medial head of gastrocnemius, and soleus was measured in the resting and stretching position using ultrasound shear-wave elastography. We also examined differences in stiffness between each muscle in resting position, and between the dominant and non-dominant side in the stretching position.
RESULTS: Stiffness at rest was significantly different between muscles ($P < 0.05$). The hip adductor muscle was the stiffest, followed by the soleus, medial head of gastrocnemius, and soleus. Muscle stiffness of the adductor muscle while stretching was higher on the dominant side than on the non-dominant side ($P < 0.05$). Muscle stiffness while stretching in the other three muscles was not different between the dominant and non-dominant side.
CONCLUSION: Soccer includes kicking, stopping, jumping, and cutting. Kicking is an asymmetric motion that requires strong ball kicking in the dominant side leg, while stability in the non-dominant side leg. Most players prefer to kick with their dominant leg. The hip adductor muscle is important on the kicking and stable side. These asymmetric motions may influence muscle stiffness in the hip adductor muscles. Because hip adductor muscles are sometimes linked to groin pain, data on differences in mechanical properties are helpful to identify the mechanism of muscle injury in soccer players.References: Mosler AB, Weir A, Eirale C, Farooq A, Thorborg K, Whiteley RJ, Holmich P, Crossley KM. (2017). Br J Sports Med. Epub ahead of prnint.
Contact: yasu.saho@gmail.com

SHORT-PASSING ABILITY OF AUSTRIAN SOCCER PLAYERS COMPETING AT DIFFERENT LEVELS

WALLNER, D.1, SIMI, H.1, GRIMM, P.1, HAGENAUER, M.1, KLÖCKL, P.1,2

1: FH JOANNEUM UNIV. OF APPLIED SCIENCES; 2: KARL-FRANZENS-UNIV. GRAZ

INTRODUCTION: Passing ability is a fundamental skill for soccer players. Several tests exist to assess short-passing ability (Aki, 2011). They show good discriminative validity between playing levels and ages (Wen et al., 2017). The aim of this study was to analyze the short-passing ability of Austrian soccer players competing at different levels.
METHODS: 168 Austrian soccer players (age: 23.2±4.6 yrs; height: 180±6 cm; BMI: 23.5±1.7 kg) performed a modified Smart Speed passing test (Thiem, 2013). This test requires players to complete 15 passes against four targets in a randomized order as quickly as possible. Targets are 90 x 35 cm and placed in the middle of each boundary line of a 6.5 x 6.5 m field. The best of two attempts counted. The players were divided into groups according to the league they played in: professional (n=33), semi-professional (n=55), amateur (n=62) and hobby players (n=18). Data were analyzed by one-way ANAOVA und Tukey post-test.
RESULTS: There was no difference in body height and BMI between groups ($p>0.05$). The passing test was performed in 24.8±1.5 s, 25.1±2.1 s, 26.6±3.1 s and 28.4±3.0 s, respectively, and revealed significant differences between groups. Post-test showed differences between all groups ($p<0.05$), except between professional and semi-professional players.
CONCLUSION: Most of the players competing at a semi-professional level in Austria are former professional players and/or skilled players trained in a national soccer academy. This may explain why no difference in passing skills between professional und semi-professional players was found. Professional and semi-professional players in Austria may differ in other characteristics, such as physical fitness.
REFERENCES:
Aki A. (2011). Scand J Med Sci Sports. 21(2), 170-183
Thiem T. (2013) Smartspeed Protokolle. Script. 2D Debus & Diebold Meßsysteme GmbH, Karlsruhe
Wen D., Robertson S., Hu G., Song B., Chen H. (2017). J Sports Sci. 24, 1-13

DIFFERENCES IN PERFORMANCE PARAMETERS BETWEEN CYPRIOT AND FOREIGN PLAYERS PARTICIPATING IN FIRST DIVISION IN CYPRUS.

PARPA, K., MICHAELIDES, M., ZACHARIA, A., NICOLAOU, S.

UCLAN UNIVERSITY OF CYPRUS

INTRODUCTION: Football has by far become the most popular sport in Cyprus. The Cypriot league has the highest percentile of foreign players compared to any European league. In 2016, 65.4% of the players participating in the league were of a foreign nationality, while in 2017 that number increased to 80.2% (1). The purpose of this study is to examine different demographic and performance characteristics of Cypriot players compared to this of foreign players. Training protocols and recruitment guidelines can be deduced based on the comparisons between Cypriot and foreign football players.
METHODS: Two hundred and thirty seven professional football players (Cypriots n=100, foreigners n=137) were evaluated using an isokinetic dynamometer. Peak torque and hamstring to quadriceps (H/Q) ratios were evaluated at both 60 degrees/s and 300 degrees/s.
RESULTS: Foreign players demonstrated significantly greater body weight ($p<0.05$) and body mass index ($p<0.05$) compared to the Cypriot players with no significant differences in body fat. In addition, Cypriot players were significantly younger ($p<0.05$) while no significant differences existed in height measurements.
Based on the isokinetic testing it was found that foreign football players produced significantly greater torques (at 60 degrees/sec) in both the right and left hamstring (H) muscles compared to Cypriot players [$F=2.96$, $p<0.05$ and $F=1.51$, $p<0.05$ for right and left H respectively]. In addition, foreign players produced significantly greater torques in the left quadriceps at 300 degrees/sec compared to the Cypriot players ($F=2.54$, $p<0.05$). Finally, significant differences were observed in hamstring to quadriceps ratio (H/Q ratio) of the right leg between Cypriot and foreign players ($p<0.05$).
CONCLUSION: It was concluded that foreign players had higher body musculature (significantly greater BMI and body weight with no differences in body fat) compared to Cypriot players. Cypriot players were significantly younger which may partially explain the selection of more experienced foreign players by the first division teams. Furthermore, foreign players demonstrated greater hamstring strength,

which is of great importance for explosive movements as well as joint balance and stabilization. Therefore, it is suggested that Cypriot players tailor their training routines towards increasing their hamstring strength in order to improve speed and explosiveness. The results of this study may provide the coaches with pertinent information not only on how to maximize exercise performance but also for recruiting more Cypriot players in the first division.

POSITION-DEPENDENT PHYSIOLOGICAL AND SOMATIC PROFILE OF ELITE YOUNG MALE BASKETBALL PLAYERS

STANULA, A.1, MIKOLAJEC, K.2, GABRYS, T.3, STANISZ, L.4, GRYKO, K.5

1-2: AWF , 3: AJD , 4: AWF , 5: AWF

INTRODUCTION: Many features characterize physiological profile of team sports players. Considering basketball most important physical abilities are: power (jumps and high intensity runs), aerobic endurance (recovering from intense actions) anaerobic endurance (up-tempo style of play), speed (1x1, fastbreak), agility (ball control, multi-directional movements) [2]. Previous investigations have reported that the level of those variables depends on playing position [1]. Therefore, the purpose of this study was to investigate the relation between selected physical abilities and playing position of youth polish national teams male basketball players at different age levels.
METHODS: 44 elite male basketball players participated in the study (U-16, n=14; U-18, n=16; U-20, n=14). Testing took place during the preparation mezocycle before FIBA Youth European Championships. Players were grouped depends on playing position on guards (playing position 1, 2), forwards (position 3 and 4) and centres (position 5). Each subject completed 10 different tests: anthropometric measurement, speed, power, aerobic and anaerobic endurance and agility. One-way ANOVA was used to investigate the mean differences in the tested features according to playing position and age category.
RESULTS: U-16. Results showed that centres and forwards are significantly higher than guards (200.0 cm vs. 182.8 cm; $p<0.01$ and 193.8 cm vs. 182.8 cm; $p<0.05$, respectively). An effect of playing position was observed in anaerobic (RAST test) and aerobic (VO2max test) endurance but the differences were not significant.
U-18. Results showed that centres are taller than forwards and guards (208,0 cm vs. 188.0 cm; $p<0.01$ and 196,8 cm vs. 188.0 cm; $p<0.05$ respectively).
U-20. Significant effect was reported in body height between centres and guards (204.0 cm vs. 190.8 cm; $p<0.001$). Results showed that forwards were significantly faster than centres for 5 m sprint (1.03 s vs. 1.12 s; $p<0.05$). Some differences were recorded in VO2max and HRmax between forward and centres, but they were not significant.
CONCLUSION: No significant difference in VO2max indicates that game requirements in this area are similar despite of the playing position. Significant differences in body height observed between centres and guards and centres and forwards which indicates that this position is very specific according to game performance. Significant effect of playing position in speed ability (5 m test) between forwards and centres can be explained by greater number of high-intensity activities in forwards compared with centres during game.
REFERENCES:
1. Delextrat A., Cohen D. Strength, power, speed, and agility of woman basketball players according to playing position. J Strength Cond Res, 23(7): 1974-81, 2009.
2. LaMonte MJ. et al. Comparison of physical and physiological variables for female college basketball players. J Strength Cond Res, 13: 264-270, 1999.
Contact: a.stanula@awf.katowice.pl

KICK OFF TIME AND TRAVEL AFFECT SLEEP RECOVERY KINETICS

MACLEOD, S., DRAKE, D., DAVIS, J., HAGAN, C., MURPHY, B.

ULSTER RUGBY

INTRODUCTION: It has been consistently reported that athletes sleep can be disrupted during competition phases due to travel and timing of fixtures (Skein et al. 2013; Fullagar et al. 2015). This investigation aimed to evaluate sleep recovery kinetics during an intensive competition phase with varying match kick-off times including travel.
METHODS: Consented data was obtained from 59 male rugby union players during the 16-17 Pro12 competition season. Players sleep-wake cycles were monitored over a 90-day period using Actigraphy (Nokia Go, California, USA) and tablet-based self-reports of sleep quantity (BrainWaveBank Ltd, Belfast). Match types were defined as; early KO: pre 5pm; Late KO: post 5pm; Home fixture or Away fixture. Baseline sleep was defined as the average hours of sleep per night with the exclusion of pre and post match sleep hours.
RESULTS: Pre-match showed significantly greater sleep duration than post-match (+120mins; $p < 0.001$) and baseline nights (+48mins; $p < 0.01$). In addition, a significant difference was present between post-match and baseline sleep duration (-72mins; $p < 0.001$).
Post-match sleep duration for Late KO was significantly less than Early KO (-42mins; $p < 0.05$) although there were no differences for pre-match sleep duration when comparing either kick off time ((Mean ± SD) Early: 522 ± 54 v Late 534 ± 78min) or match location (Home: 522 ± 78 v Away: 540 ± 90min). Also no differences were shown for post-match sleep duration between Home or Away fixtures (417 ± 78 v 396 ± 90min).
After matches, players went to bed significantly later compared to pre-match (+58mins; $p < 0.001$) and baseline (+58mins; $p < 0.001$) and bedtime was significantly later after away fixtures compared to home fixtures (+60mins; $p < 0.001$). Prior to a game, players also extended their sleep by waking significantly later compared to baseline sleep (+62mins; $p < 0.05$).
CONCLUSION: Our data suggest that elite RU players post-match sleep recovery is affected by match type. Following competition, strategies to enhance post-match sleep are required to minimize sleep disturbances. As fixture location has an impact on sleep profiles, optimising travel and training schedules surrounding competition may enhance sleep recovery kinetics in this cohort of athletes. This is due to reduced sleep being observed during the above periods. As a result, this may add to the already impaired recovery state of the athlete due to accumulated training and competition load. This may be particularly relevant over the course of a season or congested fixture block where players are exposed to numerous fixtures and travel.
REFERENCES: Skein. et al. (2013) Int J Sports Physiol Perform
Fullagar et al. (2015) Int J Sports Physiol Perform

ACUTE EFFECTS OF DIFFERENT FORWARD LEG SWING TEMPOS ON FLEXIBILITY AND JUMP PERFORMANCE

ARIYOSHI, K.

OSAKA UNIVERSITY OF HEALTH AND SPORT SCIENCES

INTRODUCTION: Forward leg swings (FLSs) are repetitive movements in which the legs rhythmically move forward and backward. It is one of the representative warm-up exercises for the hip joint. However, a more effective FLS tempo needs to be elucidated. Therefore, the objective of the present study was to investigate an FLS tempo that is effective for flexibility and jump performance.
METHODS: The study involved the right legs of nine healthy male student volunteers (age: 21.3 ± 0.7 years; height: 171.9 ± 6.5 cm; weight: 68.2 ± 10.4 kg; leg length: 77.3 ± 5.4 cm). The subjects underwent experiments four times under different conditions on different days and times and in a random order. The four conditions consisted of different FLS tempos (at rest and 34, 44 and 54 bpm). Hip joint range of motion (ROM) and one-leg vertical jump (VJ) were measured before and after each experiment. During the FLS exercises, electromyogram (EMG) data for gluteus maximus (GM), rectus femoris (RF), vastus lateralis (VL), biceps femoris (BF) and gastrocnemius (GC) muscles were recorded, and lateral-view images were recorded using a digital camera. FLSs were performed 10 times at each tempo. VJs were performed with the subjects' arms fixed near their chests to prevent arm reactions. FLS images were categorised as front-flexion, front-extension, rear-flexion and rear-extension. The root mean square (RMS) values for each category were calculated. Normalised values were then obtained by calculating RMS for maximum voluntary contraction. The statistical analysis included the comparison of ROM and VJ scores for each condition before and after FLS and that of the level of muscle activity during FLS. One-way repeated analysis of variance was performed using the Bonferroni post-hoc analysis ($p < 0.05$).
RESULTS: The ROM value significantly increased from 85.6° ± 9.8° to 92.2° ± 9.1° at 44 bpm and from 80.6° ± 10.7° to 87.2° ± 8.3° at 54 bpm. The VJ value significantly decreased from 30.4 ± 3.2 cm to 28.9 ± 2.5 cm at 34 bpm but significantly increased from 28.3 ± 1.9 cm to 30.9 ± 3.4 cm at 54 bpm. Furthermore, muscle activities showed significant differences: At front-flexion, RF activity was 52.9% ± 30.1% at 34 bpm and 25.9% ± 11.6% at 54 bpm; at front-extension, RF activity was 34.7% ± 18.1% at 34 bpm and 8.4% ± 5.1% at 54 bpm; at rear-extension, GM activity was 69.9% ± 27.7% at 34 bpm and 29.0% ± 30.1% at 44 bpm, whereas BF activity was 64.2% ± 40.8% at 34 bpm, 27.0% ± 15.6% at 44 bpm and 38.9% ± 37.6% at 54 bpm; at rear-flexion GM activity was 52.8% ± 22.0% at 34 bpm and 18.0% ± 13.7% at 54 bpm, RF activity was 4.5% ± 2.9% at 34 bpm and 10.0% ± 4.0% at 54 bpm and VL activity was 20.0% ± 13.4% at 34 bpm and 39.9% ± 25.3% at 54 bpm.
CONCLUSION: A faster tempo while performing FLS can improve flexibility and jump performance and is therefore recommended.

VALIDITY AND REPEATABILITY OF SPRINT AND AGILITY TESTS FOR TENNIS PLAYERS THROUGH MANUAL STOPWATCH MEASUREMENTS

UMEBAYASHI, K., IMANISHI, T.

OSAKA UNIVERSITY OF HEALTH AND SPORT SCIENCES

INTRODUCTION: This study aimed to determine the validity and repeatability of agility tests for tennis players through manual stopwatch measurements and by comparing the results with an automatic photocell timing system.
METHODS: Eleven male junior tennis players (age: 13.5 ± 0.5 yr) and five measurers participated in the experiment. The tennis players participated in three tests (sprint tests [5 m, 10 m, and 20 m], a sidestep pro-agility test (SSP agility test), and a 505 agility test). The manual stopwatches and the automatic photocell timing system measured concurrently, and we calculated intraclass correlation coefficient (ICC) using both methods and twice attempt data.
RESULTS: The ICC for assessing the repeatability of the 5 m and 10 m sprint tests through manual measurement was low (below 0.2). When compared with automatic measuring, the 5 m and 10 m sprint tests and the SSP agility test had low ICC (below 0.55). However, the 20 m sprint test and the 505 agility test showed high ICC values (0.75 and 0.94).
CONCLUSION: These results suggest that the 20 m sprint test and the 505 agility test are valid and repeatable assessing methods to test the sprint and agility of tennis players through manual measurement also.

ACUTE AND CHRONIC EFFECTS OF ENDURANCE TRAINING ON SR CA2+ HANDLING IN HIGHLY-TRAINED ENDURANCE ATHLETES

GEJL, K., HOLMBERG, H.C., ØRTENBLAD, N.

UNIVERSITY OF SOUTHERN DENMARK

INTRODUCTION: Endurance capacity of the human skeletal muscle is highly dependent on its mechanistic properties. However, knowledge about the responsiveness of important steps involved in the excitation-contraction (E-C) coupling to acute and chronic endurance exercise in highly-trained endurance athletes remains unclear . The present study investigated acute and chronic effects of endurance training, superimposed with three weekly high-intensity training sessions, on the SR Ca2+ release and uptake in elite endurance athletes.
METHODS: 26 elite triathletes and road cyclists completed four weeks of routine endurance training (≈ 20h/week) including three weekly days with a high-intensity cycling session in the morning and a moderate intensity cycling session in the afternoon. In the morning, the athletes performed 8x5min (6x5min @ 85% HRmax and 2x5min as 15s "all-out" - 45s recovery), while the afternoon session consisted of 120 min of moderate intensity cycling at 65% HRmax. Muscle biopsies were obtained from m. vastus lateralis before (Pre) and after (Post) the training period as well as one hour after the 120min moderate intensity bike session on the 7th day with two bike sessions (Acute). The fluorescent dye technique was used to determine Ca2+ uptake and release rates in SR vesicles in homogenate from the biopsies.
RESULTS: The maximal SR Ca2+ release rate, measured during resting conditions, increased to 110 ± 4 % of Pre during the 4-week training period ($P = 0.01$), while the SR Ca2+ uptake rate remained unchanged (99 ± 5 % of Pre, ns). One hour after finishing the 120min session, on the 7th day with two cycling sessions, the SR Ca2+ release rate was reduced to 78 ± 4 % of Pre ($P < 0.0001$) while the SR Ca2+ uptake rate, measured as the time for free [Ca2+] to decrease by 63%, was increased to 121 ± 10 % of Pre ($P = 0.02$).
CONCLUSION: The present findings demonstrate that the SR Ca2+ handling in the skeletal muscle of highly-trained endurance athletes is plastic and that deteriorations in both SR Ca2+ release and uptake rates may partly explain the development of muscle fatigue during exhaustive exercise. Moreover, improvements in muscle performance after a period of endurance training may be partly explained by chronic adaptations in the SR Ca2+ release rate.

PHYSIOLOGICAL CHARACTERISTICS OF LONG-DISTANCE RUNNERS PARTICIPATING IN INSPIRATORY MUSCLE TRAINING

ROZEK-PIECHURA, K., KURZAJ, M., KUCHARSKI, W., OKRZYMOWSKA, P., MACKALA, K., STODOLKA, J.
UNIVERSITY SCHOOL OF PHYSICAL EDUCATION

INTRODUCTION: The aim of the study was to evaluate selected physiological parameters of long distance runners participating in addition in 8-week inspiratory muscle training.

METHODS: The research was carried out on 20 athletes of the Sports Club AZS AWF Wrocław, long distance runners who were divided into two groups depending on the sex: 1st group: 10 women, average age 21 ± 2.1, average body height 1.69 ± 0.04, average weight body 56.5 ± 5 in which, in addition to the standard sports training, inspiratory muscle and exhalation training was implemented on the Threshold device. II group: 10 men, average age 21 ± 2.4, average body height 1.79 ± 0.07, mean body weight 66.4 ± 4.8, which in addition to the standard sports training was implemented inspiratory muscles and exhalation on the Threshold device.The following examinations were performed before and after 8 weeks of training: lung ventilation (VC, FEV1) and respiratory muscle strength (PImax and PEmax values) on the Jaeger MasterScreen Pneumo spirometer using a special attachment, physical efficiency test using a spiroergometric test on the treadmill, where VO2max, VO2max / kg body weight and HRmax were measured, the lactate concentration after 4-5 minutes was also measured.
Respiratory muscle training took place 5 days a week. In the first week, load was 30% PI max, and each session lasted 5 minutes, twice a day. The value of the initial load was dictated by the safety conditions of conducting the training. In the following weeks, the load and duration of exercise during the day was increased. The maximum training load was 60% PI max, and the time of a single session last week was 15 minutes.
The sports training was carried out during the preparatory period, which included the MWP introductory mesure and MPO mesozoic general preparation. During the race, the athletes worked on improving the running strength in the first range of intensity, running strength in the second range of intensity, general strength, rhythm and fitness.
RESULTS: The average values of ventilation parameters were as follows: in women VC before training 4.08 liters, after 4.21 liters in men, 4.14 liters before and 4.42 liters after, in women FEV1 before training 3.79 liters, 4 each, 14 liters in men 4.2 liters before and 4.55 liters after, in women PImax before training 9.97 mmHg, after 11.56 mmHg in men 9.36 mmHg before and 10.64 mmHg after, in women PEmax before training 9.62 mmHg , at 11.07 mmHg in men, 8.14 mmHg before and 9.55 mmHg after, and lactate was 8.06 in women before and 7.06 after, in men 9.06 before and 7,96 after
CONCLUSION: There was a slight increase in ventilation parameters in both women and men after 8 weeks of training, while the parameters of inspiratory and expiratory muscle strength increased significantly.
2. Physiological characteristics of the VO2max / kg parameter showed a significant increase after 8 weeks of training, while the level of lactic acid decreased, which may indicate improved training of athletes.

EFFECTS OF RAIN WITH WIND ON THERMAL RESPONSES AND ENERGY METABOLISM WHILE RUNNING IN A MODERATELY COLD ENVIRONMENT

ITO, R.
DAIDO UNIVERSITY

INTRODUCTION: Outdoor exercises, such as jogging, football and marathons, often take place in rainy environments, but relatively few reports have described human physiological responses to exercise in cold rainy conditions. We have been investigating the physiological effects of rain on human physiological responses while running in different environmental temperatures. However, the influence of rain together with wind on body temperature and energy metabolism while running has not been investigated. We hypothesized that rain and wind together would increase physiological stress via body cooling during exercise, even in a moderately cold environment of 10°C.
This study aimed to determine the effects of rain with wind on physiological responses while running at 70%VO2max in a moderately cold environment.
METHODS: Seven healthy men (age, 20.7 ± 2.3 y; height, 172.7 ± 6.5 cm; mass, 68.8 ± 7.1 kg; VO2max, 61.9 ± 4.89 mL/kg/min [means ± SD]) who were non-smokers and not currently taking medication, rested for 10 min and then ran on a treadmill at 70%VO2max for 60 min either with 10 mm/h of rain (WR) or without rain (CON) at a climatic chamber of 10°C. Both WR and CON trials included a 2 m/sec wind and an additional headwind blowing at a velocity equal to the running speed of each participant. The participants were randomly assigned to the trials and balanced for order.
RESULTS: Rectal temperature, mean weighted skin temperature and thermal sensation were significantly lower, and oxygen consumption was significantly higher in WR than in CON (all $p < 0.05$). Heart rate did not differ significantly between the two conditions, but the rating of perceived exertion was significantly higher in WR than in CON at 50 and 60 min, and the respiratory exchange ratio was significantly higher in WR than that in CON throughout the entire trial ($p < 0.05$ for both). Plasma lactate and plasma norepinephrine levels were significantly higher in WR than those in CON ($p < 0.05$), whereas plasma glucose and plasma epinephrine did not differ significantly between the two groups.
CONCLUSION: The lower rectal temperature and thermal sensation accompanied by higher plasma norepinephrine levels indicated that rain with wind increased heat loss and cold stress. Furthermore, exercise efficiency that was probably decreased because the body was cold, might have resulted in increased oxygen consumption, carbohydrate oxidation and lactate concentrations.
Rain with wind intensifies body cooling and increases energy expenditure while running at moderate intensity in a cool environment.

PREDICTION OF MARATHON PERFORMANCE TIME USING PROGRESSION RUN

ADACHI, T.
OSAKA UNIVERSITY OF HEALTH AND SPORT SCIENCES

INTRODUCTION: Marathon performance time (MPT) has a high correlation with physiological factors such as maximal oxygen uptake or lactate threshold. However, in order to determine these physiological factors, expensive apparatus and specialized techniques such as blood collection are necessary.
The purpose of this study is to examine the relationship between progression run and MPT in order to find out methods to predict MPT from routine training results quickly.

METHODS: The test subjects were 66 male and female runners (36 men and 30 women) who belonged to a running club. The age of the subjects was 47.7 ± 8.9 years for men and 46.9 ± 5.7 years for women. The MPT for men was 3 hours 31 minutes 06 seconds ± 32 minutes 06 seconds, and for women was 3 hours 58 minutes 48 seconds ± 22 minutes 06 seconds. Further, MPT was not ones personal best record but the closest race result on the day of the implementation of the progression run, with net time adopted as the MPT.
Progression run is an endurance training that starts with running from a slack pace and gradually increasing the pace. For the progression run, a 500m lapel course was used, and a distance of 8-10km was run. The pace setting began with running at a pace of more than 30-40 seconds per kilometer with the MPT as the base to free pace for the last one kilometer. For example, in case of a MPT of 3 hours (4 minutes 16 seconds/km）, the pace was set at 4 minutes 40 seconds for start of running and paced up to 3 minutes 30 seconds. The test subjects were made to run dividing them into six groups from between 3 hours to 4 hours 30 minutes based on MPT. Regarding the pacing of each group, the running coach ran in the lead and controlled the pace. When the test subjects completed a run of 1km at a set pace, that speed was defined as the highest speed.
RESULTS: The maximum speed in the progression run was 247 ± 30 seconds/km for male runners and 280 ± 20 seconds/km for female runners, with a significant difference between them（$p<0.05$）. A comparison of the relationship between the maximum speed in the progression run and the MPT, shows a high correlation for both male and female runners and the regression formula of Y=1.029X-42.714（r=0.947, $p<0.001$）for male runners and, Y=0.989X-38.059（r=0.884, $p<0.001$）for female runners was obtained. As a result of a covariance analysis, no differences were observed between males and females. Based on a comparison between all male and female runners for the relationship between MPT and the maximum speed in progression run, the regression formula of Y=0.964X - 28.659（Y : MPT（minutes）, X : maximum speed of progression run（seconds/km）, r=0.941, $p<0.001$, R2=0.885）was obtained and a high correlation was observed.
CONCLUSION: There was a close relationship between maximum speed in progression run and MPT. The result suggests that it is possible to predict MPT with a contribution rate of 88.5% according to the maximum speed in the progression run.

HIGH-INTENSITY INTERVAL TRAINING ENHANCES CONTRACTILITY EFFICIENCY AND DIASTOLIC FUNCTION OF LEFT VENTRICULAR DURING EXERCISE

WANG, J.

CHANG GUNG UNIVERSITY

INTRODUCTION: Improved myocardial contractility is a critical circulatory adaptation to exercise training. However, the types of exercise that enhance left ventricular (LV) contractile efficiency and diastolic function have not yet been established. This study investigated how high-intensity interval (HIIT) and moderate-intensity continuous training (MICT) influence LV mechanics during exercise.
METHODS: Fifty-four healthy males were randomized to engage in either HIIT (3-minute intervals at 40% and 80% of VO2max, n=18) or MICT (sustained 60% of VO2max, n=18) for 30 minutes/day, 5 days/week for 6 weeks or to a control group (CTL, n=18) that did not engage in exercise intervention. LV mechanics during semi-upright bicycle exercise tests were measured by two-dimensional speckle-tracking echocardiography.
RESULTS: Before the interventions, acute bicycle exercise increased (i) peak radial and circumferential strain rates (SRs) at apical and basal segments, (ii) peak apical rotation and torsion, and (iii) peak systolic twisting and early diastolic untwisting velocities in the left ventricle. After the 6-week interventions, the HIIT group exhibited greater LV mass and diastolic internal diameter as well as higher early diastolic propagation velocity and E/A ratio than the MICT group. Moreover, only HIIT increased peak circumferential SR at apical segment and reduced the time to reach peak untwisting velocity despite decreased peak apical rotation and torsion during exercise. The LV mechanics at rest and during exercise were unchanged in the CTL group.
CONCLUSION: HIIT but not MICT induces eccentric myocardial hypertrophy. Moreover, HIIT effectively improves the LV mechanics during exercise by increasing contractile efficiency and diastolic function.

INCREASED THIGH VOLUME FOLLOWING SHORT-DURATION CYCLING SPRINT INTERVAL TRAINING

SEAMAN, K., JOHNSON, J., SÉNÉCHAL, M., KURUGANTI, U.

UNIVERSITY OF NEW BRUNSWICK

INTRODUCTION: Interval training has been widely examined for its ability to improve cardio-metabolic health. However, sprint interval training (SIT) requires maximal power output of the active muscles which may facilitate hypertrophic adaptations to the active muscles. To date, little research has examined the hypertrophic adaptations to SIT. The purpose of the study was to investigate the impact of eight weeks of 10-second or 30-second SIT on hypertrophic adaptations of the thigh. Due to the high contractile power exerted on the pedal during SIT, it was hypothesized that SIT would influence hypertrophy of the active muscles.
METHODS: Seventeen active participants (age 19-35) were recruited. A voluntary activation ratio of 90% of the knee extensors was required for inclusion in the study. Participants were randomized into either: 10 seconds on:2 minutes off group (SIT-10), 30 seconds on:4 minutes off group (SIT-30), or control group (CON). All training was performed on a Racermate Velotron, with resistance applied at 7.5% of the participant's body mass. Participants began with four intervals per session, with an additional interval added each subsequent two weeks. Training occurred three days a week for eight weeks. The control group was instructed to maintain their typical daily activity patterns. Lean body mass was assessed via the air displacement plethysmography. Thigh volume was calculated based on a three-point girth assessment, with skin fold thickness removed from the volume to obtain lean thigh volume. Force output was assessed via isometric maximal knee extensions/flexions, and co-activation ratio of agonist and antagonist muscles was calculated through surface electromyography.
RESULTS: A significant group by time interaction effect was observed for the thigh volume variable ($F(4)= 5.464$, $p<0.05$). Adjusted pairwise comparisons revealed a significant increase in thigh volume between baseline and Week-4 in the SIT-10 group (0.472 ±0.050m3 vs 0.506 ±0.051m3, $p<0.05$, Cohen's D=0.67)), and baseline and Week-8 (0. 472 ±0.050m3 vs 0.520 ±0.050m3, $p<0.05$, Cohen's D=0.96), representing a 7.6 ±3.7% and 10.3 ±4.4% increase in thigh volume, respectively. No other main or interaction effects were observed for force, lean mass, or co-activation ratio ($P> 0.05$).
CONCLUSION: SIT-10 appears to be a viable means of achieving local muscular hypertrophy following four and eight weeks of training. However, this effect was not observed in the SIT-30 group despite the greater volume of work completed. The greater thigh muscle volume did not result in a significant increase in muscular force output. Future research should assess the additive nature of this training method to traditional resistance training.

EFFECTS OF PLYOMETRIC TRAINING ON JUMPING, SPRINTING AND CHANGE OF DIRECTION ABILITIES IN CHILD FEMALE ATHLETES

DONTI, O.1, PAPIA, A.1, DONTI, A.1, APOSTOLIDIS, N.1, SANDS, W.A.2, BOGDANIS, G.C.1

1: NKUA ; 2: USSA

INTRODUCTION: Plyometric training is an effective method to enhance jumping performance, sprinting and change of direction ability in adults. However, evidence is limited in child-athletes, and especially in girls. The aim of this study was to examine the effect of 8 weeks of plyometric training, on jumping, sprinting and change of direction abilities, in child female athletes.
METHODS: Fifty female 'Gymnastics for All' gymnasts (age: 8.0 ± 0.7 years, training experience: 2.4 ± 0.6 years, height: 129 ± 7 cm, body mass: 28.1 ± 5.8 kg) were randomly assigned to a training (n=33) and a control group (n=17). The gymnasts of the training group performed plyometric training twice per week, in addition to their regular training. Each plyometric training lasted ~20-25 min and included 180 jumps per session during the first 4-weeks, and 210 jumps per session during the last 4-weeks of training. All gymnasts underwent the following tests at baseline, and after 8 weeks of training: one and two-leg countermovement jumps (CMJ), drop jump, squat jump, standing long jump, 10 and 20 m sprints, and two change of direction tests: 10 m (5 + 5 m with a 180° turn) and 20 m (10 + 10 m with a 180° turn). Also, their performance in a gymnastics floor exercise was evaluated. Statistical analysis was performed using 2-way ANOVA (time x group) and Tukey post-hoc test. For pairwise comparisons, effect sizes were determined by Cohen's d (trivial: 0–0.19, small: 0.20–0.49, medium: 0.50–0.79 and large: 0.80 and greater).
RESULTS: Standing height and body mass did not differ between groups at baseline (p>0.485), and there was a similar increase in standing height after 8 weeks between the training (by 0.6±0.3 cm, p=0.001, d=-0.21) and the control group (by 0.6±0.4 cm, p=0.001, d=-0.17), with no difference between groups. Body mass did not change after 8 weeks of training (p>0.05). Plyometric training induced a significant improvement (p <0.05) in the training group, in 10 and 20 m sprint speed tests by 10 and 9%, respectively (d=1.19-1.31), 20 m change of direction test by 5% (d=0.41), one and two-leg CMJ height by 26% (d=0.66) and 13% (d=0.67) and floor exercise performance by 12% (d=-0.79). In the control group, there were small increases in 10 m and 20 m sprint performance by 3%(d=0.52 and 0.29), while 20 m change of direction performance decreased by 4% (d=-0.68). In addition, a modest increase was observed in one and two-leg CMJ height by 16% (d=0.20) and 7% (d=0.40), and floor exercise performance by 8% (d=-0.24).
CONCLUSION: The results of this study suggest that completion of an 8-week plyometric training program in addition to gymnastics training, significantly increases performance in all sprint tests, selected change of direction ability tests, and enhances CMJ height more than gymnastics training alone. Furthermore, addition of plyometric training to regular gymnastics practice, further improves gymnastics performance in child female athletes.

STUDY ON PHYSIQUE AND MOTOR ABILITY OF ELITE JUNIOR BADMINTO PLAYERS IN JAPAN

WATANABE, E.1, MISHIMA, T.2, ABUTANI, H.3, SATO, T.4, SEKI, K.5

<1> SENSHU UNIVERSITY, <2> OSAKA UNIVERSITY OF HEALTH AND SPORT SCIENCES, <3> SMART SYSTEM STRENGTH, <4> JISSEN WOMENS UNIVERSITY, <5> WASEDA UNIVERSITY

INTRODUCTION: Badminton is one of the popular sports enjoyed widely. Many young athletes are doing hard training to participate in the Olympic Games because the Tokyo Olympics are held in 2020. In order to win in the game, it is necessary to prepare for motor ability, skill and mind. In this study, we aimed to clarify the physique and motor ability necessary for elite junior badminton players.
METHODS: Subjects were badminton players who belong to the badminton club. The period of this study started from April 2016 and it was up to February 2018. The total of 1360 players participated in this study (692 male players and 668 female players, 10 to 18 years old). We classified the participants into groups A and B. Group A is a junior national team, representative candidate, national tournament high prize winner. Group B will be other players. We performed body-based measurement (height, weight, %body fat) and motor ability test (20m dash, pro-agility test, standing long jump, side steps, vertical jump, rebound jump index).
RESULTS: A significant difference was almost observed in body-based characteristics and motor ability between male and female. A significant difference was also observed between the group A (both for males and females) and the group B in ages from 10 to 15 years old. In body-based characteristics, there was no difference in male for ages from 16 to 18 years old. In females, height at 16 years, body fat percentage at 17 years, body weight and body fat percentage differed at age 18. In motor ability, there was no difference in male. In female, RJ at 16 years, 17 years at vertical jump and RJ, 20m dash differed at age 18.
CONCLUSION: The differences in motor ability between males and females are considered to be derived from body-based characteristics. The performance difference is strongly involved in motor ability from 10 to 15 years old. After the age of 16, we assume that other elements are complicatedly related. The degree of growth and development is also relevant. However, group A has better results than group B in most measurements, so it is certain that high motor ability is required.
In this study, I got the target value of children playing badminton. These results can be used as a guideline for coaches to adapt their coaching to the level and growth and development of their players. A longitudinal study with players of different ages is necessary to complement this study, and measurements is still continuing now.
ACKNOWLEDGEMENT:
We appreciate all the players, instructors, and guardians who cooperated in this study. This study was supported by JSPS KAKENHI Grant Number 26350790 and Senshu University research grant.
CONTACT:
Address Correspondence to Eiji Watanabe. E-mail: watana@isc.senshu-u.ac.jp

MILITARY PHYSICAL TRAINING - STRENGTH TEST RESULTS FROM THE DANISH ARMED FORCES

SEVELSTED, F., SØRENSEN, K.G.

DANISH ARMED FORCES

INTRODUCTION: The physical stress in military operational tasks is well known to be severe strenuous for the individual combat soldier. The operational tasks often take place in hostile environments and the work effort performed requires high levels of both endurance and strength. To withstand the physical challenges during combat operations as well as daily military training, combat soldiers are being prepared with physical training as part of their daily military training. In the Danish Armed Forces a concept for military physical training has been developed over the last years. The concept consists of test and training protocols to ensure the specific training types and amount required, as well as recommendations and demands for the different types of units in the armed forces. This paper presents the

strength test results from an armored infantry unit in the Danish army who has partly followed the training recommendations in the concept.
METHODS: An armored infantry company was recruited to complete a strength test which consisted of five different exercises; pull-ups, lunges, dips, deadlifts and burpees. The exercises were part of their weekly training routines and technical standards therefore were well known. All exercises were evaluated based on 10 preprogrammed levels. For the pull-ups, dips and deadlifts the participants should perform 5 repetitions with as much load as possible. For the lunges it was 10 repetitions for each leg with as much load as possible, and the burpees were performed as AMRAP (as many repetitions as possible) in five minutes. Individuals were instructed to make their best and had two attempts to achieve the highest level as possible in each exercise.
RESULTS: Results are shown as average (n=99). Pull-ups; level 4,9 which equals 5 repetitions with 4,5kg additional load. Lunges; level 4,2 which equals 10 repetitions (pr leg) with 44kg additional load. Dips; level 6,4 which equals 5 repetitions with 12kg additional load. Deadlifts; level 5,6 which equals 5 repetitions with 106kg additional load. Burpees; level 4,1 which equals 66 repetitions in 5 minutes.
CONCLUSION: The results were roughly as expected. The recommended level for this type of unit (level 5) was not fully met in all exercises. Although the exercises were known from the training sessions, the test method was new and the unit had not trained specific for this type of test. Even though the average is close to the recommended level 5 for all exercises, a closer look at the results reveal, that the variation width of the results ranges from level 0-10 in the exercises; pull-ups, lunges, dips and deadlifts, an level 0-9 for burpees, which is far from optimal. This can either be due to a high incidence of injuries, which has been investigated in a follow-up study, or that the physical training is inadequate in specificity and/or amount. The latter two was not in accordance with the stated training concept. These findings led to corrected training advice and follow-up recommendations for the present unit.

RELATIONSHIP BETWEEN SPECIAL JUDO FITNESS TEST AND MAXIMUM ANAEROBIC POWER AND PHYSICAL PERFORMANCE AMONG MALE JUDO ATHLETES

SANOMURA, M.1, SAHO, Y.1, YAMAMOTO, A.1, WAKAMATSU, K.2, MIYAHARA, Y.3, MARUYAMA, M.3

1: FACULTY OF MEDICAL TECHNOLOGY, TEIKYO UNIVERSITY , 2: J. F. OBERLIN UNIVERSITY , 3: TEIKYO UNIVERSITY

INTRODUCTION: According to an analysis of video images, a judo match can be seen as a repetition of 20 ~ 30 seconds of vigorous activities with 5 ~ 10 seconds of rest periods in-between. To accommodate such pattern and judo specific movements, Special Judo Fitness Test (SJFT) has been devised as a specialized method to evaluate physical fitness among judo players (Sterkowicz, 1995), and previous study has shown a significant correlation to pedaling by upper limbs on a bicycle ergometer for men. The purpose of this study was to examine the relationship between SJFT and maximal anaerobic power (MAnP) and trunk muscle endurance among male judo athletes.
METHODS: 1. Subjects
Twenty-five male college judo athletes (mean ± SD; age: 19.1 ± 0.8 years; height: 168.8 ± 4.9 cm; body weight: 75.5 ± 12.2 kg (range: 60.7 ~ 106.1 kg); judo experience: 12.6 ± 2.5 years (range: 5.5 ~ 16.4 years)) participated in this study.
2. Measurements
SJFT: Two players (partner) are positioned at 6 m away from one another. Subject attempts at throwing the two players using the ippon-seoi-nage technique as many as possible in a set period of time. The procedure is divided in three periods (series A = 15 seconds, B = 30 seconds, and C = 30 seconds) with 10 seconds recovery intervals among them. Heart rate is recorded immediately after the test (HR 1) and 1 minute later (HR 2). Performance index was calculated using the following formula: Performance index = (HR 1 (bpm) + HR 2 (bpm)) / Total number of throwers (series A, B, and C)
MAnP test: MAnP test using a cycle ergometer (PowerMax VIII; Konami Sports & Life, Tokyo, Japan). Procedure is divided in three stages, and maximal efforts pedaling for 10 seconds, and 120 seconds resting time between each stage. MAnP output was recorded as watts and watts per kg.
Prone bridge test (PBT): PBT was to measure the trunk strength and endurance performance. Subject started from prone bridge position (elbow-toe position), and immediately put a weight plate of half weight of the body weight on the lower back and buttock. We instructed neutral trunk and pelvis position (no excessive trunk flexion or extension). We measured the time until the abdominal touches the mat (balance pad) placed on the floor.
3. Analysis
Relationships between the SJFT and MAnP test and PBT were analyzed, and correlation coefficients were calculated using Pearson's test. Significance levels were set at $p < 0.05$.
RESULTS: SJFT (performance index) was significantly and negatively correlated with MAnP (Watts per kg) ($r = -0.605$ and $p = 0.001$).
CONCLUSION: While a significant negative correlation was found between SJFT and MAnP by this study, previous study on MAnP test using a bicycle ergometer has shown lower values for heavier body weights (e.g., 95kg or more). This indicates that such correlations could well be influenced by the number of players in the heavyweight class, hence research according to each weight class should be considered for future studies.

CAN FUNCTIONAL PHYSICAL TRAINING PROGRAM IMPROVE CONSCRIPTS' FITNESS LEVEL BETTER THAN TRADITIONAL PHYSICAL TRAINING?

STAMM, M., STAMM, R., ANTSON, H.

ESTONIAN DEFENCE FORCES

INTRODUCTION: The purpose of the physical training of conscripts is not to achieve sporting performance, but to prepare staff for service loads and to operate in a tactical situation. In this case, it is not essential to go deep into the methodology of a particular sport, but to look at the distribution of methods based on the structure and nature of the exercises (Bompa, 1991). The aim of this study was to check the influence of the implementation of the functional physical training program (FPTP) to conscripts' fitness and functional capabilities.
METHODS: Two separate experiments were conducted: short-term (7 week) and mid-term (15 week). In both experiments the sample consisted of two company-size units, from which one (test-group) trained according to the FPTP and second (control-group) had traditional physical training (PT), which mostly consisted of running and bodyweight exercises. FPTP consisted of 25 physical training lessons with progressive degree of difficulty. Each training consisted of seven parts: warm up; development of flexibility; learning functional training movements; development of endurance; high intensity functional training; development of trunk muscle; relaxing and stretching exercises (Senin, 2017). The standard Army Physical Fitness Test (APFT) was used for the fitness level measurements. Measurements were conducted on the first, the 7th and the 15th week of the training cycle.

RESULTS: The results show that for the short-term training cycle advantages of the implementation of the developed program are limited. Comparing to the traditional PT, the usage of the FPTP provides at least the same improvement in push-up and sit-up tests. At the same time, the FPTP enables to achieve statistically significant higher improvement in the 3,2km running test. It is important that the advantages of the developed program over traditional PT were more apparent during the midterm implementation period. After the 15-week cycle, the application of the FPTP provided significantly higher improvement and better results in all physical test tasks. It is important to mention that FPTP effectiveness becomes more significant in a cycle where physical training volume is limited to one class (90 min) per week.
CONCLUSION: Taking into account the outcome of the experiments we can conclude that successful implementation of the FPTP is possible. Compared to the usual PT the application of the developed program is more effective in terms of soldiers' preparation for battle related physical tasks. That kind of preparations creates conditions for the acquisition of skills and knowledge during collective (tactical) training.
REFERENCES: Bompa, T. 1999. Periodization: theory and methodology of training, pp. 315–375.
Senin, V. 2017. Improving the physical training of conscripts in the Kuperjanov Infantry Battalion.
CONTACT: mella@tlu.ee

GROSS ECONOMY OF CHILDREN TO TREADMILL EXERCISE

BELCASTRO, A., MATTA, H.
YORK UNIVERSITY

INTRODUCTION: Oxygen cost and metabolic/gross economy (GE) of movement to exercise (increasing speed (TS)) vary with increases in body stature/growth. Whether stature/growth profiles and/or body composition and fitness factors have a similar impact on childrens GE when indexed to physical activity (PA) levels (quantified by accelerometry) is unclear. Is the relationship between GE for PA comparable to GE for TS? The purpose of this study was to determine the GE of childrens participation to varying levels of physical activity and assess their relationships to stature, body dimensions and body composition.
METHODS: Children (9.8±0.9 yrs) were assessed for VO2, HR, VCO2, and RER over treadmill speeds (66.6, 99.6 and 132.6m/min for 3 min each at 0% grade). Accelerometers (ActiGraph GT1X - hip) were used to quantify physical activity (PA) levels in counts/min (3sec epochs). Gross economy (GE) for treadmill speed (TS) was expressed as relative VO2/m/min from 66.6 and 132.6 m/min; and GE for physical activity (PA) was expressed relative VO2/cnt/min from 2000-6000 cnts/min. ANOVA and statistical comparisons were assessed at a p=0.05.
RESULTS: The GE-TS (VO2/m/min) for children (height 155.0±5.6cm; weight 64.6±11.3kg) increased from 0.170±0.017 to 0.213±0.018 over speeds of 66.6 and 132.6 metres/min ($p<0.05$). The relationships (r2) between GE-TS and height and leg length (LL) were -0.92 and -0.88, respectively ($p<0.05$). The PA levels varied from 2071±308 to 5465±1424 counts/min ($p<0.05$). The GE-PA (VO2/cnt/min) values ranged from 0.0056±0.001 and 0.0057±0.001, respectively ($p>0.05$). The relationships (r2) between GE-PA and height and leg length (LL) were -0.13 and -0.31, respectively ($p>0.05$). BMI, body fatness and aerobic power were related to GE-PA but not GE-TS. Minimal relationship was observed for GE-TS and GE-PA (r2=0.01).
CONCLUSION: The primary finding was that metabolic/gross economy for children participating over a range of treadmill speeds and physical activity levels are impacted differently by stature/growth. As predicted GE-TS was highly related to stature/growth; in contrast minimal impact was observed for GE-PA and stature/growth. The GE-PA was related to BMI and aerobic power over the range of PA assessed. Therefore, the GE differences observed for TS and PA needs to be considered when estimating childrens oxygen consumption from ACC-derived PA linear regression during laboratory (i.e., TM), active play and/or activities of daily living.

TRAINING USING A DYNAMIC ERGOMETER IN COMPETITIVE ROWERS

KAMEI, E., HOSHINO, R., TANAKA, T., ENDO, S., KOMINE, T., YASUKAWA, M.
CHUO UNIVERSITY

INTRODUCTION: Because the outcomes of rowing races are decided by fractions of a second, many different training methods have been developed to improve performance. Among them is the ergometer rowing, which is commonly used by coaches and competitive rowers to improve distance per stroke (DPS). However, the most appropriate rowing motion parameter is unknown. The purpose of this study was to determine the most relevant parameter of rowing techniques in competitive rowers.
METHODS: We included one female Japanese collegiate competitive rower. Dynamic Ergometers and video analysis system were used to check the rowing techniques of the subject. DPS (Y), drive length (X1), position of the peak force (X2), drive time (X3), the difference in time (X4) between when maximum angular velocities of the knee and trunk, slide length (X5), angle of the knee (X6), angle of the shin (X7), and shoulder motion (X8) were determined. Multiple linear regression was calculated to evaluate the relationship between these parameters.
RESULTS: The data had an uptrend in the first 30 strokes (Phase 1) and downtrend in the last 23 strokes (Phase 2). Multiple linear regression was calculated for each phase. The regression line obtained for Phase 1 was as follows: $Y = 2.7781X1 - 1194.3483X5 + 2310.4988$ (where Y = DPS, X1 = drive length, X5 = slide length). A significant relationship was observed between Y and Xi for i = 1, 5 ($R2 = 0.5570$, $F = 17.0053$, $P < 0.0001$). The regression line for Phase 2 was as follows: $Y = 2.9317X1 + 1289.3297X5 - 1679.1698$. We found a significant relationship between Y and Xi for i = 1, 5 ($R2 = 0.6100$, $F = 15.5537$, $P < 0.0001$).
CONCLUSION: These findings suggest that there was a relationship between "DPS" and "drive length, slide length," and may help to understand rowing techniques in competitive rowers.

RELATIONSHIP BETWEEN PHYSICAL ACTIVITY LEVEL, SLEEPING TIME, AND EXERCISE CAPACITY IN YOUNG CHILDREN

DEMURA, T.
JIN-AI UNIVERSITY

INTRODUCTION: In recent years, attention has been focused on decreasing the physical activity and physical strength of children; a number of studies have examined the relationship between these factors (Tanaka and Tanaka, 2009; Barnett et al., 2011). In addition, the relationship between lifestyle such as sleep and level of physical activity level has been investigated (Motegi and Ohyama, 2005). The purpose of the present study was to examine the relation between physical activity level, sleeping time, and exercise capacity in young children.
METHODS: The participants included 33 young children (18 boys and 15 girls) aged between four and six years. Physical activity was measured by means of a triaxial accelerometer (Active Style Pro HJA-350 IT, Omron Healthcare, Japan). It measured the number of steps

and moderate-to-vigorous physical activity (<4 METs (Sasaki et al., 2013), MVPA) in the morning on arriving at nursery school until lunchtime. The measurement period lasted for one month in June 2017. A questionnaire was administered to the children's parents to assess their sleeping habits. To determine exercise capacity, three types of 25m running time, standing long jump distance and the distance they could throw a tennis ball were measured.
With reference to gender, a partial correlation coefficient was employed to investigate the relationship between each variable with a consideration for each child's age. The significance level of this study was set at 5%.
RESULTS: In boys, a significant correlation was found between height and weight, MVPA and 25m running time and number of steps, sleeping time and 25m running time ($r = -0.63–0.83$; $p < 0.05$).
In girls, a significant correlation was found between height and weight, MVPA and number of steps, standing long jump and throwing a tennis ball throwing ($r = -0.70–0.71$; $p < 0.05$).
CONCLUSION: Boys had a tendency to run 25m run faster ($r = -0.63$) when the MVPA was long, and ran 25m ($r = 0.49$) slower when they slept for a long time. In addition to the notion that it is difficult to obtain objective data (Motegi and Ohyama, 2005), it is difficult to investigate sleep by means of a questionnaire survey. The latter should be examined carefully in future studies. With reference to girls, there was no relationship between focused MVPA and time slept and other variables. It is believed that girls are already affected by social and cultural influences from early childhood. Therefore, this study shows men and womens different behavior patterns and activities.
References: Barnett LM, Morgan PJ, Van Beurden E, Ball K, Lubans DR. (2011). Medicine and Science in Sports and Exercise, 43(5), 898-904.
Motegi A, Ohyama K. (2005). The Journal of Child Health, 64(1), 39-45.
Sasaki R, Ishizawa J, Kusuhara K, Okuyama S. (2013). Bulletin of the institute of physical education, Keio Uniersity, 52(1), 1-10.
Tanaka C, Tanaka S. (2009). Journal of Physiological Anthropology, 28(6), 283-288.
Contact: Tomohiro Demura, E-mail: tomodemu@jindai.ac.jp

PREDICTING MAXIMAL HEART RATE IN YOUNG ADULTS IS INAPPROPRIATE: FURTHER EVIDENCE TO ABANDON THE PRACTICE

LAMB, K.

UNIVERSITY OF CHESTER

INTRODUCTION: While taught often during the PE curriculum that a person's maximal heart rate (HRmax) can be predicted simply from the 220-age ('Fox') equation, and often reinforced during undergraduate Sports Science programmes, the custom has no empirical foundations. Moreover, given its status as a secondary criterion for the attainment of maximal oxygen uptake, and its frequent use in setting exercise intensity training thresholds, the Sports Science community needs to be convinced to abandon it. Evidence exists of the inaccuracy of the Fox equation and numerous attempts have been made to establish more accurate age-based equations from large samples of heterogeneous adults. However, few studies have compared the accuracy of these alternatives among young adults. The aim of this study was to examine the validity of four contemporary HRmax prediction equations against HRmax derived from a maximal treadmill test.
METHODS: Following institutional ethical approval, 47 active male and female university students (aged 20.7 ± 1.6 y; mass 73.05 ± 11.85 kg; peak oxygen uptake 54.4 ± 7.8 ml/kg/min) volunteered to take part in a graded exercise test to volitional exhaustion. Heart rates (HR) were recorded throughout by telemetry. The highest HR recorded was taken as HRmax. Mean HRmax calculated via the equations of Gellish et al (2007; GE), Whaley et al (1992; WH), Nes et al (2013; NE) and Fox et al (1971; FO) were compared to the criterion values and the within-subject variability ('error') quantified by the 95% limits of agreement (95% LoA).
RESULTS: The mean criterion HRmax (195.2 ± 9.3 b/min) was over-estimated by the equations of FO (199.3 ± 1.3 b/min), WH (198.8 ± 1.5 b/min), and NE (197.8 ± 1.0 b/min), and under-estimated by that of GE (192.5 ± 1.1 b/min). The proportions predicted within ± 5 b/min and ± 10 b/min of the criterion HRmax ranged from 36-48% and 64-74%, respectively. For each comparison 95% (LoA) of predicted values varied by up to ± 17 or 18 b/min of the mean difference.
CONCLUSION: These findings highlight the inaccuracy both of the established and newer age-related HRmax equations among young, active adults, and reinforce there is no convincing case for sports scientists or physical educators to continue to advocate their use for prescribing health/fitness enhancing exercise intensities, or for verifying the occurrence of a maximal oxygen uptake. Moreover, if HRmax is to remain an important measure in this context, better predictive approaches need to be devised.
References: Fox, SM, Naughton, JP, & Haskell, WL (1971). Annals Clin Res, 3, 404-432.
Gellish, RL, Goslin, BR, Olson, RE, et al (2007). Med Sci Sports Exerc, 39, 822-829.
Nes, B M, Janszky, I, Wisloff, U, et al (2013). Scand J Med Sci Sports, 23, 697-704.
Whaley, MH, Kaminsky, LA, Dwyer, GB, et al (1992). Med Sci Sports Exerc, 24, 1173-1179.

CHANGES OF BIOCHEMICAL MARKERS IN BLOOD PLASMA FOR MILITARY PERSONNEL AFTER HIGH PHYSICAL AND PSYCHO-EMOTIONAL LOAD

PLAVINA, L.

NATIONAL DEFENCE ACADEMY OF LATVIA

INTRODUCTION: Combat training course is a compulsory part of the training program of cadets in National Defense academy of Latvia. Cadets have ten days long Combat training course with high physical load, psycho-emotional stress, nutrition deprivation and limits for rest / sleep. High intensity of physical load in military surrounding is a risk factor for heath disorders, muscular and skeletal pathology and psychological overload. Muscular and skeletal disorders are wide spread in military personnel population. Early diagnostic and management of preventive measures program give results as decreasing impact of external and internal risk factors for development muscular and skeletal disorders. Aim of the study is assessment of biochemical markers that indicate initial stages of muscular skeletal pathology, in the group of cadets, Combat training course participants. Biochemical markers analysis was provided for participants in some days before and directly after the Combat training course.
METHODS: We provided biochemical markers analysis of blood plasma of 59 participants of both genders 12 female and 47 male in aged 23 to 30 years. We provided assessment of following bio-markers of muscular and skeletal pathology: Lactate dehydrogenase (LDH); Creatine phosphokinase (CPK); Alanine amino transferase (ALT) and Aspartate amino transferase (AST). The health status control was organized before and after combat training course, the blood examples were taken before and after ten days long combat training course.

RESULTS: Analysis of the biochemical markers data revealed that the level of CPK , that support creatine phosphorylation to creatinine and ATF (adenosine triphosphate),have jumped four times from the standard interval for more than half participants (50.9%) of CTC participants from the standard interval for one third of participants. The level of CPK increased three times, but for one fifth of participants the level of CPK and only for some individual the CPK analysis data stay in the standard deviation interval. But for some individuals the level of CPK analysis increases sharply, more than five times.
The level of LDH, that characterized glycolysis and oxidative processes of lactates, in the blood plasma increased two times for half of participants (57.9 %) of CTC, but for the rest part of the participants (42.1 %) it stays in the standard level. The level of AST stays in the standard deviation interval, but we have fixed elevation of absolute data of analysis for participants of CTC. The level of ALT biochemical markers increased two times in the blood plasma for half of participants of CTC (56,1 %), for some of participants the level of ALT increased three (7%) and five times (1,7 %).
CONCLUSION: Changes of the level of CPK, LDH reflected functional disorders for muscular and skeletal pathology for participants of Combat training course. Biochemical markers as ALT and AST were less sensitive to influence of high the physical load and emotional stress.

ASSESSMENT RELIABILITY OF MAXIMAL SPRINT CAPACITY ON A NON-MOTORISED TREADMILL IN YOUNG HEALTHY ADULTS

DOMA, K., CONNOR, J., LEICHT, A.

JAMES COOK UNIVERSITY

INTRODUCTION: Maximal sprint ability (MSA) has been documented as a key performance indicator in a range of sports and athletes. Determination of MSA typically involves repeated performances or trials using cycling or field running with appropriate rest between trials. Non-motorised treadmills have been increasingly utilised in MSA assessment but little information exists about these protocols. Therefore, the aim of the current study was to examine the reliability of performance during a typical MSA protocol using a non-motorised treadmill.
METHODS: One-hundred and twenty (77 males, 43 females) young, healthy, active adults volunteered for this study. Following a standardised 10-minute warm-up, participants completed 3 x 4-second sprints on a non-motorised treadmill with each separated by 3 minutes. Peak and mean velocity/power, total work and 1-second acceleration were assessed during each sprint. Comparisons between trials were examined via 1-way repeated-measures ANOVA and pairwise comparisons with Bonferroni correction. Reliability was assessed via intraclass correlations coefficients (ICC), typical error expressed as a coefficient of variation (CV) and bias with limits of agreement (LOA).
RESULTS: All variables assessed during Trials 2 and/or 3 were significantly ($p<0.05$) greater than Trial 1 values while half were significantly ($p<0.05$) greater during Trial 3 compared to Trial 2. Reliability (ICC) for Trials 2 and 3 was excellent ($p<0.001$) for peak and mean velocity (>0.98), peak (>0.95) and mean (>0.98) power, total work (>0.98), and acceleration (>0.94). The CV were small for most variables including peak (<1.7%) and mean velocity (<2.4%), mean power (<4.1%), and total work (<4.1%). Slightly greater CV were identified for peak power (<9.1%) and acceleration (<8.0%). Biases were small (<1.6%) for all variables with LOA identified.
CONCLUSION: The present study has demonstrated that assessment of MSA using a non-motorised, treadmill should involve at least 2-3 trials with these later assessments highly reliable in young, healthy adults. The current non-motorised, treadmill protocol provides sport scientists, researchers, coaches and athletes with a reliable assessment of MSA.

THE DIFFERENCE OF INFLUENCING FACTORS FOR SHOOTING BY PLAYERS' STANDING HEIGHT IN BASKETBALL GAMES

YAITA, A., AOYAGI, O., KURAISHI, O., NODERA, K.

KYUSHUKYORITSU UNIVERSITY

INTRODUCTION: Whether shots are successful or not is affected by various factors depending on shooting situations in basketball games. In general, basketball is characteristized by the fact that the standing height of players impacts various plays and outcomes because the basket is located on a horizontal plane over their heads. Similarly, standing height also affects whether shots are successful or not and shooting areas. Thus, this study aimed to investigate the characteristics of shooting situations according to standing height by examining the factors influencing whether shots are successful or not by the standing height of shooters.
METHODS: The subject matter was 10 men's games held in the quarter finals or later in the 66th All-Japan Collegiate Basketball Championship in 2014. The following items regarding "a> game situation;" "b> shot attempt;" "c> strategy leading to the shot;" and "d> defensive situation of the opponent" and "whether shots were successful or not" were checked or counted in all shots: 1> score difference;" "2> reminder seconds of shot clock;" "3> area where the shot was attempt;" "4> shooting direction;" "5> shooting methods;" "6> standing height of the shooter;" "7> play leading up to the shot;" "8> whether a screen play was conducted or not;" "9> action of the shooter before the shot;" "10> movement of the basketball before a shot;" "11> distance to the defensive player;" "12> hands-up of the defensive player;" "13> block shot;" "14> whether a foul was committed by the opponent or not;" and "15> difference in standing heights of the shooter and the defensive player" 15 items in total.
RESULTS: As the mean standing height of shooters in games concerned was 186.4, they were categorized into two groups, i.e. HG of 187cm or higher and LG of less than 187cm. In the HG, stepwise procedure found the model consisting of "3> the area where the shot was attempted ;" "4> shooting direction ;" "5> shooting method ;" "7> the play leading to the shot ;" "12> hands-up of the defensive player ;" "14> whether a foul was committed by the opponent ;" and "15> difference of standing height between the shooter and the defensive player " to be the best fit . In the LG, the stepwise procedure detected the best fit regression model consisting of "3> area where the shot was attempted ;" "4> shooting direction ;" and "11> distance to the defensive player " with chi-square [df = 9] = 76.72 .
CONCLUSION: "3> area where the shot was attempted" and "4> shooting direction" were commonly chosen as the influencing factors for a shot due to the difference of standing height between both groups. As shot attempts close to the basket and that the defenders are close to the offense are large in number in the HG, three-dimensional items such as shooting methods, strategy leading to the shot and height were shown to be decisive factors for successful shots. On the other hand, two-dimensional items were decisive factors for successful shots in the LG because the shooting area was also wide and the distance from the defender was critical.

WAIST-TO-HEIGHT RATIO AS A BETTER ANTHROPOMETRIC INDICATOR IN THE EVALUATION OF CARDIOMETABOLIC FACTORS IN STUDENTS OF THE SOUTH OF BRAZIL

BRITO, L.M.S., LEITE, N., MOTA, J., CAT, M.N.L., BOGUSZEWSKI, M.C.S.

UNIVERSIDADE FEDERAL DO PARANA

INTRODUCTION: Anthropometric indicators are used to identify children and adolescents with cardiometabolic risk, with the body mass index and the waist-to-height ratio being highlighted. BMI identifies general obesity, whereas the WHtR assesses central obesity and, because it is corrected according to stature, it becomes an anthropometric index which allows comparisons to be drawn between several different age groups with less dependency on age and sex. Therefore, the objective of this study was to verify which anthropometric indicator correlates best with blood pressure and cardiorespiratory fitness in both sexes.
METHODS: An observational study was carried out on 324 students, with 148 boys <45.6%> in three full-time public education schools in the South of Brazil. Anthropometric data , waist circumference , systolic blood pressure and diastolic blood pressure were measured. BMI and WHtR were calculated. The Léger test was used to estimate the maximum oxygen consumption and the CRF level was calculated . Statisc 10.0 software was used for statistical analysis of data, basic descriptive statistics, Spearman correlation coefficient and Odds Ratio, considering a difference of $p<0.05$.
RESULTS: Elevated WHtR was present in 25% of the girls and 22.6% of the boys. 21.9% of girls and 22.7% of boys were overweight . Hypertensive measures of SBP or DBP were found in 38.3% of boys and 48.8% in girls. An unsatisfactory CRF was found in 53.22% of the boys and 77.9% of the girls. An inverse and significant correlation between HM and CRF , a direct and very weak correlation between HM and BMI and a weak correlation with WHtR were all found. OW boys are more likely to have unsatisfactory CRF and OW girls than eutrophic adolescents. High WHtR is more likely to detect HM in girls and boys than high BMI in girls and boys . Adequate levels of CRF act as a protective factor for the presence of high WHtR in boys .
CONCLUSION: The distribution of body adiposity is an important factor in the development of cardiovascular diseases . In this study, the anthropometric indicators BMI and WHtR were increased and correlated with HM and unsatisfactory levels of CRF, which are considered cardiometabolic risk factors in this population . Our results reinforce the usefulness of anthropometric measurements as a tool for the detection of health risks in adolescents, and the WHtR showed to be a better anthropometric indicator for recognizing cardiometabolic factors in both sexes.

COMPARATIVE EFFECTS OF YI JIN JING VERSUS TAI CHI EXERCISE TRAINING ON PROSTATE FUNCTIONS IN OLDER ADULTS

XIANGYUN, L.

SHANGHAI UNIVERSITY OF SPORT

INTRODUCTION: Benign prostatic hyperplasia and its associated lower urinary tract symptoms occur very commonly in older men. Current surgical and pharmacological therapies are expensive, may not effectively improve prostate function and health but cause adverse effects. There is an urgent need to find new and effective non-pharmacological preventions and treatments. Yi Jin Jing and Tai Chi, two common mind-body Chinese tradition exercises, are not or very little studied for being potentially utilized to treatment of benign prostatic hyperplasia-related problems. The purpose of the study is to assess the effectiveness of a randomized parallel group controlled clinical trial of Yi Jin Jing exercise, compared with Tai Chi, on the monographic and functional changes of prostate in older men.
METHODS: This study is a single-center, six-month, randomized controlled trial of Yi Jin Jing versus Tai Chi to be conducted at an urban tertiary of Shanghai, China. One hundred and fifty men at age of 60-70 years old will be recruited from the community. Participants will be randomly assigned to three parallel groups: 50 as a control group and 50 each to two intervention groups. Individuals in two intervention groups will be trained with Yi Jin Jing or Tai Chi exercise continuously for six-months, while the control group has no any intervention. The primary outcomes will be changes of signs and symptoms in BPH and lower urinary tractfrom baseline to post-intervention. The main secondary outcomes will be exercise-induced effects on the circulating levels of estrogen and androgen. All the outcome measures will be assessed at baseline, after the six-month intervention.
RESULTS: There was a significant effect of yi jin jing and tai chi on testosterone but
no significant effect on insulin or glucose. No serious adverse events were observed during the study period.
CONCLUSION: This study is a single-center, six-month, randomized controlled trial of Yi Jin Jing versus Tai Chi to be conducted at an urban tertiary of Shanghai, China. One hundred and fifty men at age of 60-70 years old will be recruited from the community. Participants will be randomly assigned to three parallel groups: 50 as a control group and 50 each to two intervention groups. Individuals in two intervention groups will be trained with Yi Jin Jing or Tai Chi exercise continuously for six-months, while the control group has no any intervention. The primary outcomes will be changes of signs and symptoms in BPH and lower urinary tractfrom baseline to post-intervention. The main secondary outcomes will be exercise-induced effects on the circulating levels of estrogen and androgen. All the outcome measures will be assessed at baseline, after the six-month intervention.

EFFECTS OF A MULTI-COMPONENT EXERCISE PROGRAM ON HEALTH, PHYSICAL FITNESS AND PHYSICAL ACTIVITY OF INSTITUTIONALIZED OLDER ADULTS

UGARTEMENDIA, M., ZINKUNEGI, N., CALVO, J.J., MENDILUCE, N., VIRGALA, J., ZARRAZQUIN, I., IRAZUSTA, A., KORTAJARENA, M.

UNIVERSITY OF THE BASQUE COUNTRY-UPV/EHU

INTRODUCTION: Sarcopenia is the principal cause of fragility and the physical activity based on multi-component exercise program, is the main intervention to stand up to it and not to exacerbate the functional capacity. The aim of this study was to analyze the effects of a multi-component exercise program on health, fitness and physical activity on institutionalized elder people.
METHODS: Participants were 38 institutionalized elder people (age 80.2+7.65) from Zorroaga long-term care facility center in San Sebastian (Spain) who were randomized in two groups: Control and Experimental (a multi-component exercise session, three days per week during 3 months). Inclusion criteria were ≥ 65 years, Barthel index > 60, Mini mental State Examination > 14 and without unstable medical conditions that prevented physical activity. Before and after the program, physical activity was recorded by Yale Physical Activity Survey, intramuscular fat infiltration on quadriceps measured by nuclear magnetic resonance (NMR), fitness was analysed with SFT battery and walking speed, and anthropometric parameters were measured.

RESULTS: After the intervention, the experimental group reduced significantly the waist circumference (p=0.001) and the intramuscular fat (p<0.05). After the intervention, the experimental group improved significantly in fast walking speed at 6 meters (p<0.05), upper (p<0.05) and lower (p<0.05) extremities strength. While control group did not show any change in anthropometric measures neither in fitness parameters (p>0.05). At baseline, none of participants practiced vigorous physical activities but after the intervention, 13.16% of participants achieved vigorous physical activity (p< 0.05). Control group reduced the level of activity (p=0.002).
CONCLUSION: Other studies present an improvement in strength and walking speed, in addition, they also observed improves in aerobic capacity and flexibility. There are some published researches where they showed higher levels of physical activity after the intervention. Few published studies have assessed the muscular composition of elder people by NMR or computerised axial tomography, but they obtained similar results us in our study.
Further studies are needed to assess the specific exercise programmes and strategies to increase physical activity in institutionalized older people.

DISTINCT EFFECTS OF REPEATED-SPRINT TRAINING IN NORMOBARIC HYPOXIA AND BETA-ALANINE SUPPLEMENTATION

WANG, R., FUKUDA, D.H., HOFFMAN, J.R., LA MONICA, M.B., STARLING, T.M., STOUT, J.R., KANG, J., HU, Y.
SHANGHAI UNIVERSITY OF SPORT

INTRODUCTION: Muscle buffering capacity is a key mechanism related to high-intensity exercise performance. Many training programs and dietary supplementation strategies have focused on elevating muscle buffering capacity and improving anaerobic performance. Recently, several studies have demonstrated the effectiveness of repeated-sprint training in hypoxia, which is based on the repetition of all-out efforts of short duration activity interspersed with brief incomplete recoveries. Beta-alanine (BA) is commonly employed as an ergogenic aid and has been identified as the rate-limiting precursor to carnosine synthesis which acts as an intracellular buffer. Therefore, the combination of repeated-sprint training in hypoxia and BA may provide independent but additive ergogenic effects on muscle buffering capacity through a variety of potential mechanisms, but it has yet to be evaluated with regard to exercise performance. Considering the lack of research examining the interaction between repeated-sprint training in hypoxia and BA, the purpose of this study was to examine the effects of repeated-sprint training in hypoxia and BA on aerobic, anaerobic, and repeated-sprint performance in recreationally-trained men.
METHODS: Participants were randomly assigned to one of the following groups: normoxia/beta-alanine (NB, n = 11), normoxia/placebo (NP, n = 8), normobaric hypoxia/beta-alanine (HB, n = 10) and normobaric hypoxia/placebo (HP, n = 9). All participants completed 8 training sessions over 4 weeks on a cycle ergometer either in normobaric hypoxia (Oxygen fraction: FiO2 = 14.2%) or normoxia (FiO2 = 20.9%). Participants were instructed to consume a daily dosage of 6.4g of BA or placebo. Changes in performance in a graded exercise test, repeated-sprint test (RST) and 3-min all-out test (3MT) were examined before and after training and supplementation.
RESULTS: No between-group differences were observed for training volume or supplementation compliance. Anthropometric and hematological measures remained unchanged before and after intervention in all groups. A main effect of training condition was shown for oxygen consumption and power output at respiratory compensation point, average power output during the last sprint of the RST, heart rate recovery following the RST, and total work during the 3MT. These measures in the normobaric hypoxia groups were significantly (p<0.05) higher (lower for heart rate recovery following the RST) than the normoxia groups. A main effect of supplement was detected in anaerobic working capacity, with post-intervention values in the BA groups being significantly (p<0.05) higher than the placebo groups.
CONCLUSION: Repeated-sprint training in hypoxia improved aerobic performance, exercise tolerance, cardiovascular recovery and overall working capacity, while BA maintained the anaerobic working capacity. However, BA did not provide additional benefits with respect to attenuating fatigue or enhancing repeated sprint performance.

TEN-SECOND MAXIMAL ANAEROBIC POWER AS A PREDICTOR OF 500M AND 1000M PERFORMANCE IN JUNIOR SPRINT SPEED SKATERS

KUMAGAWA, D., IMAWAKA, T., TSUNODA, N.
KOKUSHIKAN UNIVERSITY

INTRODUCTION: Muscle force and maximal anaerobic power (MAnP) are improved by speed skating training (Nemoto et al. 1990, de Koning et al. 1991). Further, these functional characteristics of muscle are closely related to short-distance skating performance. However, the effects of anaerobic power on skating performance in child and adolescent speed skaters has yet to be elucidated. Therefore, this study evaluated 10-s MAnP as a predictor of 500-m speed skating time (SS500) and 1000-m speed skating time (SS1000) in junior sprint speed skaters.
METHODS: Participants were Japanese sprint speed skaters aged 9 to 20 years old. Subjects were divided into 12 groups according to age in 1-year intervals. MAnP generation capacity was measured using a bicycle ergometer. Participants pedaled for 10 s at the effort determined by their three-step maximum load, and rested for 2 min between pedaling trials. MAnP was calculated from a linear equation relating load and pedaling velocity, averaged over three trials. Participants' recently attained personal best SS500 and SS1000 times were investigated, and correlation analysis was used to obtain a regression equation for the relationship between MAnP and skating time. The SS500 and SS1000 times estimated from this formula were then compared with actual skating times.
RESULTS: A strong positive correlation coefficient was observed between MAnP and SS500 (p<0.01) and between MAnP and SS1000 (p<0.01) using the estimation equation. No significant difference between predicted times and actual times was found for either SS500 or SS1000, in all age groups.
CONCLUSION: The present estimation equation has high accuracy and significance, and low estimation error due to age. Thus, the equation can be considered effective for estimating the necessary muscle power to skate at a target time in junior speed skaters.

COMPARISON OF ALPINE SKIERS' LACTATE KINETICS DURING RECOVERY PHASE FOR WINGATE TEST AND SQUAT REBOUND JUMP TEST

HOSHINO, H.
HOKUSEI GAKUEN UNIVERSITY

INTRODUCTION: The goal of any training regimen is to best prepare an athlete for their particular sport through discipline specific exercise. Choosing what exercises are effective is vital for obtaining peak condition; outside of the sport's competitive season, physiological

tests are used to obtain such information in lieu of competitive results. Many assays yield general fitness data that would be useful over a wide range of physical endeavors (e.g., Vo2 max, heart rate, and lactate kinetics). However, some tests are easy to do, while others require elaborate preparation and equipment. An idyllic test would be convenient, cheap, and speedy and provide a wealth of useful data. The purpose of this study is to compare the lactic acid elimination kinetics in the recovery period in two widely used exercises, the squat rebound jump and the Wingate test, in alpine skiers. However, it is hoped this test will be beneficial to non-alpine sports.
METHODS: Subjects were six male alpine skiers. Subjects ranged from international elite level, to competitive domestic level able to compete at FIS events. Thus, all can be considered as bona fide athletes. Currently the best single test for determining physical characteristics suitable for alpine skiing is the 90 second squat rebound jump exercise developed by Bosco (BRJ); it is a good indicator of the competitive level of an alpine racer, though the Wingate test is also widely used. Both Wingate and BRJ tests were performed over 90 seconds following which subjects rested in the sitting position and lactate levels were assayed every minute for 30 minutes by fingertip puncture using a lactate Pro 2 (Arkray Co., Ltd.). For the Wingate test resistance was set at 7.5% load per body weight. Both tests were performed prior to and after the alpine competitive season.
RESULTS: The maximum lactic acid values following each of the two test types were assayed pre and post competitive season. In the BRJ test, there was a significant increase, while there was no change observed for the Wingate 90 test. Furthermore, when comparing lactate kinetics after exercise, no change in time constant was observed in both tests. The most obvious result is that there was no apparent change in lactate levels pre and post season assayed by both the Wingate and BRJ. This is only based on a sample size of six subjects, but the BRJ looks more promising for finding possible seasonal changes. Though not significant in this study, it would be expected that the BRJ would be more affected by the musculature developed over an alpine competitive season as the BRJ examines muscle groups specifically used by alpine skiers, while the Wingate test is more an indicator of general fitness. Put another way, stretch shortening is required for alpine skiing which the BRJ tests.
CONCLUSION: Peak lactate levels relate to lactate kinetics, but are much more easily obtained. However, in this study of only six subjects, peak lactate levels did not yield any significant findings.

Authors index

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z